STORMWATER MANAGEMENT PROGRAM PLAN

FOR THE

TOWN OF WARWICK

JANUARY 2026

ORANGE COUNTY, NEW YORK

PREPARED FOR:
Town of Warwick
132 Kings Highway
Warwick, NY 10990

PREPARED BY:
MHE Engineering D.P.C
33 Airport Center Dr., Suite 202
New Windsor, NY 12553

NEW YORK OFFICE
33 Airport Center Drive, Suite 202, New Windsor, NY 12553
845-567-3100 | F: 845-567-3232 | mheny@mhepc.com

PENNSYLVANIA OFFICE
111 Wheatfield Drive, Suite 1, Milford, PA 18337
570-296-2765 | F: 570-296-2767 | mhepa@mhepc.com

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Responsible Parties for SWMP Plan Implementation

Town of Warwick

January 2026

	Title	Name	Contact Information
MS4 Operator	Supervisor	Jesse Dwyer	845-986-1124 supervisor@townofwarwick.gov
Stormwater Program Coordinator	Town Engineer	Jamison Zajac	845-567-3100 jzajac@mhepc.com
MCM 1	Building Inspector	Tony Pascullo	845-986-1124 building@townofwarwick.gov
MCM 2	Building Inspector	Tony Pascullo	845-986-1124 building@townofwarwick.gov
MCM 3	Building Inspector	Tony Pascullo	845-986-1124 building@townofwarwick.gov
MCM 4	Town Engineer	Jamison Zajac	845-567-3100 jzajac@mhepc.com
MCM 5	Town Engineer	Jamison Zajac	845-567-3100 jzajac@mhepc.com
MCM 6	Public Works Commissioner	Benjamin Astorino	845-986-3358 bastorino@townofwarwick.gov

A. INTRODUCTION

The United States Environmental Protection Agency (EPA) and the New York State Department of Environmental Conservation (NYSDEC) have implemented requirements to aid in the preservation of the quality of local water resources. To that end, much attention has been given to stormwater pollution prevention through a State mandated initiative known as the Municipal Separate Storm Sewer System Program (MS4). In New York State, MS4 areas are designated based on criteria set by the EPA and the NYSDEC, focusing on population density, urban settings, and environmental impact. Specifically, these areas are defined by whether they are located within Census-defined urban areas or specifically designated by the NYSDEC. The NYSDEC requires all municipalities with MS4 areas to develop, implement, and enforce a Stormwater Management Program (SWMP) in accordance with the NYSDEC's SPDES General Permit for Stormwater Discharges from MS4s (Permit No. GP-0-24-00). The Town of Warwick has been designated as an MS4 by the NYSDEC and is therefore required to adhere to the NYSDEC's SWMP requirements. The Permit requirements for SWMPs include designating an MS4 Operator and a Stormwater Program Coordinator and ensuring that specific tasks outlined within the Permit are completed. This Stormwater Management Program Plan (SWMP Plan) outlines practices and measures that the Town of Warwick is undertaking or will undertake to implement its SWMP and ensures compliance with Permit regulations.

The Town of Warwick is a large rural township in Orange County, NY. It borders the state of New Jersey to the south, the Towns of Chester and Goshen to the north, the Towns of Monroe and Tuxedo to the east, and the Towns of Minisink and Wawayanda to the west. The Town's population was 32,027 according to the 2020 Census. It occupies 104 square miles and includes the Villages of Florida, Greenwood Lake, and Warwick. Note that this SWMP Plan covers the MS4 areas within the Town, and not those areas within any of the three incorporated Villages.

In 2003, the Town of Warwick obtained coverage under the NYSDEC MS4 Program. The Town has been assigned permit number NYR-20A409. The last revision of the SWMP Plan was in 2025 to meet the one-year requirements of NYSDEC's General Permit GP-0-24-001, Municipal Separate Storm Sewer Systems (MS4s). This General Permit (Permit) was issued by the NYSDEC on December 13, 2023 and its Effective Date of Coverage (EDC) is January 3, 2024. The Permit is

included as Attachment 1 to this Plan. This SWMP Plan will serve as an update to the 2025 Storm Water Management Program Plan and meets the two-year requirements of the Permit.

The Permit identifies actions that must be taken by MS4 communities, outlining general requirements as well as six (6) individual regulatory programs called Minimum Control Measures (MCMs), each of which has measurable goals and required timelines. As a traditional land use control MS4 as defined in the Permit, the Town of Warwick's SWMP Plan must address the following six (6) MCMs:

1. Public Education and Outreach
2. Public Involvement/Participation
3. Illicit Discharge Detection and Elimination (IDDE)
4. Construction Site Stormwater Runoff Control
5. Post Construction Stormwater Management
6. Pollution Prevention/Good Housekeeping for Municipal Operations

The general MS4 stormwater regulations as well as the requirements for each of the six MCMs are further described in sections B and C of this SWMP. These sections emphasize the timeline requirements defined within the Permit. As milestone tasks are completed in accordance with the required time frames, this SWMP will be updated to detail the Town's actions, thus reflecting compliance with the Permit.

B. GENERAL STORMWATER REGULATIONS

1. Stormwater Management Plan Coverage Area

The Town of Warwick's SWMP Plan covers construction and post construction activities (for projects requiring NYSDEC SPDES General Permit coverage and MS4 Acceptance) throughout the entire Town of Warwick, all of which is within either an Automatically-Designated MS4 Area or an Additionally-Designated Area (ADA). These two regulated areas are depicted on the Town's Stormwater Basemap, included as Attachment 2 to this Plan.

The Town of Warwick drains into three major hydrologic systems: the Wallkill River, the Moodna Creek, and the Passaic River. The Wallkill River and Moodna Creek are tributaries of the Hudson River. Below are details from New York's State's Waterbody Inventory/Priority Waterbodies List (WI/PWL) about the surface waterbodies within the Town, organized by

watershed. The excerpts were taken from the Waterbody Segment Assessment Factsheets found online at the DEC info Locator[1].

Wallkill River Watershed

- *Wallkill River, upper and minor tribs (Segment ID 1306-0017) – Impaired segment*

Best Use	Use Assessment	Use Assessment Confirmation	Pollutant(s) Cause(s)	303(d) Year	Integrated Reporting Category
Fishing	Impaired	Confirmed	Dissolved Oxygen	2022	IR5
Secondary Contact Recreation	Impaired	Confirmed	Total Phosphorus	2018	IR5
Primary Contact Recreation	N/A for Waterbody Class	—	—	—	—
Source of Water Supply	N/A for Waterbody Class	—	—	—	—

The Wallkill River delineates a portion of the western municipal boundary of the Town. The area alongside the River includes the extensive Black Dirt Region, which is wide floodplain of the River that is used primarily for agricultural but also supports some residential and commercial uses within the floodplain's "islands." Warwick has no Automatically-designated MS4 Areas within this Watershed.

[1] https://gisservices.dec.ny.gov/gis/dil/

- *Quaker Creek and tribs (Segment ID 1306-0025) – Impaired Segment*

Best Use	Use Assessment	Use Assessment Confirmation	Pollutant(s) Cause(s)	303(d) Year	Integrated Reporting Category
Fishing	Impaired	Confirmed	Water Level/Flow	NA	IR4c
			Dissolved Oxygen	2004	IR5
			Total Phosphorus	2018	
Secondary Contact Recreation	Fully Supported	Unconfirmed	Nutrients	N/A	IR3
Primary Contact Recreation	N/A for Waterbody Class	—	—	—	—
Source of Water Supply	N/A for Waterbody Class	—	—	—	—

The Quaker Creek is a direct tributary of the Wallkill River and is also predominantly in the Black Dirt Region and not in an automatically-designated MS4 Area. This drainage area includes Wheeler Creek and Stony Creek.

- *Wawayanda Creek, lower and minor tribs (Segment ID 1306-0079) – Needs Verification*

Best Use	Use Assessment	Use Assessment Confirmation	Pollutant(s) Cause(s)	303(d) Year	Integrated Reporting Category
Fishing	Impaired	Unconfirmed	Nitrite pH	N/A	IR3
Secondary Contact Recreation	Unassessed	—	No Data	N/A	IR3
Primary Contact Recreation	N/A for Waterbody Class	—	—	—	—
Source of Water Supply	N/A for Waterbody Class	—	—	—	—

The Wawayanda Creek has a large drainage area that includes the Village of Warwick, which it flows through.

- *Wawayanda Creek, upper and minor tribs (Segment ID 1306-0015) – Minor Impacts*

Water Quality Problem/Issue Information (CAPS indicate MAJOR Use Impacts/Pollutants/Sources)

Use(s) Impacted
Aquatic Life

Severity
Stressed

Problem Documentation
Known

Type of Pollutant(s)
Known: NUTRIENTS (phosphorus)
Suspected: Silt/Sediment
Possible: - - -

Source(s) of Pollutant(s)
Known: - - -
Suspected: AGRICULTURE, URBAN/STORM RUNOFF
Possible: Construction (resident.develop.), Municipal (Warwick WWTP), On-Site/Septic Syst

- *Long House Creek, upper and tribs (Segment ID 1306-0082) - Needs Verification*

Best Use	Use Assessment	Use Assessment Confirmation	Pollutant(s) Cause(s)	303(d) Year	Integrated Reporting Category
Fishing	Fully Supported	Unconfirmed	Dissolved Oxygen	N/A	IR3
Secondary Contact Recreation	Unassessed	—	No Data	N/A	IR3
Primary Contact Recreation	Unassessed	—	No Data	N/A	IR3
Source of Water Supply	N/A for Waterbody Class	—	—	—	—

Long House Creek is a direct tributary of the Wawayanda Creek.

- *Pochuck Creek and minor tribs (Segment ID 1306-0078) – Needs Verification*

Best Use	Use Assessment	Use Assessment Confirmation	Pollutant(s) Cause(s)	303(d) Year	Integrated Reporting Category
Fishing	Stressed	Unconfirmed	Total Dissolved Solids (TDS)	N/A	IR3
Secondary Contact Recreation	Unassessed	—	No Data	N/A	IR3
Primary Contact Recreation	N/A for Waterbody Class	—	—	—	—
Source of Water Supply	N/A for Waterbody Class	—	—	—	—

Pochuck Creek is a direct tributary to the Wallkill River.

- *Wickham Lake (Segment ID 1306-0083) – Needs Verification*

Best Use	Use Assessment	Use Assessment Confirmation	Pollutant(s) Cause(s)	303(d) Year	Integrated Reporting Category
Fishing	Impaired	Unconfirmed	Dissolved Oxygen	N/A	IR3
Secondary Contact Recreation	Unassessed	—	No Data	N/A	IR3
Primary Contact Recreation	Unassessed	—	No Data	N/A	IR3
Source of Water Supply	N/A for Waterbody Class	—	—	—	—

Wickham Lake is the headwaters of the Wawayanda Creek. The Lake is within an automatically-designated MS4 area, but the Town is seeking to remove this designation, as its origin was based on the population of a correctional facility that no longer exists in this area.

- *Glenmere Lake*

Best Use	Use Assessment	Use Assessment Confirmation	Pollutant(s) Cause(s)	303(d) Year	Integrated Reporting Category
Fishing	Impaired	Unconfirmed	Dissolved Oxygen	N/A	IR3
			Total Phosphorus		
Secondary Contact Recreation	Impaired	Confirmed	Total Phosphorus	2005	IR4a*
			Algal/Weed Growth	NA	IR4c
Primary Contact Recreation	Impaired	Confirmed	Algal/Weed Growth	NA	IR4c
Source of Water Supply	Impaired	Confirmed	Algal/Weed Growth	NA	IR4c

- Glenmere Lake is a drinking water supply for the Village of Florida, as well as the Orange County Correctional Facility in Goshen, and is an important water resource but is not included in the WI/PWL. The Lake was the focus of a management plan, which was undertaken by the Orange County Water Authority in 2012 to balance the lake's use for water supply with aesthetic, ecological, and recreational values. Urban development is limited around Glenmere Lake, with the Village of Florida and Orange County owning the majority of the land surrounding the Lake.

Passaic River watershed

- *Tribs to Greenwood Lake (Segment ID 1501-0070) – Unassessed (no data)*
- *Ringwood River and tribs (Segment ID 1501-0064) - Unassessed (no data)*
- *Greenwood Lake (Segment ID 1501-0001) -Impaired Segment*

- *Sterling Lake (Segment ID 1501-0068) – Needs Verification*

Best Use	Use Assessment	Use Assessment Confirmation	Pollutant(s) Cause(s)	303(d) Year	Integrated Reporting Category
Fishing	Stressed	Unconfirmed	pH	N/A	IR3
Secondary Contact Recreation	Unassessed	—	No Data	N/A	IR3
Primary Contact Recreation	Unassessed	—	No Data	N/A	IR3
Source of Water Supply	Stressed	Unconfirmed	Nitrate and Nitrite	N/A	IR3

- *Sterling Forest Lake (Segment ID 1501-0066) – Needs Verification*

Best Use	Use Assessment	Use Assessment Confirmation	Pollutant(s) Cause(s)	303(d) Year	Integrated Reporting Category
Fishing	Impaired	Unconfirmed	Dissolved Oxygen	N/A	IR3
Secondary Contact Recreation	Unassessed	—	No Data	N/A	IR3
Primary Contact Recreation	Unassessed	—	No Data	N/A	IR3
Source of Water Supply	Impaired	Unconfirmed	Iron	N/A	IR3

Moodna Creek Watershed

- *Moodna Creek, upper and minor tribs (Segment ID 1303-0011) – Needs Verification*

Best Use	Use Assessment	Use Assessment Confirmation	Pollutant(s) Cause(s)	303(d) Year	Integrated Reporting Category
Fishing	Stressed	Unconfirmed	Dissolved Oxygen	N/A	IR3
Secondary Contact Recreation	Unassessed	—	No Data	N/A	IR3
Primary Contact Recreation	N/A for Waterbody Class	—	—	—	—
Source of Water Supply	N/A for Waterbody Class	—	—	—	—

- *Black Meadow Creek (Segment ID 1303-0025) – Needs Verification*

Best Use	Use Assessment	Use Assessment Confirmation	Pollutant(s) Cause(s)	303(d) Year	Integrated Reporting Category
Fishing	Stressed	Unconfirmed	Dissolved Oxygen pH	N/A	IR3
Secondary Contact Recreation	Unassessed	—	No Data	N/A	IR3
Primary Contact Recreation	N/A for Waterbody Class	—	—	—	—
Source of Water Supply	N/A for Waterbody Class	—	—	—	—

2. 303(d) List and Impaired Waters Requirements

Greenwood Lake has been impacted by excessive phosphorus loading in recent decades, which has caused water quality, ecological, and aesthetic concerns. Because of this cultural eutrophication, the New York State portion of Greenwood Lake was designated as eutrophic/impaired on the Section 303(d) list in 2004. This is also the year that New Jersey established a Total Maximum Daily Load (TMDL) for its portion of the Lake. New York then followed suit and developed a companion report that was complimentary to the New Jersey TMDL. This TMDL Report was prepared by the NYSDEC's Division of Water and approved by the EPA and is entitled *Impaired Waters Restoration Plan for Greenwood Lake – Total Maximum Daily Load for Total Phosphorus (2005).* The TMDL Report estimated that the annual influx of phosphorus from various sources was 5,936 kilograms/year. The majority of the estimated phosphorus load originated from stormwater runoff and internal loading, but septic tanks and sewage treatment plant effluent [2]were also identified as being responsible for a sizeable portion. The TMDL Report proposed an annual target concentration of 0.02 mg/l for phosphorus. A bi-

[2] There are no wastewater treatment plants contributing effluent within the New York portion of the Lake, but there were five small plants on the Lake in New Jersey at the time of the writing of the TMDL Plan (2005).

state Greenwood Lake Commission was formed in 2000 to address environmental issues in the Lake, and the Commission had an active role in the TMDL Report.

Subsequent to this TMDL Report, the NYSDEC worked with local and regional partners to build on the Report and developed the Greenwood Lake Watershed Phosphorus TMDL Implementation Plan (Implementation Plan) in May 2021. This Implementation Plan is specific to the New York portion of the Lake and its watershed and emphasizes actions that citizens can take to help reduce phosphorus contributions to the Lake, as well as recommending stormwater retrofits. Evidence of phosphorus pollution in the Lake are noted in the Implementation Plan including the growth of algae (including toxic blue-green algae, at times), phytoplankton and nuisance aquatic weeds. The smell of algae and excessive weed growth were noted as affecting the suitability of the Lake's recreational use.

The Implementation Plan highlights the need for strict stormwater management in order to reduce the amount of phosphorus entering the Lake through soil erosion and runoff. The Permit (Attachment 1) outlines measures the Town can and should take to reduce stormwater impacts to the Lake and requires actions above and beyond the basic MS4 regulations, requiring the Town to adhere to the Permit requirements in both Part VIII, "Enhanced Requirements for Impaired Waters" and Part IX.B, "Other Phosphorus Impaired Watershed MS4s." Below is a summary of the defined actions and associated milestones established in these two Parts of the Permit, noting that some requirements that are not listed below are discussed in the applicable MCM sections.

The Permit requires that, within six months of the EDC, the MS4 Operator make available information on how phosphorus impairment is being addressed. The Town therefore updated its Stormwater Education and Outreach pamphlet (Attachment 3) to include an emphasis on phosphorous pollution, focusing on sources of the nutrient, impacts to water quality, and best practices for reducing phosphorus levels in surface water. This pamphlet is posted on the Town webpage and available to the public In Town Hall

A requirement within one year of the EDC is the development of a retrofit plan that proposes a retrofit (or retrofits) that will reduce phosphorus to the level specified in the Implementation Plan. This retrofit plan was submitted to the NYSDEC on March 21, 2025, and NYSDEC has

provided comments on the retrofit plan that the Town is currently reviewing and discussing. The MS4 Operator will continue to work on the requirements of the retrofit program according to the following schedule:

a. **Within five (5) years** of the EDC, all retrofit projects will be constructed to achieve the five (5) year phosphorus reduction assigned to the MS4 Operator, as required by the Greenwood Lake Watershed Phosphorus TMDL Implementation Plan, October 2019. Annually, by December 31, MS4 Operators will submit to the Department any changes made to the retrofit plan.

- MS4 Operators will document the retrofit program in the SWMP Plan specifying:
    1) Progress on retrofit projects already commenced
    2) Identification of retrofit projects for the upcoming construction season
    3) Certification that completed retrofit projects have been constructed in accordance with the retrofit plans.

Other actions that the Town has taken to reduce phosphorus loading into the Lake include revising their Stormwater Management Code (§164-47.10.E.5.a of Attachment 4) to require that SWPPPs for land disturbance activities greater than ¼ acre that would discharge into Greenwood Lake to include post-construction stormwater management practices that would mitigate runoff into the Lake.

Town Code also requires properties within and surrounding Greenwood Lake to inspect and pump out their septic systems every 3 years.[3] Any septic systems that are found to be failing are required to be replaced. These replacements must be designed and then submitted to the Town's Building Department for review.[4] This is a direct response to the special conditions of the town code, which requires that no increase of pollutants to any 303(d) listed waters, such as Greenwood Lake, can occur.[5] The town code mandates that when activities that contaminate stormwater occur, the perpetrator must implement structural or non-

[3] Town of Warwick Town Code, §100-9. Use of best management practices to prevent, control and reduce stormwater pollutants.B(1)(a).

[4] Town of Warwick Town Code, §100-9. Use of best management practices to prevent, control and reduce stormwater pollutants. B(1)(a).

[5] Town of Warwick Town Code, §100-2 Definitions, Special Conditions.

structural BMPs to reduce or eliminate the source of pollutants. The Town's Building Inspector then ensures that the required measures are implemented.

The local law used to satisfy Part IV.E.2.b of the Permit is currently being revised to include the following language requiring the use of the Enhanced Phosphorus Removal Design Standards in accordance with the NYSDEC Stormwater Design Manual 2024 for the applicable watershed:

"Land development activities requiring water quantity and quality controls (post-construction stormwater runoff controls) must include: "Single-family home construction located in the Greenwood Lake watershed" and "Single-family residential subdivisions located in the Greenwood Lake watershed."

3. Administration and Reporting

As of the writing of this Plan, the Town has completed the actions that the Permit requires within the first year of the EDC, as outlined below.

- The Town has completed an Enforcement Response Plan (ERP, Attachment 5) that outlines the processes for reviewing and documenting potential illicit discharges and potential stormwater violations at construction sites. Attachment A to the ERP includes a Violation and Enforcement Documentation form that the Town utilizes when potential or actual violations arise. These forms will be filed digitally as well as in the Building Department with other MS4 materials.
- The Town completed an organizational chart, which is Attachment C to the ERP, that outlines municipal staff responsibilities for enforcing the six Minimum Control Measures and includes contact information for the public to use to report violations and complaints. As displayed in chart, the Town Supervisor has been designated to be the MS4 Operator. The Supervisor can be reached at Town Hall at 845-477-9215 or via email at supervisor@townofwarwick.gov. The Operator has assigned staff to administer, track, enforce, and report on the various MCM activities defined in the Permit as being due in the first year of the EDC. The Operator has designated the Town Consulting Engineer, as the Stormwater Program Coordinator. The MS4 Operator will work with the Coordinator, staff, consultants and other parties to ensure that all mapping, reporting, and other

requirements established by the Permit are completed and will update this SWMP Plan as needed, no less frequently than annually. As of the writing of this Plan, the entities that are assisting with implementation of the Permit are Town staff from various Departments and applicable Town consultants.

- The Town is undertaking the comprehensive system mapping of stormwater infrastructure, in accordance with Part IV.D.1 of the Permit. When completed, this system mapping will include MS4 outfalls, interconnections, sewershed boundaries, conveyance systems, culvert crossings and stormwater structures. These features will be added to the Town's Stormwater System Map (Attachment 6) once mapping has been completed. It should be noted that the Town of Warwick is actively petitioning New York State to remove the Automatically-designated area around Wickham Lake, as it originally received this designation due to the former Mid-Hudson Correctional Facility being located in this area which closed down in 2011. As such, the Town has not collected infrastructure information within this area and the Town's inventory is limited to the Automatically-designated area that corresponds to the Greenwood Lake watershed. The Town's Stormwater Basemap (Attachment 2) shows stream classifications, topography, land use, and the MS4 areas.

In addition to the features already mapped and included in this SWMP Plan, further mapping will be updated in two phases:

a. **Phase I: Within three (3) years of the EDC**, the comprehensive system mapping must include the following information:
    - Monitoring locations, with associated prioritization
    - Focus areas
    - Publicly owned/operated post-construction stormwater management practices (SMPs). The publicly owned/operated post-construction SMPs subject to this requirement are in the automatically designated area or an additionally designated area subject to Criterion 1, 2, or 3 of the Additional Designation Criteria
    - Municipal facilities, with associated prioritization

- As per Part IX.B.1 of the Permit, the MS4 Operator will update, in geographic information system (GIS) format with a scale of 1:24,000 or finer, the comprehensive system mapping to include areas with potential to contribute phosphorus to the TMDL waterbody, which include:
  1. Retail and wholesale plant nurseries (including big box stores)
  2. Commercial lawn care facilities
  3. Golf courses
  4. Commercial or industrial yard waste storage areas (e.g., yard waste composting and disposal areas)

b. Phase II: Within five (5) years of the EDC, the comprehensive system mapping must include the following information:

- MS4 infrastructure, including:
  Conveyance system - Type (closed pipe or open drainage)and direction of flow
  Stormwater structures - Type (drop inlet, catch basin, or manhole) and number of connections to and from drop inlets, catch basins, and manholes
- Privately owned/operated post-construction SMPs which discharge to the MS4. The privately owned/operated post-construction SMPs subject to this requirement are in the automatically designated area or an additionally designated area subject to Criterion 1, 2, or 3 of the Additional Designation Criteria.
- If the location of the privately-owned post-construction SMPs cannot be determined without accessing the private property, the MS4 Operator will map the location of the property that the post- construction SMP is located on using street address or tax parcel.

c. Recordkeeping: The MS4 Operator will keep records required by this SPDES general permit for five (5) years after they are generated. Records will be submitted to the NYSDEC within a reasonable specified time period of a written NYSDEC request for such information. Documents may be maintained in electronic format if the manner reasonably assures the integrity of the records, in accordance with NYCRR 750-

2.5(e)(1). Records, including the Notice of Intent (NOI) and the SWMP Plan, will be made available to the public at reasonable times during regular business hours.

This SWMP Plan is available online at the Town's MS4 Stormwater website and in hard copy form in the Town Clerk's office in Town Hall. The hard copy is available during normal business hours to allow the public, municipal employees and representatives of NYSDEC and EPA to review the SWMP Plan, offer comments, and ask questions.

d. Reporting: Annually, the MS4 Operator will submit an Annual Report to the NYSDEC using the form provided by the NYSDEC by April 1 of each year.

An Interim Progress Certification for the period of January 3 through June 30 of 2025 was submitted to the NYSDEC on September 25, 2025. The Report was deemed complete by the NYSDEC. An Interim Progress Certification for the period July 1, 2025 through January 2, 2026 will be submitted to the NYSDEC by April 1, 2026 along with the Annual Report. Interim reports will continue to be submitted semiannually as required by the Permit.

Reports submitted to the NYSDEC on an annual and semiannual basis will be saved electronically with hard copies being placed in a separate file entitled "MS4 Reporting" to be kept in the Building Department. The reports are posted on the Town's webpage with an option for viewer to email the Town with questions or comments. A phone number is also provided on the webpage for the same purpose.

e. Once every five (5) years: The MS4 Operator must evaluate the SWMP for compliance with the terms and conditions of the Permit, including the effectiveness or deficiencies of components of the individual SWMP Plan, and the status of achieving the requirements outlined in the Permit.

4. Exempt Activities

This SWMP Plan exempts activities for discharges including those activities identified in the Town's Stormwater Management Regulations (Attachment 4) and the Permit, which lists the following discharges from MS4 Operators as being exempt from the requirements of the Permit:

- Stormwater discharges associated with an industrial activity provided the discharges are covered by the SPDES Multi-Sector General Permit for Stormwater Discharges Associated with Industrial Activity, GP-0-23-001 (MSGP).
- Individual SPDES permitted stormwater discharges provided the discharges are in compliance with their individual SPDES permit limitations.

Additionally, the following discharges from MS4 Operators are not authorized by the Permit:

- Stormwater discharges that may adversely affect an endangered or threatened species, or its designated critical habitat, unless the MS4 Operator has obtained a permit issued pursuant to 6 NYCRR Part 182 or the NYSDEC has issued a letter of non-jurisdiction.
- Stormwater discharges which adversely affect properties listed or eligible for listing in the National Register of Historic Places unless the covered entity is in compliance with requirements of the National Historic Preservation Act and has coordinated with the appropriate State Historic Preservation Office any activities necessary to avoid or minimize impacts.
- Stormwater discharges, the permitting of which is prohibited under 40 CFR 122.4 and 6 NYCRR 750-1.3.
- The discharge of vehicle and equipment washwater from municipal facilities, including tank cleaning operations.

5. Enforcement Measures and Tracking

The Town is committed to identifying and documenting stormwater violations and has described its process of ensuring compliance in its Enforcement Response Plan (ERP, Attachment 5). As outlined in the ERP, the MS4 Operator must address violations of stormwater regulations and attempt to remediate the issue through a well-documented process. Ongoing and completed Violation and Enforcement Documentation forms will be saved electronically with hard copies being placed in a file entitled “Violation and Enforcement Documentation” to be kept in the Town Clerk’s Office.

C. MINIMUM CONTROL MEASURES

The Permit requires that regulated municipalities implement their SWMPs, in part, through six Minimum Control Measures (MCMs). These MCMs range from involving the public in the municipality's stormwater management program to reducing surface water pollution through various means that are within the municipality's control, such as locating and eliminating sources of illegal pollution, monitoring construction sites, properly maintaining stormwater infrastructure, and minimizing pollution from municipal activities. Illicit discharges from private properties are also regulated through the municipal stormwater management program. The Town of Warwick implementation of these six MCMs is described below.

1. Minimum Control Measure #1: Public Education and Outreach

The MS4 Operator has developed and implemented an education and outreach program to increase public awareness of pollutant generating activities and behaviors. This MCM is designed to inform the public about the impacts of stormwater on water quality, the general sources of stormwater pollutants, and the steps the general public can take to reduce pollutants in stormwater runoff.

The MS4 Operator has delegated management of this MCM to the Building Inspector. The Building Inspector maintains the Town's MS4 Stormwater webpage, oversees distribution of the Town's Stormwater Education and Outreach pamphlet (Attachment 3), and ensures that the goals and obligations of this MCM are met in a timely manner. The Building Inspector can be reached by email at building@townofwarwick.gov or by phone at 845-986-1124 ext 260.

The Town has also made information about illicit discharges available to municipal employees, businesses, and the public by posting information on the Town's website and by including information about illicit discharges in the pamphlet. This information includes:

- What types of discharges are allowable
- What an illicit discharge is and why they are prohibited
- The environmental hazards associated with illicit discharges and improper disposal of waste
- Proper handling and disposal practices for the most common behaviors within the

community (e.g., septic care, car washing, household hazardous waste, swimming pool draining, or other activities resulting in illicit discharges to the MS4)

- How to report illicit discharges they may observe

a. Within three (3) years of the EDC:

- **Focus Areas**: the MS4 Operator will identify and document the focus areas in the SWMP Plan. The focus areas to be considered are as follows:
- Areas discharging to waters with Class AA-S, A-S, AA, A, B, SA, or SB (mapped in accordance with Part IV.D.1.e.ii.a of the Permit)
- Sewersheds for impaired waters listed in Appendix C subject to Part VIII of the Permit
- TMDL watersheds (subject to Part IX of the Permit)
- Areas with construction activities
- Areas with on-site wastewater systems (subject to Part VIII or Part IX of the Permit)
- Residential, commercial, and industrial areas (mapped in accordance with Part IV.D.1.e.iii of the Permit)
- Stormwater hotspots
- Areas with illicit discharges

b. Target Audience and Associated Pollutant Generating Activities: The MS4 Operator will identify and document the applicable target audience(s) and associated pollutant generating activities that the outreach and education will address for each focus area identified by the MS4 Operator in Part VI.A.1.a of the Permit. The target audiences are as follows:

- Residents
- Commercial:[6] Business owners and staff
- Institutions:[7] Managers, staff, and students
- Construction: Developers, contractors, and design professionals

[6] Business, retail stores, and restaurants.
[7] Hospitals, churches, colleges, and schools.

- Industrial:[8] Owners and staff
- MS4 Operator's municipal staff

c. Education and Outreach Topics: The MS4 Operator will identify and document in the SWMP Plan the education and outreach topics and how the education and outreach topics will reduce the potential for pollutants to be generated by the target audience(s) for the focus area(s).

- Following the completion of Part IX.B.1 of the Permit, twice a year, once from March to August and once from September to February, the MS4 Operator will provide educational messages with information specific to phosphorus to the applicable target audiences within the TMDL watershed focus area, identified in Part VI.A.1.b of the Permit. The SWMP Plan will be updated with changes made to public education and outreach program.
- Twice a permit term, separated by a minimum of one (1) year, the MS4 Operator will educate residential on-site wastewater system users on the on-site wastewater inspection program described in Part IX.B.4.c of the Permit and proper maintenance practices. The SWMP Plan will be updated with changes made to public education and outreach program.

d. Once every five (5) years of the EDC:

Distribution Method of Educational Messages: The MS4 Operator will identify and document in the SWMP Plan which of the following method(s) are used for the distribution of educational messages:

- Printed materials (e.g., mail inserts, brochures, and newsletters)
- Electronic materials (e.g., websites, email lists)
- Mass media (e.g., newspapers, public service announcements on radio or cable)
- Workshops or focus groups
- Displays in public areas (e.g., town halls, library, parks)

[8] Factories, recyclers, auto-salvage, and mines.

- Social media (e.g., Facebook, Twitter, blogs)

e. Frequency: After completion of focus areas, target audience identification and educational and outreach topic development, MS4 Operator must:

- Deliver an educational message to each target audience(s) for each focus area(s) based on the defined education and outreach topic(s).
- Document the completion of this requirement in the SWMP Plan.

Upon completion of the above, annually, by April 1, the MS4 Operator must review and update the focus areas, target audiences and/or education and outreach topics, and Document the completion of this requirement in the SWMP.

2. Minimum Control Measure #2: Public Involvement/Participation

The MS4 Operator provides opportunities to involve the public in the development, review, and implementation of the SWMP. This MCM is designed to give the public the opportunity to include their opinions in the implementation of this SPDES general permit.

The MS4 Operator has delegated management of MCM 2 to the Building Inspector. The Building Inspector will work to disseminate information about the Town's MS4 activities and solicit feedback and participation from the public and can be reached by email at building@townofwarwick.gov or by phone at 845-986-1124 ext. 260. The Operator will also address stormwater issues received from the public, staff, or otherwise, and ensure enforcement issues are documented in compliance with the guidelines set forth in the ERP. As referenced earlier in this SWMP Plan, the Town's primary methods of engaging the public in its Stormwater Management Program are its Stormwater Outreach and Education Pamphlet (Attachment 3), its website, and Public Hearings/Notices. Copies of the Town's SWMP Plan, Annual Report and Stormwater Pamphlet are available for review on the website for public review and comment.

Other methods that the MS4 Operator may use to inform the public of the opportunity for involvement and participation in the development and implementation of the SWMP Plan include public notices and public displays of educational information. The Town conducted a public hearing on July 24, 2025 to present the SWMP Plan and Annual Report, and to solicit public comments and feedback. The Town will also explore synergistic opportunities to

coordinate with other pre-existing public involvement/participation activities.

The Town Clerk will file a summary of comments received on the SWMP Plan and draft Annual Report in the Building Department with other MS4 paperwork. Whenever public input is received, this SWMP Plan will be updated, where appropriate, to reflect the public input received.

3. Minimum Control Measure #3: Illicit Discharge Detection and Elimination (IDDE)

The Town has established a program to detect, trace and eliminate illicit discharges in accordance with the two (2) year permit requirements, as described below. Additional training of personnel as required by the permit is currently underway and will be completed prior to the initiation of any required sampling activities.

The Town of Warwick has designated the Building Inspector, to oversee the implementation of the Town's Illicit Discharge Detection and Elimination Program (IDDE Program). He will receive illicit discharge reports from the public via emails to building@townofwarwick.gov or by phone at 845-956-1127 ext 269.

If illicit discharge violations are confirmed by the Town to have taken place, enforcement actions will be taken as per the ERP (Attachment 3) and documented using Attachment A of the ERP. Within thirty (30) days of confirmation of an illicit discharge, the Building Inspector, or their designee, will re-visit the site and document conditions to determine if the violation has been resolved. All Violation and Enforcement Documentation reports will be kept in a separate file in the Building Department with all other MS4-related files as well as electronically.

The EPA has published a document entitled "Illicit Discharge Detection and Elimination: A Guidance Manual for Program Development and Technical Assessment" (Attachment 8) which is to be used as a guide for Town personnel involved with illicit discharge, detection and elimination. Additionally, the Town is currently in the process of coordinating specific training for those individuals involved in this MCM.

In compliance with Minimum Control Measure 3 of the NYSDEC MS4 General Permit, the MS4 Operator has developed three programs to systematically detect, investigate (track

down), and eliminate illicit discharges to the MS4. To meet this requirement, the Town has established the following three programs:

a. Monitoring Locations Inspection and Sampling Program
b. Illicit Discharge Track Down Program
c. Illicit Discharge Elimination Program

These programs are designed to identify potential sources of illicit discharges through scheduled inspections, sampling, and field investigations, and to ensure timely corrective actions in accordance with state and federal guidance, as further described below:

a. Monitoring Locations Inspection and Sampling Program

The Town of Warwick will perform one (1) Dry Weather Inspection and one (1) Wet Weather Inspection of each outfall within the Automatically Designated Area (ADA) at a minimum frequency of once every five years. All inspections shall be conducted by a qualified individual who has received training consistent with the standards outlined in the EPA's Publication on Illicit Discharge Detection and Elimination (Attachment 8). Each inspection will be documented using the inspection form shown in Attachment 5. Completed inspection forms and sample results will be retained in the Town Clerk's office and digitally.

All suspect or obvious illicit discharges identified during inspections must be sampled and evaluated in accordance with the latest NYSDEC MS4 Permit requirements. Obvious illicit discharges shall be investigated using the Illicit Discharge Track Down Program detailed below.

All suspect or obvious illicit discharges identified during inspections will be handled in accordance with the latest NYSDEC MS4 Permit requirements with obvious illicit discharges being immediately advanced to track down and elimination procedures. Suspect illicit discharges will await track down and enforcement pending results of analytical samples or five (5) business days, whichever occurs first.

Chapter 12 of *Illicit Discharge Detection and Elimination*: *A Guidance Manual for Program Development and Technical Assessments* will be used as resource for the Monitoring Locations Inspection and Sampling Program. This publication was developed

by the Center for Watershed Protection in collaboration with Dr. Robert Pitt of the University of Alabama and funded by the US EPA. The full 378-page document is included as Attachment 8 of this SWMP Plan.

b. Training Requirements for Monitoring Locations Inspection and Sampling Program

All personnel responsible for conducting inspections and sampling must receive appropriate training associated with the Monitoring Locations Inspection and Sampling Program's procedures prior to performing any inspection or sampling activities. Refresher training is required at least once every five (5) years or whenever there are updates to inspection or sampling procedures. The names, titles, and contact information for trained personnel are provided in Attachment D of the Enforcement Response Plan. Additional names, titles and contact information will be added once training has been provided and completed.

c. Illicit Discharge Track Down Program

The Town of Warwick has implemented an Illicit Discharge Track Down Program consistent with Chapter 13 of the most recent version of the EPA's publication on Illicit Discharge Detection and Elimination (Attachment 8), "Tracking Discharges to a Source," is being used as the primary methodology for identifying and tracing illicit discharges to their origin. The steps to be taken for Illicit Discharge Track Down are as follows:

- Within twenty-four (24) hours of discover, the MS4 Operator must initiate track down procedures outlined in Attachment 8 for flowing MS4 monitoring locations with obvious illicit discharges.
- Within two (2) hours of discovery, the MS4 Operator must initiate track down procedures outlined in Attachment 8 for obvious illicit discharges of sanitary wastewater that would affect bathing areas during bathing season, shell fishing areas or public water intakes and report orally or electronically to the NYSDEC Regional Director and Orange County Health Department.
- Within five (5) days of discovery (pending analytical results), the MS4 Operator will initiate track down procedures outlined in Attachment 8 for suspect illicit discharges.

- Re-inspect the monitoring location within thirty (30) days of initial inspection. If observed illicit discharges remain, the MS4 Operator will pursue (or continue to pursue) enforcement and elimination.

d. Training Requirements for Illicit Discharge Track Down Program

All personnel responsible for tracking down illicit discharges will receive appropriate training regarding the Program's procedures prior to performing any inspection or sampling activities. Refresher training is required at least once every five (5) years or whenever there are updates to inspection or sampling procedures. The names, titles, and contact information for trained personnel are provided in Attachment D of the Enforcement Response Plan. Additional names titles and contact information will be added once training has been provided and completed.

e. Illicit Discharge Elimination Program

Procedures for escalation of enforcement and tracking as well as provisions to ensure corrective actions are taken are outlined in the Town's Enforcement Response Plan (Attachment 5). Once an illicit discharge's source has been identified, the following timelines will be followed by the MS4 Operator and/or their trained personnel:

- Within twenty-four (24) hours of identification of an illicit discharge, that has a reasonable likelihood of adversely affecting human health or the environment, the MS4 Operator must eliminate (or cause the elimination of) the illicit discharge.
- Within five (5) days of identification of an illicit discharge that does not have a reasonable likelihood of adversely affecting human health or the environment, the MS4 Operator must eliminate (or cause the elimination of) the illicit discharge.
- Where elimination of an illicit discharge within the specified timeframes (Part VI.C.3.a.iv of the Permit) is not possible, the MS4 Operator must notify the NYSDEC Regional Director.

f. Training Requirements for Illicit Discharge Elimination Program

1. As new staff are added, training on the MS4 Operator's illicit discharge elimination procedures will be provided prior to conducting illicit discharge eliminations.

2. For existing staff, training on the MS4 Operator's illicit discharge elimination procedures will be given prior to conducting illicit discharge elimination. At a minimum, refresher training will be provided once every five (5) years, thereafter.
3. If the illicit discharge elimination procedures are updated, training on the updates will be given to all staff prior to conducting illicit discharge eliminations.

g. Within three (3) years of the EDC:

Monitoring Locations Inventory: The MS4 Operator will develop and maintain an inventory of the monitoring locations in the SWMP. The following information will be included in the inventory and will be updated annually:

i. Inventory information for MS4 outfalls

- ID
- Prioritization (high or low)
- Type of monitoring location
- Name of MS4 Operator's municipal facility, if located at a municipal facility
- Receiving waterbody name and class (mapped in accordance with Part IV.D.1.e.ii.a of the Permit)
- Receiving waterbody WI/PWL Segment ID (mapped in accordance with Part IV.D.1.e.ii.b of the Permit)
- Land use in drainage area
- Type of conveyance (open drainage or closed pipe)
- Material
- Shape
- Dimensions
- Submerged in water
- Submerged in sediment

ii. Inventory information for interconnections

- ID
- Prioritization (high or low)

- Type of monitoring location
- Name of MS4 Operator receiving discharge or private storm system
- Name of MS4 Operator's municipal facility, if located at a municipal facility
- Receiving waterbody name and class (mapped in accordance with
- Part IV.D.1.e.ii.a of the Permit)

iii. Inventory information for municipal facility interconnection

- ID
- Prioritization (high or low)
- Type of monitoring location
- Name of MS4 Operator's municipal facility
- Receiving waterbody name and class (mapped in accordance with Part IV.D.1.e.ii.a of the Permit)

h. Monitoring Locations Prioritization: The MS4 Operator must prioritize monitoring locations which are included in the monitoring locations inventory (Part VI.C.1.c of the Permit) as follows:

i. High priority monitoring locations include monitoring locations:

- At a high priority municipal facility, as defined in Part VI.F.2.c of the Permit
- Discharging to impaired waters subject to Part VIII of the Permit
- Discharging within a TMDL watershed subject to Part IX of the Permit
- Discharging to waters with Class AA-S, A-S, AA, A, B, SA, or SB (mapped in accordance with Part IV.D.1.e.ii.a of the Permit)
- Confirmed citizen complaints on three or more separate occasions in the last twelve (12) months

ii. All other monitoring locations are considered low priority.

iii. Within thirty (30) days of when a monitoring location is constructed or the MS4 Operator discovers it, the MS4 Operator must prioritize those monitoring locations, and annually, after the initial prioritization (Part VI.C.1.d.i of the

Permit), the MS4 Operator must update the monitoring location prioritization in the inventory (Part VI.C.1.c of the Permit) based on information gathered as part of the monitoring location inspection and sampling program (Part VI.C.1.e of the Permit). The completion of this permit requirement must be documented in the SWMP.

iv. Within five (5) years of the EDC:

- Inventory of Potential Phosphorus Sources: Following the completion of Part IX.B.1, within five (5) years of the EDC, the MS4 Operator will include on the MS4 outfall inventory (Part VI.C.1.c of the Permit) the number of each item identified in Part VIII.B.1.a of the Permit for each associated MS4 outfall.
- On-site wastewater systems: The MS4 Operator will develop, implement, and enforce a program that ensures residential on-site wastewater systems (i.e., septic tanks, cesspools, absorption fields or distribution systems) are properly operated and do not contribute pollutants to the MS4. The MS4 Operator will:
- Once every five (5) years, ensure that residential septic tanks/cesspools are pumped out and system components (i.e., septic tanks, cesspools and installed absorption field) are inspected.
- Ensure the following information is collected and document the completion of this requirement in the SWMP Plan:
    - Individual performing inspection
    - Inspection date
    - Address
    - Location of system on property
    - Inspection rating (pass/fail)
    - Evidence of failed systems
- Refer failures to the appropriate agency to ensure corrective actions are taken.

- Eliminate illicit discharges from on-site wastewater systems to the MS4 in accordance with the time frames specified in Part VI.C.3 of the Permit.

4. Minimum Control Measure #4: Construction Site Stormwater Runoff Control

The MS4 Operator has developed the following construction Site Runoff Control program to ensure active construction sites are effectively controlled. This MCM is designed to prevent pollutants from construction related activities as well as promote proper planning and installation of post-construction Stormwater Management Practices (SMPs).

The MS4 Operator has delegated management of MCM 4 to the Town's Stormwater Program Coordinator (Town's Consulting Engineer). The Coordinator will work closely with the Building Department to implement the goals and meet the requirements of this MCM. The Building Inspector will receive correspondence regarding construction site complaints from the public and other parties. The Building Inspector can be reached at 845-986-1124 ext 260. The Building Inspector will follow procedures in the Town's ERP, involving the Coordinator when necessary. Reports of concerns will be filed in the Building Department along with other MS4 paperwork.

An inventory of construction sites is maintained (and kept current) by the Town's consulting engineering firm. This inventory is included in this Plan as Attachment 11 and kept in a separate file in the Building Department with all other MS4-related files.

As of January 2025, the Town has established a Construction Oversight Program. The elements of the Program, while in compliance with State regulations, are unique to the Town of Warwick and therefore any individuals assisting with the Program will need training in the applicable procedures; these individuals are listed in Attachment 10.

The basis of the Program is construction site inspections. Any staff who will be inspecting construction sites will (at a minimum) have received 4 hours of NYSDEC-endorsed training in Erosion and Sediment Control principles. After successfully completing the training, these individuals (listed in Attachment 10) can perform inspections and complete the associated inspection report under the direct supervision of a CPESC, Professional Engineer or Licensed Landscape Architect. The individuals who

have completed the 4-hour Erosion and Sediment Control training will need to re-certify every 3 years. Currently, the Town Consulting Engineers are performing construction site inspections with trained individuals under direct supervision of a Certified CPESC and CESSWI.

Stormwater management for land disturbance activities is addressed within the Town of Warwick Code §164-47.10 "Stormwater management." This section identifies three (3) levels of stormwater pollution protection plans (SWPPPs) that apply to varying intensities of land clearing activities: simple SWPPP, intermediate SWPPP, and complete SWPPP. While State regulations require a SWPPP for land disturbances of one acre or more, the Building Inspector can mandate a SWPPP for projects of any size if it meets the criteria set forth in §164-47.10.C.2. The Town also requires that certain land development activities greater than 1/4 acres include water quantity and water quality controls (post-construction stormwater runoff controls) if it would discharge a pollutant of concern into Greenwood Lake. Most land development activities will require one of the three and will be reviewed by the Town's Planning Board engineers. Criteria to determine the level of SWPPP are outlined in the Town Code.

The Town's Planning Board Engineer also reviews post-construction SMPs contained in the SWPPP for conformance with the NYSDEC Design Manual 2024 or equivalent, including:

- All post-construction SMPs must meet the sizing criteria contained in the NYSDEC Construction General Permit GP-0-25-001 and the NYSDEC Stormwater Design Manual 2024.
- Deviations from the performance criteria of the NYSDEC Design Manual 2024 must demonstrate they are equivalent.
- Ensures that all SWPPPs include an Operation and Maintenance (O&M) plan that includes inspection and maintenance schedules and actions, and that a responsible entity is identified to oversee the long-term operation and maintenance of each practice.

Once the SWPPP's have been found to substantially comply with both the Town's requirements laid out in §164-47.10 and the requirements of the NYSDEC SPDES General Permit for Stormwater Discharges from Construction Activities (Permit GP 0-20-001 or date of latest revision), an approval letter is issued. Then the Coordinator reviews the associated MS4 Acceptance paperwork (as submitted by the Design Professional for the Applicant) and coordinates with the Town Supervisor/MS4 Operator for signature and return to the Design Professional for filing with the NYSDEC to obtain permit coverage. The Coordinator also documents the SWPPP review by mailing the landowner a letter of approval and filing a copy of this letter in the Town Supervisor's office and Building Department along with other MS4 files. This letter will include information about pollutant-specific BMPs when the MS4 discharges to Greenwood Lake, which is an impaired waterbody as per Part III.B. of the Permit. The Town local law allows for a funding mechanism to reimburse the Town for costs associated with SWPPP reviews. Immediately after SWPPP review, the construction site inventory is updated to include this project as a new active project in the Town. This inventory is maintained by Town's consulting engineer and is included as Attachment 11.

Once a SWPPP has been approved and final approvals are provided by the Town Planning Board, a preconstruction meeting is held with the Planning Board Engineer, Building Inspector, Engineering Consultant and Developer/Applicant and their representatives and professionals. During the pre-construction meetings the Town's Engineering Consultant utilizes a standard, MS4-approved pre-construction meeting agenda to explain its review and requirement process to the site operators, covering periodic review of construction sites, SWPPP onsite information and submission of reports required. These meetings serve to:

- Confirm the approved project has received coverage under the Permit or an individual SPDES permit.
- Verify contractors and subcontractors selected by the Owner/Operator of the construction activity have identified at least one individual that has received 4 hours of NYSDEC-endorsed training in Erosion and Sediment Control principles.

- Review and discuss the requirements for owner and contractor certifications to be completed, as well, as required items to be included in the SWPPP mailbox at the construction site.
- Review the construction oversight program (Part VI.D.3 of the Permit) and expectations for compliance.

The pre-construction process also serves to educate site owners/operators, their Design Professionals, as well as, updating Town personnel as to the requirements for construction activities within the Town. Detailed descriptions of the procedures to be implemented are provided at the pre-construction meeting with attendees in the development process. Contact information for attendees at the pre-construction meeting are exchanged. General stormwater requirements, as well as, any site-specific concerns such as sensitive receptors, area water bodies, existing stormwater facilities, etc. are identified and discussed during pre-construction meetings. Copies of the standard agenda and minutes from the meeting are subsequently distributed to meeting attendees and filed in the Building Department along with other MS4 paperwork.

Once a project moves into the active construction phase, the Coordinator monitors sites for compliance with the approved SWPPP, MS4 Stormwater requirements and NYSDEC General Permit for construction. Within the Coordinator's inventory of construction sites (Attachment 11), some are considered to be "high priority" as per Part VI.D.5 of the Permit. The priority projects are thus identified based on the following:

- Directly convey runoff to Greenwood Lake
- Involve earth disturbance within one hundred (100) feet of any lake or pond.
- Are within fifty (50) feet of any rivers or streams (perennial or seasonal).
- Will have greater than five (5) acres of disturbed earth at any one time.

Projects not meeting the above criteria are considered low priorities.

Construction site operators are required to submit copies of field reports to the Coordinator for review. MS4 inspections utilizing the Construction Site Inspection Report (Attachment 12) are also performed by representatives of MHE. All completed field and inspection reports are filed in the Supervisor's office with other MS4 paperwork. High priority sites are inspected every two weeks, while low priority sites are inspected

monthly. Violations of the Town Stormwater regulations or NYSDEC General Permit are addressed in accordance with the approved ERP and procedures referenced in the SWMP Plan. Funding for the inspection is provided for in the Town of Warwick Town Code including an escrow account which is established for reimbursing the Town for costs associated with periodic review. Trained individuals involved with MS4 construction site inspections are listed in Attachment 10.

Individual Construction Site Closeout/Notice of Termination has been standardized by the Town for all sites and includes the following:

- Final review of the site (and accompanying report by the Applicants qualified professional) combined with a signed and sealed Stormwater Certification from the Design Professional indicating that all permanent stormwater devices associated with the project have been constructed in compliance with the Planning Board-approved plans, and SWPPP, including volumes for stormwater basins, ponds, etc. The final site inspection paperwork is filed in the Building Department along with other MS4 paperwork.
- Once the above information has been provided, a follow-up review of the submitted documentation as well as any accompanying field review is performed by the Coordinator. If all information and conditions appear to meet permit and Town Code requirements the certification and executed Notice of Termination (by the applicant/developer side) is submitted to the MS4 Operator for execution and subsequently returned to the Applicant/Developer side for filing with the NYSDEC. It is at this time that the construction site inventory is updated to show the project as being closed out.
- Post Construction reviews are then handled in conformance with MCM 5 and includes the post construction operations, maintenance and reporting requirements required by the executed Stormwater Management Agreement with the Owner/Applicant.

The Town's Construction Oversight Program, combined with compliance with applicable Federal, State and local regulations, is mitigating pollutants of concern from construction sites in the Town of Warwick.

In addition to the above, the MS4 Operator will incorporate three (3) to five (5) year permit requirements in accordance with the permit time frames outlined below:

a. Within three (3) years of the EDC:

Construction Site Inspections: The Operator must:

- Ensure individuals(s), responsible for construction site inspections, receive four (4) hours of NYSDEC endorsed training in proper erosion and sediment control principles from a Soil & Water Conservation District, or other NYSDEC endorsed entity. This training must be complete, within three (3) years of the EDC and every three (3) years thereafter and document the completion of this requirement in the SWMP Plan.
- Ensure all MS4 Construction Site Inspectors receive NYSDEC endorsed training in erosion and sediment control principles prior to conducting construction site inspections. Individuals without these trainings cannot inspect construction sites. Individuals who meet the definition of a qualified professional or qualified inspector are exempt from this requirement.
- Annually inspect all sites with construction activity identified in the inventory during active construction or sooner if deficiencies are noted that require attention. Follow up to construction site inspections must confirm corrective actions are completed within timeframes established by the Construction General Permit (CGP) and the MS4 Operator's ERP (Part IV.F.1 of the Permit).
- In the SWMP Plan, document and update annually the names, titles, and contact information for the individuals who have received the training listed in Part VI.D.8.a of the Permit.
- Document all inspections using the MS4 Construction Site Inspection Report Form (Attachment 12) or an equivalent form containing the same information. The MS4 Operator must include the completed Construction Site Inspection Reports in the

SWMP Plan.

b. Construction Site Closeout:

- The MS4 Operator will ensure a final construction site inspection is conducted, and documentation of the final construction site inspection will be maintained in the SWMP Plan. The final construction site inspection will be documented using the Construction Site Inspection Report form (Appendix D of the Permit), or an equivalent form containing the same information, or accept the construction site owner/operator's qualified inspector final inspection certification required by the CGP as well as the MS4 Notice of Termination paperwork.
- The Notice of Termination (NOT) will be signed by the MS4 Operator as required by the CGP for projects determined to be complete. The NOT will be signed in accordance with Part X.J of the Permit.

5. Minimum Control Measure #5: Post-Construction Stormwater Management

The MS4 Operator has developed a program to ensure proper operation and maintenance of post construction SMPs for new and redeveloped sites. This MCM is designed to promote the long-term performance of post-construction SMPs in removing pollutants from stormwater runoff.

The MS4 Operator has delegated oversight of MCM 5 to the Town's Stormwater Program Coordinator (Town's Consulting Engineer). The Coordinator has designed and will oversee the Town's Post Construction Stormwater Inspection and Maintenance Program and will ensure proper management of stormwater management practices (SMPs) once they have been approved and built. A primary component of this program is an inventory (ATTACHMENT 13) of publicly- and privately-owned/operated post-construction SMPs that meet the following criteria:

1. Post-construction SMPs that have been installed as part of any CGP covered construction site or individual SPDES permit (since March 10, 2003)
2. All new post-construction SMPs constructed as part of the construction site stormwater runoff control program.

The Coordinator has compiled an inventory based on the SPDES general permit for

post-construction SMPs installed after March 10, 2003. The inventory includes post-construction SMPs as they are approved or discovered or after the owner/operator of the construction activity has filed the Notice of Termination with the NYSDEC (Part VI.D.9.b of the Permit). The Engineering Consultant updates this inventory as each construction project is completed and the Notice of Termination is filed to end coverage under the General SPDES permit for Construction Activity. Further, as additional SMPs are discovered, the inventory is updated to include them. This inventory also includes drainage districts (as applicable).

In addition to the inventory of post-construction SMPs, the Town's Post-Construction Stormwater Inspection and Maintenance Program includes monitoring provisions to ensure that stormwater facilities are maintaining their intended functionality and adhering to long-term operation and maintenance (O&M) plans. The Town's monitoring provisions require that privately owned practices be inspected annually, and reports provided back the Town in accordance with the project's Stormwater Maintenance Agreement (Attachment 14). The annual reports are required to be received by October 15th annually.

The Town requires that any staff who will be inspecting post-construction SMPs to be trained in the Town's Post Construction SMP Inspection and Maintenance Program. This training is based not only on the Town's own procedures but also the procedures outlined in the Department-endorsed program. Training occurs before a staff member proceeds to perform an inspection and is required to be repeated at least every five years. This training will be modified if and when the Town's or the State's procedures are updated. See Attachment 10 for a list of the individuals who have been trained in post-construction SMP inspection and maintenance procedures. This list will be revisited at least annually and updated as needed. Trained individuals utilize the Post-construction SMP Checklist (Attachment 15) when conducting inspections; this paperwork is filed in the Building Department.

The Town of Warwick has instituted through its local law requirements and Stormwater Management Agreement that long-term operation and maintenance of

Stormwater Management facilities be undertaken by the site owners. The Town requires periodic review and maintenance of these practices constructed in compliance with the SWPPP.

The Town of Warwick's Building Department maintains Notice of Terminations for individual projects. The Notice of Termination triggers the requirements for the individual site owners to undertake operation and maintenance of stormwater improvements on commercial lots. The Town Building Department maintains records of all stormwater maintenance agreements.

The Town of Warwick has developed the above referenced system to assure long term operation and maintenance of stormwater best management practices implemented on development projects within the Town. The above referenced program has evolved through several decades of planning, zoning and building projects in the Town. Enforcement of long-term operation and maintenance on private properties is the responsibility of the Town's Building Department. The Town's Attorney prepares approval resolutions requiring long term operation and maintenance through one or more of the practices identified above.

a. Within three (3) years of the EDC: The Town's post-construction SMP inventory will be updated to include type and ownership.

b. Within five (5) years of the EDC, the following information will be included in the inventory either by using the MS4 Operator maintenance records or by verification of maintenance records provided by the owner of the postconstruction SMP:

- Street address or tax parcel
- Receiving waterbody name and class (mapped in accordance with Part IV.D.1.e.ii.a of the Permit)
- Receiving waterbody WI/PWL Segment ID (mapped in accordance with Part IV.D.1.e.ii.b of the Permit)
- Date of installation (if available) or discovery
- Responsible party for maintenance
- Contact information for party responsible for maintenance

- Location of documentation depicting O&M requirements and legal agreements for post-construction SMP
- Frequency for inspection of post-construction SMP, as specified in the New York State Department of Environmental Conservation Maintenance Guidance: Stormwater Management Practices, March 31, 2017 (NYS DEC Maintenance Guidance 2017) or as specified in the O&M plan contained in the approved SWPPP (Part VI.D.6. of the Permit)
- Reason for installation (e.g., new development, redevelopment, retrofit, flood control), if known
- Date of last inspection
- Inspection results
- Any corrective actions identified and completed

6. Minimum Control Measure #6: Pollution Prevention/Good Housekeeping for Municipal Operations

The MS4 Operator has developed a pollution prevention and good housekeeping program for municipal facilities and municipal operations to minimize pollutant discharges. This MCM is designed to ensure the MS4 Operator's own activities do not contribute pollutants to surface waters of the State.

The MS4 Operator has delegated management of MCM 6 to the Town of Warwick's Department of Public Works (DPW) Commissioner who will ensure that the goals and requirements of this MCM are met in a timely and proficient manner.

The Town has established its MS4 training program for Town employees to increase awareness of water quality issues. Training topics include the following:

- Good Housekeeping & Spill Prevention
- Spill Control & Response
- Vehicle Fueling
- Vehicle & Equipment Maintenance
- Vehicle & Equipment Washing
- Materials Management
- Waste Management
- Street Cleaning

- Storm Drain System Cleaning
- Municipal Facilities Maintenance
- Landscaping and Ground Maintenance

This training is based, in part, on guidelines set forth in Attachment 16: Pollution Prevention and Good Housekeeping Publication, which details a variety of methods that municipalities can utilize to reduce the environmental footprint left by its day-to-day functions. One such operation is street sweeping, which the Town performs on an annual basis as weather permits.

Street sweeping operations begins in the early spring and continue until winter weather which causes the street sweeping operations to be terminated. Town staff complete a Sweeping Log (Attachment 17) to document such maintenance. All municipal streets, bridges, parking lots and rights of way in the Town of Warwick are swept twice a year. Drivers of the street sweeper turn in daily reports for the roadways which are swept. The daily reports are maintained by the Highway Department to track the amount of street sweeping and to direct street sweeping activities throughout the year to provide for each street to be swept at least once a year. If contaminated material is identified, a licensed contractor would be utilized to remove the material.

The Town has completed an inventory of all municipally owned properties and facilities and included this as Attachment 18 to this Plan. This inventory will be reviewed annually to ensure that it is kept current and will update it when required by the Permit.

a. Within three (3) years of the EDC:

Best Management Practices (BMPs) for Municipal Facilities and Operations*:* The MS4 Operator will incorporate best management practices (BMPs) into the municipal facility program and municipal operations program to minimize the discharge of pollutants associated with municipal facilities and municipal operations, respectively. The BMPs to be considered are as follows and will be documented in the SWMP Plan:

i. Minimize Exposure. Exposure of materials to rain, snow, snowmelt, and runoff will be minimized, unless not technologically possible or not economically

practicable and achievable in light of best industry practices, including areas used for loading and unloading, storage, disposal, cleaning, maintenance, and fueling operations, with the following BMPs:

- Locate materials and activities inside or protect them with storm resistant coverings
- Use grading, berming, or curbing to prevent runoff of contaminated flows and divert run-on away from these areas
- Locate materials, equipment, and activities so leaks and spills are contained in existing containment and diversion systems
- Clean up spills and leaks promptly using dry methods (e.g., absorbents) to prevent the discharge of pollutants
- Store leaky vehicles and equipment indoors or, if stored outdoors, use drip pans and absorbents
- Use spill/overflow protection equipment
- Perform all vehicle and/or equipment cleaning operations indoors, under cover, or in bermed areas that prevent runoff and run-on and also captures any overspray
- Drain fluids, indoors or under cover, from equipment and vehicles that will be decommissioned, and, for any equipment and vehicles that will remain unused for extended periods of time, inspect at least monthly for leaks
- Minimize exposure of chemicals by replacing with a less toxic alternative (e.g., use non-hazardous cleaners)

ii. No Exposure Certification for High Priority Municipal Facilities

- Municipal facilities may qualify for No Exposure Certification (Appendix D) when all activities and materials are completely sheltered from exposure to rain, snow, snowmelt and/or runoff.
- High priority municipal facilities with uncovered parking areas for vehicles awaiting maintenance may be considered a low priority municipal facility if

only routine maintenance is performed inside and all other no exposure criteria are met.

- Municipal facilities accepting or repairing disabled vehicles and/or vehicles that have been involved in accidents are not eligible for the No Exposure Certification.
- Municipal facilities will maintain the No Exposure Certification and document in the SWMP Plan. The No Exposure Certification ceases to apply when activities or materials become exposed.

iii. Follow a Preventive Maintenance Program

Implement a preventative maintenance program that includes routine inspection, testing, maintenance, and repair of all fueling areas, vehicles and equipment and systems to prevent leaks, spills and other releases. This includes:

- Performing inspections and preventive maintenance of stormwater drainage, source controls, treatment systems, and plant equipment and systems
- Maintaining non-structural BMPs (e.g., keep spill response supplies available, personnel appropriately trained, containment measures, covering fuel areas)
- Ensure vehicle washwater is not discharged to the MS4 or to surface waters of the State. Wash equipment/vehicles in a designated and/or covered area where washwater is collected to be recycled or discharged to the sanitary sewer
- Routine maintenance will be performed to ensure BMPs are operating properly
- When a BMP is not functioning to its designed effectiveness and needs repair or replacement:

  Maintenance will be performed before the next anticipated storm event, or as necessary to maintain the continued effectiveness of stormwater controls. If maintenance prior to the next anticipated storm

event is impracticable, maintenance will be scheduled and accomplished as soon as practicable.

Interim measures will be taken to prevent or minimize the discharge of pollutants until the final repair or replacement is implemented, including cleaning up any contaminated surfaces so that the material will not be discharged during subsequent storm events.

iv. Spill Prevention and Response Procedures

Minimize the potential for leaks, spills and other releases that may be exposed to stormwater and develop plans for effective response to such spills if or when they occur. At a minimum, the MS4 Operator must:

- Store materials in appropriate containers
- Label containers (e.g., "Used Oil," "Spent Solvents," "Fertilizers and Pesticides") that could be susceptible to spillage or leakage to encourage proper handling and facilitate rapid response if spills or leaks occur
- Implement procedures for material storage and handling, including the use of secondary containment and barriers between material storage and traffic areas, or a similarly effective means designed to prevent the discharge of pollutants from these areas.
- Develop procedures for stopping, containing, and cleaning up leaks, spills, and other releases. As appropriate, execute such procedures as soon as possible.
- Keep spill kits on-site, located near areas where spills may occur or where a rapid response can be made.
- Develop procedures for notification of the appropriate facility personnel, emergency response agencies, and regulatory agencies when a leak, spill, or other release occurs. If possible, one of these individuals should be a member of the stormwater pollution prevention team (Part VI.F.2.d.i.a of the Permit). Any spills will be reported in accordance with 6 NYCRR 750-2.7.

- Following any spill or release, the MS4 Operator will evaluate the adequacy of the BMPs identified in the municipal facility specific SWPPP. If the BMPs are inadequate, the SWPPP will be updated to identify new BMPs that will prevent reoccurrence and improve the emergency response to such releases.

Measures for cleaning up spills or leaks will be consistent with applicable petroleum bulk storage, chemical bulk storage, or hazardous waste management regulations at 6 NYCRR Parts 596-599, 613 and 370-373.

This SPDES general permit does not relieve the MS4 Operator of any reporting or other requirements related to spills or other releases of petroleum or hazardous substances. Any spill of a hazardous substance will be reported in accordance with 6 NYCRR 597.4. Any spill of petroleum will be reported in accordance with 6 NYCRR 613.6 or 17 NYCRR 32.3.

v. Manage Vegetated Areas and Open Space on Municipal Property

Maintain vegetated areas on MS4 Operator owned/operated property and right of ways:

- Specify proper use, storage, and disposal of pesticides, herbicides, and fertilizers including minimizing the use of these products and using only in accordance manufacturer's instruction
- Use lawn maintenance and landscaping practices that are protective of water quality. Protective practices include reduced mowing frequencies; proper disposal of lawn clippings; and use of alternative landscaping materials (e.g., drought resistant planting)
- Place pet waste disposal containers and signage concerning the proper collection and disposal of pet waste at all parks and open space where pets are permitted
- Address waterfowl congregation areas where needed to reduce waterfowl droppings from entering the MS4

vi. **Municipal Facilities Program**: The MS4 Operator will develop and implement a municipal facility program. The municipal facility program will be documented in the SWMP Plan specifying:

1. The municipal facility procedures include:
    - The BMPs incorporated into the municipal facility program
    - The high priority municipal facility requirements as applied to the specific municipal facility
    - The low priority municipal facility requirements as applied to the specific municipal facility
2. The training provisions for the MS4 Operator's municipal facility procedures.
    - If new staff are added, training on the MS4 Operator's municipal facility procedures will be given prior to conducting municipal facility procedures
    - For existing staff, training on the MS4 Operator's municipal facility procedures will be given prior to conducting municipal facility procedures and once every five (5) years, thereafter
    - If the municipal facility procedures are updated training will be given to all staff prior to conducting municipal facility procedures.
3. The names, titles, and contact information for the individuals who have received municipal facility training and update annually.
4. Annually, by April 1, the MS4 Operator must:
    - Review and update the municipal facility procedures.
    - Document the completion of this requirement in the SWMP Plan.

vii. **Municipal Facility Prioritization**: The MS4 Operator must prioritize all known municipal facilities as follows:

a) High priority municipal facilities include municipal facilities that have one or more of the following on site and exposed to stormwater:

- Storage of chemicals, salt, petroleum, pesticides, fertilizers, anti- freeze, lead-acid batteries, tires, waste/debris
- Fueling stations
- Vehicle or equipment maintenance/repair

Within thirty (30) days of when a municipal facility is added to the inventory, the MS4 Operator will prioritize those municipal facilities. Annually, after the initial prioritization (Part VI.F.2.c.i of the Permit), the MS4 Operator will update the municipal facility prioritization in the inventory based on information gathered as part of the municipal facility program, including cases where a No Exposure Certification ceases to apply. The completion of this permit requirement will be documented in the SWMP Plan.

viii. Municipal Operations & Maintenance

Municipal Operations Program: Municipal operations are street and bridge maintenance, winter road maintenance, MS4 maintenance, open space maintenance, solid waste management, new construction and land disturbances, right-of-way maintenance, marine operations, or hydrologic habitat modification. Within three (3) years of the EDC, the MS4 Operator will develop and implement a municipal operations program. The municipal operations program will be documented in the SWMP Plan specifying:

1. The municipal operations procedures include:
    - The BMPs incorporated into the municipal operations program
    - The municipal operations corrective actions requirements
    - Catch basin inspection and maintenance requirements
    - Roads, bridges, parking lots, and right of way maintenance requirements
    - All other municipal operations maintenance requirements
2. The training provisions for the MS4 Operator's municipal operations procedures (Part VI.F.3.a.i of the Permit).

- If new staff are added, training on the MS4 Operator's municipal operations procedures will be given prior to conducting municipal operations procedures.
- For existing staff, training on the MS4 Operator's municipal operations procedures will be given prior to conducting municipal operations procedures and once every five (5) years, thereafter.
- If the municipal operations procedures are updated, training on the updates will be given to all staff prior to conducting municipal operations procedures.
- The names, titles, and contact information for the individuals who have received municipal operations training and update annually.

3. Annually, by April 1, the MS4 Operator must:
   - Review and update the municipal operations procedures
   - Document the completion of this requirement in the SWMP Plan

Municipal Operations Corrective Actions: For municipal operations, MS4 Operators will either:

1. Ensure compliance with the terms and conditions of the Permit or
2. Implement corrective actions according to the following schedule and, after implementation, ensure the operations are in compliance with the terms and conditions of this SPDES general permit:
   - **Within twenty-four (24) hours of discovery** for situations that have a reasonable likelihood of adversely affecting human health or the environment;
   - Initiated within seven (7) days of inspection and completed within thirty (30) days of inspection for situations that do not have a reasonable likelihood of adversely affecting human health or the environment; and
   - For corrective actions that require special funding or construction that will take longer than thirty (30) days to complete, a schedule will be

prepared that specifies interim milestones that will ensure compliance in the shortest reasonable time.

ix. Catch Basin Inspection and Maintenance

Within three (3) years of the EDC, the MS4 Operator will:

1. Identify when catch basin inspection is needed with consideration for:
    - Areas with construction activities (mapped in accordance with Part IV.D.2.a.iii of the Permit)
    - Residential, commercial, and industrial areas (mapped in accordance with Part IV.D.1.d.iii of the Permit)
    - Recurring or history of issues
    - Confirmed citizen complaints on three or more separate occasions in the last twelve (12) months
2. Inventory catch basin inspection information including:
    - Date of inspection
    - Approximate level of trash, sediment, and/or debris captured at time of clean-out (no trash, sediment, and/or debris, <50% of the depth of the sump, >50% of the depth of the sump)
    - Depth of structure
    - Depth of sump
    - Date of clean out, if applicable
3. Based on inspection results, clean out catch basins within the following timeframes:
    - Within six (6) months after the catch basin inspection, catch basins which had trash, sediment, and/or debris exceeding 50% of the depth of the sump as a result of a catch basin inspection will be cleaned out.
    - Within one (1) year after the catch basin inspection, catch basins which had trash, sediment, and/or debris at less than 50% of the depth of the sump as a result of a catch basin inspection will be cleaned out.

- MS4 Operators are not required to clean out catch basins if the catch basins are operating properly and there is no trash, sediment, and/or debris in the catch basin or the sump depth of the catch basin is less than or equal to two (2) feet.

4. Properly manage (handling and disposal) materials removed from catch basins during clean out so that:
   - Water removed during the catch basin cleaning process will not reenter the MS4 or surface waters of the State.
   - Material removed from catch basins is disposed of in accordance with any applicable environmental laws and regulations.
   - Material removed during the catch basin cleaning process will not reenter the MS4 or surface waters of the State.
5. Determine if there are signs/evidence of illicit discharges and procedures for referral/follow-up if illicit discharges are encountered.

x. Municipal Facility-Specific SWPPP

Within five (5) years of the EDC, he MS4 Operator must develop and implement a municipal facility specific SWPPP for each high priority municipal facility and retain a copy of the municipal facility specific SWPPP on site of the respective municipal facility. The SWPPP will contain:

1. Stormwater Pollution Prevention Team

   The municipal facility specific SWPPP will identify the individuals (by name and/or title) and their role/responsibilities in developing, implementing, maintaining, and revising the municipal facility specific SWPPP. The activities and responsibilities of the team will address all aspects of the municipal facility specific SWPPP.

2. General Site Description

   A written description of the nature of the activities occurring at the municipal facility with a potential to discharge pollutants, type of pollutants expected, and location of key features as detailed in the site map.

3. Summary of potential pollutant sources

   The municipal facility specific SWPPP will identify each area at the municipal facility where materials or activities are exposed to stormwater or from which authorized non-stormwater discharges (Part I.A.3 of the Permit) originate, including any potential pollutant sources for which the municipal facility has reporting requirements under the Emergency Planning and Community Right-To-Know Act (EPCRA), Section 313.

   - Materials or activities include machinery, raw materials, intermediate products, byproducts, final products or waste products and material handling activities which includes storage, loading and unloading, transportation or conveyance of any raw material, intermediate product, final product or waste product.
   - For each separate area identified, the description must include:

     Activities - A list of the activities occurring in the area (e.g., material storage, equipment fueling and cleaning).

     Pollutants - A list of the associated pollutant(s) for each activity. The pollutant(s) list will include all materials that are exposed to stormwater.

     Potential for presence in stormwater - For each area of the municipal facility that generates stormwater discharges, a prediction of the direction of flow, and the likelihood of the activity to contaminate the stormwater discharge. Factors to consider include the toxicity of chemicals, quantity of chemicals used, produced or discharged, the likelihood of contact with stormwater; and history of leaks or spills of toxic or hazardous pollutants.

4. Spills and Releases

   For areas that are exposed to precipitation or that otherwise drain to a stormwater conveyance to be covered under this SPDES general permit, the municipal facility specific SWPPP will include a list of spills or releases[9] of

[9] This may also include releases of petroleum or hazardous substances that are not in excess of reporting

petroleum and hazardous substances or other pollutants, including unauthorized non-stormwater discharges, that may adversely affect water quality that occurred during the last three-year period. The list must be updated when spills or releases occur.

5. Site Map

   The municipal facility specific SWPPP will include a site map identifying the following, as applicable:

   - Property boundaries and size in acres.
   - Location and extent of significant structures (including materials shelters), and impervious surfaces.
   - Monitoring locations (mapped in accordance with Part IV.D.2.a.i of the Permit) with its approximate sewershed. Each monitoring location will be labeled with the monitoring location identification.
   - Location of all post-construction SMPs (mapped in accordance with Part IV.D.2.a.iv of the permit) and MS4 infrastructure (mapped in accordance with Part IV.D.2.b.i of the Permit).
   - Locations of discharges authorized under other SPDES permits.
   - Locations where potential spills or releases can contribute to pollutants in stormwater discharges and their accompanying drainage points.
   - Locations of haul and access roads Rail cars and tracks
   - Arrows showing direction of stormwater flow
   - Location of all receiving waters in the immediate vicinity of the municipal facility, indicating if any of the waters are impaired and, if so, whether the waters have TMDLs established for them (mapped in accordance with Part IV.D.1.e.ii of the Permit)
   - Locations where stormwater flows have significant potential to cause erosion.

quantities but which may still cause or contribute to significant water quality impairment.

- Location and source of run-on from adjacent property containing significant quantities of pollutants and/or volume of concern to the municipal facility.
- Locations of the following areas where such areas are exposed to precipitation or stormwater:
    a. Fueling stations
    b. Vehicle and equipment maintenance and/or cleaning areas
    c. Loading/unloading areas
    d. Locations used for the treatment, storage or disposal of wastes;
    e. Liquid storage tanks
    f. Processing and storage areas
    g. Locations where significant materials, fuel or chemicals are stored and transferred
    h. Locations where vehicles and/or machinery are stored when not in use
    i. Transfer areas for substances in bulk
    j. Location and description of non-stormwater discharges (Part I.A.3 of the Permit)
    k. Locations where spills[10] or leaks have occurred
    l. Locations of all existing structural BMPs

6. Stormwater Best Management Practices (BMPs)

   The municipal facility specific SWPPP will document the location and type of BMPs implemented at the municipal facility. The municipal facility specific SWPPP will describe how each BMP is being implemented for all the potential pollutant sources.

7. Municipal facility assessments

   The municipal facility specific SWPPP will include a schedule for completing

[10] A spill includes: any spill of a hazardous substance that must be reported in accordance with 6 NYCRR 597.4 and any spill of petroleum that must be reported in accordance with 6 NYCRR 613.6 or 17 NYCRR 32.3.

and recording results of routine and comprehensive site assessments (Part VI.F.2.d.ii.c of the Permit).

xi. Municipal Facility Assessments

1. Wet Weather Visual Monitoring: **Once every five (5) years,** the MS4 Operator will conduct wet weather visual monitoring of the monitoring locations (Part VI.C.1.b of the Permit) and other sites of stormwater leaving the site that are discharging stormwater from fueling areas, storage areas, vehicle and equipment maintenance/fueling areas, material handling areas and similar potential pollutant generating areas (Part VI.F.2.d.i.e.xiii of the Permit).
    - All samples will be collected from discharges resulting from a qualifying storm event. The storm event will be documented using the Storm Event Data Form (Appendix D of the Permit) and kept with the municipal facility specific SWPPP. The sample will be taken during the first thirty (30) minutes (or as soon as practical, but not to exceed one hour) of the discharge at the monitoring location.
    - No analytical tests are required to be performed on the samples for the purpose of meeting the visual monitoring requirements.
    - The visual examination will document observations of color, odor, clarity, floating solids, settled solids, suspended solids, foam, oil sheen, and any other obvious indicators of stormwater pollution.
    - The visual examination of the sample will be conducted in a well-lit area.
    - Where practicable, the same individual should carry out the collection and examination of discharges for the entire permit term for consistency.

    The MS4 Operator will document the visual examination using the Visual Monitoring Form (Appendix D of the Permit) and keep it with the municipal facility specific SWPPP to record:
        - Monitoring location ID
        - Examination date and time

- Personnel conducting the examination
- Nature of the discharge (runoff or snowmelt)
- Visual quality of the stormwater discharge including observations of color, odor, clarity, floating solids, settled solids, suspended solids, foam, oil sheen, and other obvious indicators of stormwater pollution
- Probable sources of any observed stormwater contamination.
- Corrective and follow up actions – If the visual examination indicates the presence of color, odor, floating solids, settled solids, suspended solids, foam, oil sheen, or other indicators of stormwater pollution, the MS4 Operator will, at minimum, complete and document the following actions:
    - Evaluate the facility for potential sources
    - Remedy the problems identified
    - Revise the municipal facility specific SWPPP
    - Perform an additional visual inspection during the first qualifying storm event following implementation of the corrective action. If the first qualifying storm event does not occur until the next visual monitoring period, this follow up action may be used as the next visual inspection.

2. The monitoring locations inspection and sampling program will be implemented at the municipal facility.
3. Comprehensive Site Assessments: **Once every five (5) years** following the most recent assessment, the MS4 Operator will complete a comprehensive site assessment for each high priority municipal facility as identified in the inventory using the Municipal Facility Assessment Form (Appendix D of the Permit) or an equivalent form containing the same information, and document in the municipal facility specific SWPPP and SWMP Plan that:

- The municipal facility is in compliance with the terms and conditions of this SPDES general permit.
- Deficiencies were identified and all reasonable steps will be taken to minimize any discharge in violation of the permit, which has a reasonable likelihood of adversely affecting human health or the environment.
- Within twenty-four (24) hours, the MS4 Operator will prepare a schedule that includes corrective actions and specific interim milestones to be implemented until the corrective action is implemented.
- Deficiencies were identified and all reasonable steps will be taken to minimize any discharge in violation of the permit, which does not have a reasonable likelihood of adversely affecting human health or the environment.
- Within seven (7) days, the MS4 Operator will prepare a schedule that includes corrective actions and specific interim milestones to be implemented until the corrective action is implemented.

xii. Low Priority Municipal Facility Requirements

1. The MS4 Operator will identify procedures outlining BMPs for the types of activities that occur at the low priority municipal facilities as described in Part VI.F.1. A municipal facility specific SWPPP is not required.
2. Municipal Facility Assessments
   - Low priority municipal facilities are not required to conduct wet weather visual monitoring.
   - The monitoring locations inspection and sampling program will be implemented at the municipal facility.
3. Comprehensive Site Assessments

   Once every five (5) years following the most recent assessment, the MS4 Operator will complete a comprehensive site assessment for each low priority municipal facility as identified in the inventory (Part VI.F.2.b.) using

the Municipal Facility Assessment Form (Appendix D) or an equivalent form containing the same information, and document in the SWMP Plan that:

- The municipal facility is in compliance with the terms and conditions of this SPDES general permit.
- Deficiencies were identified and all reasonable steps will be taken to minimize any discharge in violation of the permit, which
- has a reasonable likelihood of adversely affecting human health or the environment.
- Within twenty-four (24) hours, the MS4 Operator will prepare a schedule that includes corrective actions and specific interim milestones to be implemented until the corrective action is implemented.
- Deficiencies were identified and all reasonable steps will be to minimize any discharge in violation of the permit, which does not have a reasonable likelihood of adversely affecting human health or the environment;
- Within seven (7) days, the MS4 Operator will prepare a schedule that includes corrective actions and specific interim milestones to be implemented until the corrective action is implemented.

xiii. Roads, Bridges, Parking Lots, & Right of Way Maintenance

1. Maintenance:

   Within five (5) years of the EDC, in addition to the BMPs, the MS4 Operator will implement the following provisions:

   - Pave, mark, and seal in dry conditions
   - Stage road operations and maintenance activity (e.g., patching, potholes) to reduce the potential discharge of pollutants to the MS4 or surface waters of the State
   - Restrict the use of herbicides/pesticide application to roadside vegetation

- Contain pollutants associated with bridge maintenance activities (e.g., paint chips, dust, cleaning products, other debris).

2. Winter Road Maintenance

   Within five (5) years of the EDC, in addition to the BMPs, the MS4 Operator will implement the following provisions:

   - Routinely calibrate equipment to control salt/sand application rates; and
   - Ensure that routine snow disposal activities comply with the Division of Water Technical and Operation Guidance Series 5.1.11, Snow Disposal.

D. CONCLUSION/SUMMARY

The Town of Warwick will continue to enhance its Stormwater Management Program in response to evolving regulatory requirements and ongoing community engagement. Program improvements will align with updates to the NYSDEC MS4 Permit and be implemented as Warwick identifies additional opportunities to improve stormwater conveyance, protect and enhance water quality, and reduce the potential for future flooding impacts.

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ATTACHMENT 1

NYSDEC SPDES GENERAL PERMIT

GP-0-24-001

NEW YORK STATE | Department of Environmental Conservation

FINAL

PERMIT

for

NEW YORK STATE

DEPARTMENT OF ENVIRONMENTAL CONSERVATION

SPDES GENERAL PERMIT

for

STORMWATER DISCHARGES

from

MUNICIPAL SEPARATE STORM SEWER SYSTEMS (MS4s)

Permit No. GP-0-24-001

Issued Pursuant to Article 17, Titles 7, 8 and Article 70
of the Environmental Conservation Law

Issuance Date: December 13, 2023

Effective Date: January 3, 2024

Expiration Date: January 2, 2029

Scott Sheeley
Chief Permit Administrator

Scott E. Sheeley — DECEMBER 13, 2023

Authorized Signature — Date

Address: NYS DEC
Division of Environmental Permits
625 Broadway, 4th Floor
Albany, NY 12233

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NOTE

All italicized words within this *State Pollutant Discharge Elimination System (SPDES)* general permit are defined in Appendix A.

Part I. Permit Coverage and Limitations

A. Permit Authorization

This *SPDES* general permit authorizes the *discharge* of *stormwater* from small *MS4*s.

1. An *MS4 Operator* is eligible for coverage under this *SPDES* general permit if the *MS4* is *automatically* or *additionally designated (Appendix B)*.

   Only portions of the *MS4* which are located within the *automatically* or *additionally designated areas* are subject to, and authorized to *discharge* by, the requirements of this *SPDES* general permit (Part IV.C.).

2. This *SPDES* general permit contains terms and conditions specific for each of the following types of *MS4 Operators* that are authorized to *discharge* under this *SPDES* general permit, in accordance with Part I.A.1:

   a. *Traditional Land Use Control MS4 Operators;*

   b. *Traditional Non-land Use Control MS4 Operators;* and

   c. Non-traditional MS4 Operators.

   The minimum control measures (MCMs) for *traditional land use MS4 Operators* are listed in Part VI. The MCMs for *traditional non-land use control MS4 Operators* and *non-traditional MS4 Operators* are listed in Part VII. Part III.B, Part VIII, and Part IX. list additional requirements for all *MS4 Operators' MS4*s *discharging* to impaired waters.

3. Non-*stormwater discharges* through outfalls listed in Part 6 of the Official Compilation of Codes, Rules and Regulations of the State of New York (NYCRR) 750-1.2(a)(29)(vi) and 40 CFR 122.34(b)(3)(ii), are authorized by this *SPDES* general permit provided they do not violate Environmental Conservation Law (ECL) Section 17-0501. If the *Department* or *MS4 Operator* determines that one or more of the *discharges* are in violation of ECL Section 17-0501, the identified *discharges* are illicit and the *MS4 Operator* must eliminate such *discharges* by following the *illicit discharge* MCM requirements found in Part VI.C. or Part VII.C, depending on the *MS4 Operator* type.

   Discharges from firefighting activities are authorized only when the firefighting activities are emergencies/unplanned.

B. Exemption and Limitations on Coverage

1. The following *discharges* from *MS4 Operators* are exempt from the requirements of this *SPDES* general permit:
   a. *Stormwater discharges* associated with an *industrial activity* provided the *discharges* are covered by the SPDES Multi-Sector General Permit for Stormwater Discharges Associated with Industrial Activity, GP-0-23-001 (MSGP); and
   b. Individual *SPDES* permitted *stormwater discharges* provided the *discharges* are in compliance with their individual *SPDES* permit limitations.
2. The following *discharges* from *MS4 Operators* are not authorized by this *SPDES* general permit:
   a. *Stormwater discharges* that may adversely affect an endangered or threatened species, or its designated critical habitat, unless the *MS4 Operator* has obtained a permit issued pursuant to 6 NYCRR Part 182 or the *Department* has issued a letter of non-jurisdiction.
   b. *Stormwater discharges* which adversely affect properties listed or eligible for listing in the National Register of Historic Places unless the covered entity is in compliance with requirements of the National Historic Preservation Act and has coordinated with the appropriate State Historic Preservation Office any activities necessary to avoid or minimize impacts.
   c. *Stormwater discharges*, the permitting of which is prohibited under 40 CFR 122.4 and 6 NYCRR 750-1.3.
   d. The *discharge* of vehicle and equipment washwater from *municipal facilities*, including tank cleaning operations.
3. All documentation necessary to demonstrate *discharge* eligibility (Part I.B.1. and Part I.B.2.) must be documented in the *Stormwater Management Program Plan (SWMP Plan)* (Part IV.B.).

Part II. Obtaining Permit Coverage

A. *MS4 Operators*, meeting the eligibility requirements in Part I.A.1. of this *SPDES* general permit, must submit the notice of intent (NOI) electronically (eNOI) unless the *MS4 Operator* has obtained a waiver from the electronic submittal requirement (Part II.B.) in order to be authorized to *discharge* under this *SPDES* general permit. Access and directions for use, for electronic submission of the NOI, are located on the *Department*'s website. *MS4 Operators* must submit the eNOI as indicated in Table 1 and in accordance with Part X.J.

Table 1. eNOI Submittal for Permit Coverage			
Type of permit coverage	**Deadline to submit complete eNOI**	**Effective Date of Coverage (EDC)**	**Form to file with the *Department***
Newly designated *MS4 Operator*	180 days[1] from written notification from the *Department*	The submission of the complete eNOI	eNOI
MS4 Operators continuing coverage from GP-0-15-003	Forty-five (45) days from the effective date of the permit (EDP)	EDP	eNOI

MS4 Operators continuing coverage from GP-0-15-003 are eligible for continued coverage under this SPDES general permit (GP-0-24-001) on an interim basis for up to sixty (60) calendar days from the EDP. During this interim period, an MS4 Operator must comply with the requirements of GP-0-15-003.

By submitting the complete e*NOI*, the *MS4 Operator* certifies that the *MS4 Operator* has read and agrees to comply with the terms and conditions of this *SPDES* general permit including the provisions to update the *SWMP Plan* (Part IV.B.) in accordance with the timeframes set forth in this *SPDES* general permit.

MS4 Operators must document the complete NOI in the *SWMP Plan* (Part IV.B.). As information in the completed NOI changes, within thirty (30) days, the *MS4 Operators* must update the information on the NOI and resubmit the completed NOI to the Department. The *MS4 Operator* must document information from the Department acknowledging previous coverage or designation in the *SWMP Plan* (Part IV.B.).

Where there is a permit condition to *develop,* newly designated *MS4 Operators* must create that permit requirement. Where there is a permit condition to *develop, MS4 Operators* continuing coverage must continue to implement their current *SWMP* and update the *SWMP* to comply with the permit requirement.

For newly designated *MS4 Operators*, timeframes for compliance begin on the effective date of coverage (EDC).

B. Electronic Submission Waiver

1. *MS4 Operators* must submit all NOIs electronically unless the *MS4 Operator* has received a waiver from the Department based on one of the following conditions:

   a. If the *MS4 Operator* is physically located in a geographical area (i.e., zip code or census tract) that is identified as under-served for broadband internet

[1] In this *SPDES* general permit, days refer to calendar days.

access in the most recent report from the Federal Communications Commission; or

b. If the *MS4 Operator* has limitations regarding available computer access or computer capability.

2. If an *MS4 Operator* wishes to obtain a waiver from submitting an NOI electronically, the *MS4 Operator* must submit a request using the Application for Electronic Submittal Waiver to the *Department* at the following address:

   NYS DEC Bureau of Water Compliance

   MS4 NOTICE OF INTENT WAIVER

   625 Broadway, 4th Floor

   Albany, New York 12233-3505

3. A waiver may only be considered granted once the *MS4 Operator* receives written confirmation from the *Department*.

4. *MS4 Operators* must document the eNOI waiver in the *SWMP Plan* (Part IV.B.), if applicable.

C. *MS4 Operators* who submit a complete NOI are authorized to *discharge stormwater* under the terms and conditions of this *SPDES* general permit.

1. NOI Content

   The NOI shall include:

   a. Legal name and address of the *MS4 Operator*;

   b. Receiving waterbodies; and

   c. *Municipal Separate Storm Sewer System (MS4)* NPDES Permit-Related Information of 40 CFR Part 127 Appendix A.

Part III. Special Conditions

A. *Discharge* Compliance with *Water Quality Standards*

1. The *MS4 Operator* must implement the required controls contained in Part III. through Part IX. of this *SPDES* general permit. The *Department* expects that compliance with the terms and conditions of this *SPDES* general permit will assure *MS4 discharges* meet applicable *water quality standards*.

2. It shall be a violation of the ECL for any *discharge* authorized by this *SPDES* general permit to either cause or contribute to a violation of *water quality standards* as contained in 6 NYCRR 700-705.

3. The *MS4 Operator* must take all necessary actions to ensure *discharges* comply with the terms and conditions of this *SPDES* general permit. If at any time an *MS4 Operator* becomes aware (e.g., through self-monitoring or by notification from the *Department*) that a *discharge* causes or contributes to the violation of an applicable *water quality standard*, the *MS4 Operator* must implement corrective

actions and the *MS4 Operator* must document these actions in the *SWMP Plan* (Part IV.B.).

4. Compliance with this *SPDES* general permit does not preclude, limit, or eliminate any enforcement activity as provided by Federal and/or State law. Additionally, if violations of applicable *water quality standards* occur, then coverage under this *SPDES* general permit may be terminated by the *Department* in accordance with 6 NYCRR 750-1.21(e), and the *Department* may require an application for an alternative *SPDES* general permit or an individual *SPDES* permit may be issued.

B. Water Quality Improvement Strategies for Impaired Waters

1. List of Impaired Waters (Appendix C)

Part VIII. requirements must be implemented in addition to the applicable requirements of the six (6) MCMs in Part VI. or Part VII, depending on the *MS4 Operator* type.

For *MS4 Operators* whose *MS4 outfall*s and *additionally designated area MS4 outfalls* (*ADA MS4 outfalls*) *discharge* to waters impaired for phosphorus, silt/sediment, pathogens, nitrogen, or floatables (Appendix C), the *MS4 Operator* must *develop* and implement the *pollutant* specific *best management practices (BMPs*), listed in Part VIII, targeted towards the *pollutant of concern (POC)* causing the impairment.

For *MS4 Operators discharging* to waters within a *total maximum daily load (TMDL)* watershed that does not specify a *pollutant* load reduction necessary for *MS4*s and listed in Appendix C, the *MS4 Operator* must implement the enhanced *BMP* requirements of Part VIII. for the applicable *pollutant* of concern of the *TMDL*.

The enhanced *BMP* requirements in Part VIII. are written to address the *POCs* listed in Table 2.

Table 2. *Pollutant* Specific BMPs for Impaired Waters listed in Appendix C

POC	**Part VIII. Reference**
Phosphorus	A
Silt/Sediment	B
Pathogens	C
Nitrogen	D
Floatables	E

2. Watershed Improvement Strategy Requirements for *TMDL* Implementation (Part IX.)

Part IX. requirements must be implemented in addition to the applicable requirements of the six (6) MCMs in Part VI. or Part VII, depending on the *MS4 Operator* type.

a. *MS4 Operators discharging* to waters within the watersheds listed in Table 3 must implement additional *BMPs* and applicable *retrofit* plans as specified in Part IX. to achieve the *pollutant* load reductions specified in the referenced *TMDL* or respective implementation plan.

Table 3. Approved *TMDL* Watersheds with *MS4* Contribution

TMDL	POC	Part IX. Reference
Phase II Phosphorus TMDLs for Reservoirs in the NYC Watershed, June 2000	Phosphorus	A
Total Maximum Daily Load (TMDL) for Phosphorus in Lake Carmel, October 2016		
Total Maximum Daily Load (TMDL) for Phosphorus in Palmer Lake, March 2015		
Impaired Waters Restoration Plan for Greenwood Lake – Total Maximum Daily Load for Total Phosphorus, September 2005	Phosphorus	B
Updated Phosphorus Total Maximum Daily Load for Onondaga Lake, June 2012		
Total Maximum Daily Load (TMDL) for Phosphorus in Lake Oscawana, September 2008		
None	Pathogen	C
TMDL for Nitrogen in the Peconic Estuary Program Study Area, Including Waterbodies Currently Impaired Due to Low Dissolved Oxygen: the Lower Peconic River and Tidal Tributaries; Western Flanders Bay and Lower Sawmill Creek; and Meetinghouse Creek, Terry Creek and Tributaries, September 2007	Nitrogen	D

b. Each *MS4 Operator* is responsible for a waste load reduction as specified in the applicable *TMDL* or *TMDL* implementation plan referenced in Part IX. *MS4 Operators* may form a *Regional Stormwater Entity (RSE)* to implement *stormwater retrofits* collectively where compliance with the *pollutant* reduction requirements would be achieved on a regional basis. The individual load reduction for each participating *MS4 Operator* is aggregated to create a *RSE* load reduction. The *RSE* then designs and installs *retrofits* where they are most feasible within the boundaries of the *RSE*. Each participating *MS4*

Operator of an *RSE* complies if the aggregated *RSE pollutant* load reduction is met.

3. Impaired waters with an approved *TMDL* and listed in Appendix C

Part VIII. and Part IX. requirements must be implemented in addition to the applicable requirements of the six (6) MCMs in Part VI. or Part VII, depending on the *MS4 Operator* type.

An *MS4 discharging* to a waterbody listed in Appendix C must meet the requirements of Part VIII. for the *POC*(s) listed in Appendix C.

An *MS4 discharging* to a waterbody listed in Table 3 must meet the requirements of Part IX. for the specific *POC* identified in the *TMDL*.

Part IV. *Stormwater Management Program (SWMP)* Requirements

MS4 Operators must *develop*, implement, and enforce a *SWMP*. The *SWMP* must be retained in written format, hardcopy or electronic. The written *SWMP* is referred to as the *SWMP Plan* (Part IV.B.). The *MS4 Operator* must use the *SWMP Plan* (Part IV.B.) to document *developed*, planned, and implemented elements of the *SWMP*.

A. Administrative

1. Alternative Implementation Options

a. *MS4 Operators* may utilize other entities or the resources of those entities to assist with any portion of the *SWMP* development, implementation, or enforcement. These entities may consist of other *MS4 Operators*, an *RSE*, a Coalition of *MS4 Operators*, other public entities (e.g., non-*MS4 Operators*), or a private third-party contractor. If the *MS4 Operator* is relying upon another entity for compliance with any portion of this *SPDES* general permit, there must be an agreement in place that:

i. Is legally binding;

ii. Is documented in writing;

iii. Is signed and dated by all parties including a certification statement that explains that the *MS4 Operator* is responsible for compliance with this *SPDES* general permit;

iv. Identifies the activities that the entity will be responsible for including the particular MCM, the location and type of work;

v. Includes the name, address, and telephone number of the contact person representing the entity;

vi. Is kept up-to-date and part of the *SWMP Plan*; and

vii. Is retained by each party for the duration of the permit term.

b. In the *SWMP Plan*, the *MS4 Operator* must *develop* and maintain an inventory of entities assisting in permit implementation that includes the following information:

   i. Name of entity performing permit implementation; and

   ii. Permit requirement being implemented performed by entity.

c. Irrespective of any agreements, each party remains legally responsible for obtaining its own permit coverage, for filing the *NOI,* and satisfying all requirements of this *SPDES* general permit for its own *discharges*.

d. Within thirty (30) days signing, alternative implementation agreements (Part IV.A.1.) must be documented in the *SWMP Plan* (Part IV.B.).

e. Annually review and update any alternative implementation agreements in the *SWMP Plan*, as necessary.

2. Staffing plan/Organizational chart

Individual *SWMP* components may be *developed*, implemented, or enforced by different titles associated with the *MS4 Operator*, or other entities as described in Part IV.A.1. Within six (6) months of the EDC, the *MS4 Operator* must *develop* a written staffing plan/organizational chart which includes job titles and other entities as identified in Part IV.A.1, and the roles and responsibilities for each corresponding to the required elements of the *SWMP*. The staffing plan must describe how information will be communicated and coordinated among all those with identified responsibilities. All staffing plan/organization charts must be documented in the *SWMP Plan* (Part IV.B.).

B. *SWMP Plan*

The *SWMP Plan* must contain, at a minimum, all permit requirements implemented to meet the terms and conditions of this *SPDES* general permit, and documentation required by this *SPDES* general permit. The *SWMP Plan* may incorporate by reference any documents that meet the requirements of this *SPDES* general permit. If an *MS4 Operator* relies upon other documents to describe how the *MS4 Operator* will comply with the requirements of this SPDES general permit, the *MS4 Operator* must attach to the *SWMP Plan* a copy of these documents.

The *SWMP Plan* must identify if any requirements from Part VI. through Part IX. do not require updates and include the rationale behind the determination. The *SWMP Plan* must identify if any requirements from Part VI. through Part IX. are not applicable and include the rationale behind the determination.

1. *Stormwater* Program Coordinator

On the NOI, the *MS4 Operator* must designate a *Stormwater* Program Coordinator who must be knowledgeable in the principles and practices of *stormwater* management, the requirements of this *SPDES* general permit, and the *SWMP*. The *Stormwater* Program Coordinator oversees the *development*, implementation, and enforcement of the *SWMP;* coordinates all elements of the

SWMP to ensure compliance with this *SPDES* general permit; and *develops* and submits the Annual Report (Part V.B.2.). The name, title, and contact information of the *Stormwater* Program Coordinator must be documented in the *SWMP Plan*.

2. Availability of *SWMP Plan*

a. Within six (6) months of the EDC, the *MS4 Operator* must make the current *SWMP Plan*, and documentation associated with the implementation of the *SWMP Plan*, available during normal business hours to the *MS4 Operator*'s management and staff responsible for implementation as well as the *Department* and United States Environmental Protection Agency (USEPA) staff.[2] The completion of this permit requirement must be documented in the *SWMP Plan*.

b. Within six (6) months of the EDC, the *MS4 Operator* must make a copy of the current *SWMP Plan* available for public inspection during normal business hours at a location that is accessible to the public or on a public website. The location of the *SWMP Plan* must be kept current. The completion of this permit requirement must be documented in the *SWMP Plan*.

3. Timeframes for *SWMP* Plan Development or Updates

MS4 Operators must *develop* and implement their *SWMP Plan* in accordance with the timeframes set forth in this *SPDES* general permit. Annually, after the end of the Reporting Year and by April 1, the *SWMP Plan* must be updated to ensure the permit requirements are implemented. More frequent updates to the *SWMP Plan* are noted throughout this *SPDES* general permit in specific permit requirements.

C. Minimum Control Measures (MCMs)

The MCMs for *traditional land use MS4 Operators* are listed in Part VI. while those for *traditional non-land use control MS4 Operators* and *non-traditional MS4 Operators* are listed in Part VII. Parts III.B, Part VIII, and Part IX. list additional requirements for all *MS4 Operators discharging* to impaired waters.

MS4 Operators subject to Part VI.

For *MS4 Operators* subject to Part VI. requirements, all MCMs must be implemented within the *automatically designated area* or an *additionally designated area* subject to Criterion 1 or 2 of the Additional Designation Criteria (Appendix B).

For *MS4 Operators* subject to Part VI. requirements, MCM 4 and MCM 5 must also be implemented within an *additionally designated area* subject to Criterion 3 of the Additional Designation Criteria (Appendix B).

MS4 Operators subject to Part VII.

For *MS4 Operators* subject to Part VII. requirements, all MCMs must be implemented within the *automatically designated area* or an *additionally designated area* subject to Criterion 1 or 2 of the Additional Designation Criteria (Appendix B).

[2] Part X.F. contains the duty for the *MS4 Operator* to provide information.

MS4 Operators subject to Part VIII.

Part VIII. requirements must be implemented in addition to the applicable requirements of the six (6) MCMs in Part VI. or Part VII, depending on the *MS4 Operator* type.

For all *MS4 Operators* subject to Part VIII. requirements, all MCMs must be implemented within the *automatically designated area*.

For *MS4 Operators* subject to Part VI. requirements and subject to Part VIII. requirements, MCM 4 and MCM 5 must also be implemented within an *additionally designated area* subject to Criterion 3 of the Additional Designation Criteria (Appendix B).

MS4 Operators subject to Part IX.

Part IX. requirements must be implemented in addition to the applicable requirements of the six (6) MCMs in Part VI. or Part VII, depending on the *MS4 Operator* type.

For all *MS4 Operators* subject to Part IX. requirements, all MCMs must be implemented within the *automatically designated area* or an *additionally designated area* subject to Criterion 1 of the Additional Designation Criteria (Appendix B).

D. Mapping

The *MS4 Operator* must *develop* and maintain comprehensive system mapping to include the mapping components within the MS4 Operator's *automatically designated area* or an *additionally designated area* subject to Criterion 1 or 2 of the Additional Designation Criteria (Appendix B), unless otherwise specified. The comprehensive system mapping must be documented in the *SWMP Plan*. The comprehensive system mapping must be in a readily accessible format, with scale and detail appropriate to provide a clear understanding of the *MS4*, to serve as a planning tool to allow for prioritization of efforts and facilitate management decisions by the *MS4 Operator*. Annually, after Phase I (Part IV.D.2.a.) completion, the *MS4 Operator* must update the comprehensive system mapping including updates to prioritization information of monitoring locations (Part VI.C.1.d. or Part VII.C.1.d, depending on the *MS4 Operator* type), construction sites (Part VI.D.5. or Part VII.D.5, depending on the *MS4 Operator* type), and *municipal facilities* (Part VI.F.2.c.i. or Part VII.F.2.c.i, depending on the *MS4 Operator* type).

1. Within six (6) months of the EDC, the comprehensive system mapping must include the following information:
    a. *MS4 outfall*s (as required for *MS4 Operators* continuing coverage from previous iterations of this *SPDES* general permit);
    b. *Interconnections* (as required for *MS4 Operators* continuing coverage from previous iterations of this *SPDES* general permit);
    c. Preliminary *storm-sewershed* boundaries (as required for *MS4 Operators* continuing coverage from previous iterations of this *SPDES* general permit);

d. *MS4* infrastructure (as required for *MS4 Operators* continuing coverage from previous iterations of this *SPDES* general permit that were subject to Part IX.A. or Part IX.D.), including:
   i. Conveyance system
      a) Type (closed pipe or open drainage);
      b) Conveyance description for closed pipes (material, shape, dimensions);
      c) Conveyance description for open drainage (channel/ditch lining material, shape, dimensions); and
      d) Direction of flow;
   ii. Culvert crossings (location and dimensions)
   iii. Stormwater structures
      a) Type (drop inlet, *catch basin*, or manhole); and
      b) Number of connections to *catch basins*, and manholes;

e. Basemap information:
   i. *Automatically*[3] and *additionally designated areas* (based on criterion 3 of Additional Designation Criteria in Appendix B);[4]
   ii. Names and location of all *surface waters of the State*, including:
      a) Waterbody classification;[5]
      b) Waterbody Inventory/Priority Waterbodies List (WI/PWL);[6]
         i) Impairment status; and
         ii) *POC,* if applicable;
      c) *TMDL* watershed areas;[7]
   iii. Land use, including:
      a) Industrial;
      b) Residential;
      c) Commercial;
      d) Open space; and
      e) Institutional;
   iv. Roads; and
   v. Topography.[8]

2. The comprehensive system mapping must be updated with the data collected for each phase of mapping within the timeframe for each phase as outlined below:
   a. Phase I: Within three (3) years of the EDC, the comprehensive system mapping must include the following information:

[3]Utilizing the Stormwater Interactive Map on the Department's website or the NYS GIS Clearinghouse.
[4]Utilizing the Stormwater Interactive Map on the Department's website.
[5]Utilizing the Stormwater Interactive Map on the Department's website or the NYS GIS Clearinghouse.
[6]Utilizing the Stormwater Interactive Map on the Department's website or the NYS GIS Clearinghouse.
[7]Utilizing the Stormwater Interactive Map on the Department's website.
[8] Utilizing USGS Quadrangle Map or finer.

i. Monitoring locations, with associated prioritization (Part VI.C.1.d. or Part VII.C.1.d, depending on the *MS4 Operator* type);
ii. Preliminary *storm-sewershed* boundaries (for newly designated *MS4 Operators*);
iii. Focus areas (Part VI.A.1.a. or Part VII.A.1.a, depending on the *MS4 Operator* type);
iv. *Publicly owned/operated* post-construction *stormwater management practices* (*SMPs)* (Part VI.E.3. or Part VII.E.3, depending on the *MS4 Operator* type). The *publicly owned/operated* post-construction *SMPs* subject to this requirement are in the *automatically designated area* or an *additionally designated area* subject to Criterion 1, 2, or 3 of the Additional Designation Criteria (Appendix B); and
v. *Municipal facilities,* with associated prioritization (Part VI.F.2.c. or Part VII.F.2.c, depending on the *MS4 Operator* type).

b. Phase II: Within five (5) years of the EDC, the comprehensive system mapping must include the following information:

i. *MS4* infrastructure, including:
a) Conveyance system
i) Type (closed pipe or open drainage); and
ii) Direction of flow;[9]

b) *Stormwater* structures
i) Type (drop inlet, *catch basin*, or manhole); and
ii) Number of connections to and from drop inlets, *catch basins*, and manholes;

ii. *Privately owned/operated* post-construction *SMPs* which *discharge* to the *MS4* (Part VI.E.2.). The *privately owned/operated* post-construction *SMPs* subject to this requirement are in the *automatically designated area* or an *additionally designated area* subject to Criterion 1, 2, or 3 of the Additional Designation Criteria (Appendix B).
a) If the location of the privately-owned post-construction SMPs cannot be determined without accessing the private property, the *MS4 Operator* must map the location of the property that the post-construction SMP is located on using street address or tax parcel.

E. Legal Authority

For *MS4 Operators* continuing coverage from previous iterations of this *SPDES* general permit, adequate legal authority must be maintained in accordance with Part IV.E.1. or Part IV.E.2.

For a newly designated *MS4 Operator*, within three (3) years, the *MS4 Operator* must, to the extent allowable by State and local law, *develop* and implement

[9] Direction of flow can be a written description or indicated as an arrow on the feature.

adequate legal authority to control *pollutant discharges* to implement this *SPDES* general permit. An *MS4 Operator* must either be in conformance with Part IV.E.1. or Part VI.E.2:

1. Adopt the following model local laws and include a copy of the resolution in their *SWMP Plan*:
   a. The New York State Department of Environmental Conservation Model Local Law to Prohibit Illicit Discharges, Activities and Connections to Separate Storm Sewer Systems, April 2006 (NYS DEC Model IDDE Local Law 2006); and
   b. The New York State Department of Environmental Conservation Sample Local Law for Stormwater Management and Erosion & Sediment Control, March 2006 (NYS DEC Sample SM and E&SC Local Law 2006).
2. Enact a legal mechanism or ensure that written policies/procedures are in place with content equivalent to the model local law, with documentation in the *SWMP Plan* from the attorney representing the *MS4 Operator* of the equivalence. Equivalent legal mechanisms or written policies/procedures must include the following:
   a. For *illicit discharges*:
      i. A prohibition of:
         a) *Illicit discharges*, spills or other release of *pollutants*;
         b) Unauthorized connections into the *MS4*;
      ii. A mechanism to:
         a) Receive and collect information related to the introduction of *pollutants* into the *MS4*;
         b) Require installation, implementation, and maintenance of post-construction *SMPs*;
         c) Require compliance and take enforcement action; and,
         d) Access property for inspection.
   b. To be adequate the legal mechanism must also ensure:
      i. Applicable *construction activities* are effectively controlled and include post-construction runoff controls for new development and redevelopment projects; and
      ii. Post-construction *SMPs* are properly operated and maintained by requiring the following:
         a) A stormwater pollution prevention plan (SWPPP) with erosion and sediment controls that meets or exceed the New York State, Standards and Specifications for Erosion & Sediment Control, November 2016 (NYS E&SC 2016) and requires post-construction *SMPs* for applicable *construction activity* described in Part VI.D.1 in conformance with the

SPDES General Permit for Stormwater from Construction Activities, GP-0-20-001 (CGP);

b) Post-construction *SMPs* as required by CGP meet the *sizing criteria* specified in the New York State Stormwater Management Design Manual, January 2015 (NYS SWMDM 2015), and performance criteria, or equivalent, including Operation & Maintenance Plans for long term maintenance;

c) Construction site operators to control waste such as discarded building materials, concrete truck washout, chemicals, litter, and sanitary waste, all of which may cause adverse impacts to water quality; and

d) Receive and collect information related to compliance with the approved SWPPP including verification of maintenance of post-construction *SMPs* (if conducted by private entities).

F. Enforcement Measures & Tracking

1. Enforcement Response Plan

Within six (6) months, the *MS4 Operator* must *develop* and implement an enforcement response plan (ERP) which clearly describes the action(s) to be taken for violations that the *MS4 Operator* has enacted for illicit *discharge* (Part VI.C. or Part VII.C, depending on the MS4 Operator type), construction (Part VI.D. or Part VII.D, depending on the MS4 Operator type), and post-construction (Part VI.E. or Part VII.E, depending on the MS4 Operator type). The ERP must be documented in the *SWMP Plan*. The ERP must set forth a protocol to address repeat and continuing violations through progressively stricter responses (i.e., escalation of enforcement) as needed to achieve compliance with the terms and conditions of this *SPDES* general permit.

a. The ERP must describe how the *MS4 Operator* will use the following types of enforcement responses or combination of responses:

   i. Verbal warnings;

   ii. Written notices;

   iii. Citations (and associated fines);

   iv. Stop work orders;

   v. Withholding of plan approvals or other authorizations affecting the ability to *discharge* to the *MS4*; and

   vi. Additional measures, supported in local legal authorities, such as collecting against the project's bond or directly billing the responsible party to pay for work and materials to correct violations.

b. Enforcement responses are based on the type, magnitude, and duration of the violation, effect of the violation on the receiving water, compliance history of the operator, and good faith of the operator in compliance efforts.

c. Efforts to obtain a voluntary correction of deficiencies through informal enforcement, such as verbal warnings or written notices, must not exceed sixty (60) days in duration (from the time of the *MS4 Operator's* initial determination until a return to compliance).

2. Enforcement Tracking

The *MS4 Operator* must track instances of non-compliance in the *SWMP Plan*. The enforcement case documentation must include, at a minimum, the following:

a. Name of the owner/operator of the facility or site of the violation (can be redacted from the publicly available SWMP Plan);

b. Location of the *stormwater* source (e.g., construction project);

c. Description of the violation;

d. Schedule for returning to compliance;

e. Description of enforcement response used, including escalated responses if repeat violations occur or violations are not resolved in a timely manner;

f. Accompanying documentation of enforcement response (e.g., notices of noncompliance, notices of violations);

g. Any referrals to different departments or agencies; and

h. Date violation was resolved.

Part V. Recordkeeping, Reporting, and *SWMP* Evaluation

A. Recordkeeping

The *MS4 Operator* must keep records required by this *SPDES* general permit for five (5) years after they are generated. Records must be submitted to the *Department* within a reasonable specified time period of a written *Department* request for such information. Documents can be maintained in electronic format if the manner reasonably assures the integrity of the records, in accordance with NYCRR 750-2.5(e)(1). Records, including the NOI and the SWMP Plan, must be made available to the public at reasonable times during regular business hours.

B. Reporting

1. Report Submittal

a. Reports must be submitted electronically to the *Department* using the forms located on the Department's website (http://www.dec.ny.gov/).

b. Electronic Submission Waiver

ii. *MS4 Operators* must submit all reports electronically unless the *MS4 Operator* has received a waiver from the *Department* based on one of the following conditions:

a) If the *MS4 Operator* is physically located in a geographical area (i.e., zip code or census tract) that is identified as under-served for broadband internet access in the most recent report from the Federal Communications Commission; or

b) If the *MS4 Operator* has limitations regarding available computer access or computer capability.

iii. If an *MS4 Operator* wishes to obtain a waiver from submitting a report electronically, the *MS4 Operator* must submit a request using the Application for Electronic Submittal Waiver to the *Department* at the following address:

NYS DEC Bureau of Water Compliance

MS4 NOTICE OF INTENT WAIVER

625 Broadway, 4th Floor

Albany, New York 12233-3505

iv. A waiver may only be considered granted once the *MS4 Operator* receives written confirmation from the *Department*.

v. *MS4 Operators* must document the electronic submission waiver in the *SWMP Plan*, if applicable.

2. Annual Reports

a. Annually, *MS4 Operators* must submit an Annual Report to the *Department* using the form provided by the *Department*. The completion of this permit requirement must be documented in the *SWMP Plan*.

b. The reporting period for the Annual Report is January 3 of the current year to January 2 of the following year (Reporting Year).

c. For *MS4 Operators* continuing coverage, the Annual Report must be submitted to the *Department* by April 1 of the year following the end of the Reporting Year.

d. For newly designated *MS4 Operators*, if authorization to discharge is granted:

i. Before September 30, the first Annual Report must be submitted by April 1 of the year following the end of the Reporting Year; or

ii. After September 30, the first Annual Report must be submitted by April 1 following their first complete Reporting Year.

3. Interim Progress Certifications

a. Twice a year, *MS4 Operators* must submit to the *Department* an Interim Progress Certification that verifies the activities included in this *SPDES* general permit have been completed by the date specified using the form provided by the *Department*. The completion of this permit requirement must be documented in the *SWMP Plan*.

b. *MS4 Operators* located within the watersheds listed in Table 3 must include additional information to identify the activities that have been performed during the reporting period to demonstrate progress made by the *MS4 Operator* towards completion of the reduction requirements, prescribed in Part IX.

c. An Interim Progress Certification for the period of January 3 through June 30 of the same year must be submitted to the *Department* by October 1 of the same year. An Interim Progress Certification for the period of July 1 through January 2 of the following year must be submitted to the *Department* by April 1 of the following year along with the Annual Report. Submission of the Annual Report is not a substitute for submission of the Interim Progress Certification.

4. Shared Annual Reporting

MS4 Operators working together to implement their *SWMPs* may complete and submit a shared Annual Report to satisfy the reporting requirements specified in Part V.B.2.

a. The shared Annual Report must outline and explain group activities, but also include the tasks performed by each individual *MS4 Operator*.

b. On or before the reporting deadline, April 1, each *MS4 Operator* within the group, must sign the certification section of the Annual Report to take responsibility for the information in the Annual Report, which includes specific endorsement or acceptance of both the shared Annual Report information and Annual Report information on behalf of the individual *MS4 Operator.*

5. Certification

All reports specified within this Part must be signed and certified in accordance with Part X.J.

6. Annual Report and Interim Progress Certification Content

The Annual Report and Interim Progress Certifications shall summarize the activities performed throughout the Reporting Year, including:

a. The status of compliance with permit requirements;

b. Information documented in the *SWMP Plan*, as specified throughout this *SPDES* general permit; and

c. A certification statement in accordance with 40 CFR 122.22(d).

C. *SWMP* Evaluation

Once every five (5) years, the *MS4 Operator* must evaluate the *SWMP* for compliance with the terms and conditions of this *SPDES* general permit, including the effectiveness or deficiencies of components of the individual *SWMP Plan*, and

the status of achieving the requirements outlined in this *SPDES* general permit. The *SWMP* evaluation must be documented in the *SWMP Plan*.

Part VI. Minimum Control Measures (MCMs) for *Traditional Land Use Control MS4 Operators*

In addition to the requirements contained in Part I. through Part V, *traditional land use control MS4 Operators* must comply with the MCMs contained in this Part.

A. MCM1 – Public Education and Outreach Program

The *MS4 Operator* must *develop* and implement an education and outreach program to increase public awareness of *pollutant* generating activities and behaviors. This MCM is designed to inform the public about the impacts of *stormwater* on water quality, the general sources of *stormwater pollutants*, and the steps the general public can take to reduce *pollutants* in *stormwater* runoff.

1. Development

a. Focus Areas

Within three (3) years of the EDC, the *MS4 Operator* must identify and document the focus areas in the *SWMP Plan*. The focus areas to be considered are as follows:

i. Areas *discharging* to waters with Class AA-S, A-S, AA, A, B, SA, or SB (mapped in accordance with Part IV.D.1.e.ii.a));

ii. *Sewersheds* for impaired waters listed in Appendix C (subject to Part VIII. requirements; mapped in accordance with Part IV.D.1.c. for *MS4 Operators* continuing coverage and Part IV.D.2.a.ii. for newly designated *MS4 Operators*);

iii. *TMDL* watersheds (subject to Part IX. requirements; mapped in accordance with Part IV.D.1.e.ii.c));

iv. Areas with *construction activities*;

v. Areas with on-site wastewater systems (subject to Part VIII. or Part IX. requirements);

vi. Residential, commercial, and industrial areas (mapped in accordance with Part IV.D.1.e.iii.);

vii. *Stormwater hotspots*; and

viii. Areas with *illicit discharges*.

b. Target Audiences and Associated *Pollutant* Generating Activities

Within three (3) years of the EDC, the *MS4 Operator* must identify and document the applicable target audience(s) and associated *pollutant* generating activities that the outreach and education will address for each focus area identified by the *MS4 Operator* in Part VI.A.1.a. in the *SWMP Plan*. The target audiences are as follows:

i. Residents;

ii. Commercial:[10] Business owners and staff;

iii. Institutions:[11] Managers, staff, and students;

iv. Construction: Developers, contractors, and design professionals;

v. Industrial:[12] Owners and staff; and

vi. *MS4 Operator*'s *municipal* staff.

c. Education and Outreach Topics

Within three (3) years of the EDC, the *MS4 Operator* must identify and document in the *SWMP Plan* the education and outreach topics and how the education and outreach topics will reduce the potential for *pollutants* to be generated by the target audience(s) (Part VI.A.1.b.) for the focus area(s) (Part VI.A.1.a.).

d. *Illicit Discharge* Education

Within six (6) months of the EDC, the *MS4 Operator* must make information related to the prevention of *illicit discharges*, available to *municipal* employees, businesses, and the public and document the completion of this requirement in the *SWMP Plan*. The information related to the prevention of illicit discharges must include the following:

i. What types of *discharges* are allowable (Part I.A.3.);

ii. What is an *illicit discharge* and why is it prohibited (Part VI.C.);

iii. The environmental hazards associated with *illicit discharges* and improper disposal of waste;

iv. Proper handling and disposal practices for the most common behaviors within the community (e.g., septic care, car washing, household hazardous waste, swimming pool draining, or other activities resulting in *illicit discharges* to the *MS4*); and

v. How to report *illicit discharges* they may observe (Part VI.C.1.a.).

2. Implementation and Frequency

a. Distribution Method of Educational Messages

Once every five (5) years, the *MS4 Operator* must identify and document in the *SWMP Plan* which of the following method(s) are used for the distribution of educational messages:

i. Printed materials (e.g., mail inserts, brochures, and newsletters);

ii. Electronic materials (e.g., websites, email listservs);

[10] Business, retail stores, and restaurants.
[11] Hospitals, churches, colleges, and schools.
[12] Factories, recyclers, auto-salvage, and mines.

iii. Mass media (e.g., newspapers, public service announcements on radio or cable);

iv. Workshops or focus groups;

v. Displays in public areas (e.g., town halls, library, parks); or

vi. Social Media (e.g., Facebook, Twitter, blogs).

b. Frequency

Following the completion of Part VI.A.1.a, Part VI.A.1.b, and Part VI.A.1.c, within five (5) years of the EDC, and once every five (5) years, thereafter, the *MS4 Operator* must:

i. Deliver an educational message to each target audience(s) (Part VI.A.1.b.) for each focus area(s) (Part VI.A.1.a.) based on the defined education and outreach topic(s) (Part VI.A.1.c.); and

ii. Document the completion of this requirement in the *SWMP Plan*.

c. Updates to the Public Education and Outreach Program

Following the completion of Part VI.A.1.a, Part VI.A.1.b, and Part VI.A.1.c, annually, by April 1, the *MS4 Operator* must:

i. Review and update the focus areas, target audiences, and/or education and outreach topics; and

ii. Document the completion of this requirement in the *SWMP Plan*.

B. MCM 2 - Public Involvement/Participation

The *MS4 Operator* must provide opportunities to involve the public in the development, review, and implementation of the *SWMP*. This MCM is designed to give the public the opportunity to include their opinions in the implementation of this *SPDES* general permit.

1. Public Involvement/Participation

a. Annually, the *MS4 Operator* must provide an opportunity for public involvement/participation in the development and implementation of the *SWMP*. The *MS4 Operator* must document the public involvement/participation opportunities in the *SWMP Plan*. The opportunities for public involvement/participation are as follows:

i. Citizen advisory group on *stormwater* management;

ii. Public hearings or meetings;

iii. Citizen volunteers to educate other individuals about the *SWMP*;

iv. Coordination with other pre-existing public involvement/participation opportunities;

v. Reporting concerns about activities or behaviors observed; or

vi. Stewardship activities.

b. Annually, the *MS4 Operator* must inform the public of the opportunity (Part VI.B.1.a.) for their involvement/participation in the development and implementation of the *SWMP* and how they can become involved. The *MS4 Operator* must document the method for distribution of this information in the *SWMP Plan*. The methods for distribution are as follows:

i. Public notice;

ii. Printed materials (e.g., mail inserts, brochures and newsletters);

iii. Electronic materials (e.g., websites, email listservs);

iv. Mass media (e.g., newspapers, public service announcements on radio or cable);

v. Workshops or focus groups;

vi. Displays in public areas (e.g., town halls, library, parks); or

vii. Social Media (e.g., Facebook, Twitter, blogs).

c. Within six (6) months of the EDC, the *MS4 Operator* must identify a local point of contact to receive and respond to public concerns regarding *stormwater* management and compliance with permit requirements. The name or title of this individual, with contact information, must be published on public outreach and public participation materials and documented in the *SWMP Plan*.

2. Public Notice and Input Requirements

a. Public Notice and Input Requirements for *SWMP Plan*

Annually, the *MS4 Operator* must provide an opportunity for the public to review and comment on the publicly available *SWMP Plan* (Part IV.B.2.b.). The public must have the ability to ask questions and submit comments on the *SWMP Plan*. The completion of this permit requirement must be documented in the *SWMP Plan*. This requirement may be satisfied by Part VI.B.1.

b. Public Notice and Input Requirements for Draft Annual Report

i. Annually, the *MS4 Operator* must provide an opportunity for the public to review and comment on the draft Annual Report. The completion of this permit requirement must be documented in the *SWMP Plan*. This requirement may be satisfied by either:

a) Presentation of the draft Annual Report at a regular meeting of an existing board (e.g., administrative, planning, zoning) or a separate meeting specifically for *stormwater*, as designated by the *MS4* or if requested by the public. The public must have the ability to ask

questions about and make comments on the draft annual report during that presentation; or

b) Posting of the draft Annual Report on a public website. The website must provide information on the timeframes and procedures to submit comments and/or request a meeting. However, if a public meeting is requested by two or more persons, the *MS4 Operator* must hold such a meeting.

c. Consideration of Public Input

i. Annually, the *MS4 Operator* must include a summary of comments received on the *SWMP Plan* and draft Annual Report in the *SWMP Plan*.

ii. Within thirty (30) days of when public input is received, the *MS4 Operator* must update the *SWMP Plan*, where appropriate, based on the public input received.

C. MCM 3 - *Illicit Discharge* Detection and Elimination

The *MS4 Operator* must *develop*, implement, and enforce a program which systematically detects, tracks down, and eliminates *illicit discharges* to the *MS4*. This MCM is designed to manage the *MS4* so it is not conveying *pollutants* associated with flows other than those directly attributable to *stormwater* runoff.

1. *Illicit Discharge* Detection

a. Public Reporting of *Illicit Discharges*

i. Within six (6) months of the EDC, the *MS4 Operator* must establish and document in the *SWMP Plan* an email or phone number (with message recording capability) for the public to report *illicit discharges*.

ii. Within thirty (30) days of an *illicit discharge*, the *MS4 Operator* must document each report of an *illicit discharge* in the *SWMP Plan* with the following information:

a) Date of the report;

b) Location of the *illicit discharge;*

c) Nature of the *illicit discharge;*

d) Follow up actions taken or needed (including response times); and

e) Inspection outcomes and any enforcement taken.

b. Monitoring Locations

The monitoring locations used to detect *illicit discharges* are identified as follows:

i. *MS4 outfalls;*[13]

[13] *MS4 outfall*s can be found at a *municipal facility*.

ii. *Interconnections*;[14] and
iii. *Municipal facility intraconnections*.[15]

c. Monitoring Locations Inventory

i. Within three (3) years of the EDC, the *MS4 Operator* must *develop* and maintain an inventory of the monitoring locations in the *SWMP Plan*. The following information must be included in the inventory:[16]

a) Inventory information for *MS4 outfall*s

i) ID;
ii) Prioritization (high or low) (Part VI.C.1.d.);
iii) Type of monitoring location (Part VI.C.1.b.);
iv) Name of *MS4 Operator's municipal facility*, if located at a *municipal facility*;[17]
v) Receiving waterbody name and class (mapped in accordance with Part IV.D.1.e.ii.a));
vi) Receiving waterbody WI/PWL Segment ID (mapped in accordance with Part IV.D.1.e.ii.b));
vii) Land use in drainage area;
viii) Type of conveyance (open drainage or closed pipe);
ix) Material;
x) Shape;
xi) Dimensions;
xii) Submerged in water; and
xiii) Submerged in sediment.

b) Inventory information for *interconnections*

i) ID;
ii) Prioritization (high or low) (Part VI.C.1.d.);
iii) Type of monitoring location (Part VI.C.1.b.);
iv) Name of *MS4 Operator* receiving *discharge* or private storm system;
v) Name of *MS4 Operator*'s *municipal facility*, if located at a *municipal facility*; and
vi) Receiving waterbody name and class (mapped in accordance with Part IV.D.1.e.ii.a)).

c) Inventory information for *municipal facility intraconnections*

i) ID;
ii) Prioritization (high or low) (Part VI.C.1.d.);

[14] *Interconnections* can be found at a *municipal facility*.
[15] *Municipal facility intraconnections* can be found only at a *municipal facility*.
[16] The information included in the inventory is collected during inspections on the Monitoring Locations Inspection and Sampling Field Sheet (Appendix D) unless otherwise specified by the permit conditions.
[17] This information is collected as part of the *municipal facility* inventory.

iii) Type of monitoring location (Part VI.C.1.b.);
iv) Name of *MS4 Operator*'s *municipal facility*; and
v) Receiving waterbody name and class (mapped in accordance with Part IV.D.1.e.ii.a)).

ii. Annually, the *MS4 Operator* must update the inventory if monitoring locations are created or discovered.

d. Monitoring Locations Prioritization

i. Within three (3) years of the EDC, the *MS4 Operator* must prioritize monitoring locations which are included in the monitoring locations inventory (Part VI.C.1.c.) as follows:
a) High priority monitoring locations include monitoring locations:
i) At a high priority *municipal facility*, as defined in Part VI.F.2.c;
ii) *Discharging* to impaired waters (subject to Part VIII. requirements; mapped in accordance with Part IV.D.1.e.ii.b));
iii) *Discharging* within a TMDL watershed (subject to Part IX. requirements; mapped in accordance with Part IV.D.1.e.ii.c));
iv) *Discharging* to waters with Class AA-S, A-S, AA, A, B, SA, or SB (mapped in accordance with Part IV.D.1.e.ii.a)); and/or
v) Confirmed citizen complaints on three or more separate occasions in the last twelve (12) months.
b) All other monitoring locations are considered low priority.

ii. Within thirty (30) days of when a monitoring location is constructed or the *MS4 Operator* discovers it, the *MS4 Operator* must prioritize those monitoring locations; and

iii. Annually, after the initial prioritization (Part VI.C.1.d.i.), the *MS4 Operator* must update the monitoring location prioritization in the inventory (Part VI.C.1.c.) based on information gathered as part of the monitoring location inspection and sampling program (Part VI.C.1.e.). The completion of this permit requirement must be documented in the *SWMP Plan*.

e. Monitoring Locations Inspection and Sampling Program

Within two (2) years of the EDC, the *MS4 Operator* must *develop* and implement a monitoring locations inspection and sampling program. The monitoring locations inspection and sampling program must be documented in the *SWMP Plan* specifying:

i. The monitoring locations inspection and sampling procedures including:

a) During *dry weather,*[18] one (1) inspection of each monitoring location identified in the inventory (Part VI.C.1.c.) every five (5) years following the most recent inspection;

b) Documentation of all monitoring location inspections, including any sampling results, using the Monitoring Locations Inspection and Sampling Field Sheet (Appendix D) or an equivalent form containing the same information and include the completed monitoring location inspections and sampling results in the *SWMP Plan* (e.g., the completed Monitoring Locations Inspection and Sampling Field Sheets);

c) Provisions to sample all monitoring locations which had inspections which resulted in a *suspect* or *obvious illicit discharge* characterization. The sampling requirement is based on the number and severity of *physical indicators present in the flow* to better inform track down procedures (Part VI.C.2.). If the source of the *illicit discharge* is clear and discernable (e.g., sewage), sampling is not necessary;

d) Sampling may be done with field test kits or field instrumentation that are sufficiently sensitive to detect the parameter below the sampling action level used[19] and are not subject to 40 CFR Part 136 requirements for approved methods and certified laboratories;

e) Provisions to initiate, or cause to initiate,[20] track down procedures (Part VI.C.2.a.), in accordance with the timeframes specified in Part VI.C.2.a.iii, for monitoring locations with an overall characterization[21] as *suspect illicit discharge* or *obvious illicit discharge* or that exceed any sampling action level used;

f) Provisions to re-inspect the monitoring location within thirty (30) days of initial inspection if there is a *physical indicator not related to flow*, potentially indicative of *intermittent* or *transitory discharges,* utilizing techniques described in Chapter 12.6 of the Center for Watershed Protection Illicit Discharge Detection and Elimination: A Guidance Manual for Program Development and Technical Assistance, October 2004 (CWP 2004) or equivalent.

   i) If those same physical indicators persist, the *MS4 Operator* must initiate *illicit discharge* track down procedures (Part VI.C.2.a.).

[18] MS4 Operators can reference the Center for Watershed Protection Illicit Discharge Detection and Elimination: A Guidance Manual for Program Development and Technical Assistance, October 2004 (CWP 2004) for other factors to consider when determining when to conduct monitoring location inspection and sampling.
[19] Refer to Chapter 12 of the CWP 2004 for parameters, sampling action levels, and procedures.
[20] If track down is conducted by individuals or entities other than those conducting the monitoring locations inspections.
[21] Reference to the Monitoring Locations Inspection and Sampling Field Sheet, adapted from CWP 2004, Section 6: Overall Monitoring Location Characterization based on the Relative Severity Index of physical indicators for flowing monitoring locations only.

ii. The training provisions for the *MS4 Operator*'s monitoring locations inspection and sampling procedures (Part VI.C.1.e.i.).

a) If new staff are added, training on the *MS4 Operator*'s monitoring locations inspection and sampling procedures (Part VI.C.1.e.i.) must be given prior to conducting monitoring locations inspections and sampling procedures;

b) For existing staff, training on the *MS4 Operator*'s monitoring locations inspection and sampling procedures (Part VI.C.1.e.i.) must be given prior to conducting monitoring locations inspections and sampling and once every five (5) years, thereafter; and

c) If the monitoring locations inspection and sampling procedures (Part VI.C.1.e.i.) are updated (Part VI.C.1.e.iv.), training on the updates must be given to all staff prior to conducting monitoring locations inspections and sampling.

iii. The names, titles, and contact information for the individuals who have received monitoring locations inspection and sampling procedures training and update annually; and

iv. Annually, by April 1, the *MS4 Operator* must:

a) Review and update the monitoring location inspection and sampling procedures (Part VI.C.1.e.i.) based on monitoring location inspection results (e.g., trends, patterns, areas with *illicit discharges*, and common problems); and

b) Document the completion of this requirement in the *SWMP Plan*.

2. *Illicit Discharge* Track Down Program

Within two (2) years of the EDC, the *MS4 Operator* must *develop* and implement an *illicit discharge* track down program to identify the source of *illicit discharges* and the responsible party. The *illicit discharge* track down program must be documented in the *SWMP Plan* specifying:

a. The *illicit discharge* track down procedures including:

i. Procedures as described in Chapter 13 of CWP 2004 or equivalent;

ii. Steps taken for *illicit discharge* track down procedures;

iii. The following timeframes to initiate *illicit discharge* track down:

a) Within twenty-four (24) hours of discovery, the *MS4 Operator* must initiate track down procedures for flowing *MS4* monitoring locations with *obvious illicit discharges;*[22]

[22] Reference to the Monitoring Locations Inspection and Sampling Field Sheet, adapted from CWP 2004, Section 6: Overall Monitoring Location Characterization based on the Relative Severity Index of physical indicators for flowing monitoring locations only.

b) Within two (2) hours of discovery, the *MS4 Operator* must initiate track down procedures for *obvious illicit discharges* of sanitary wastewater that would affect bathing areas during bathing season, shell fishing areas or public water intakes and report orally or electronically to the Regional Water Engineer and local health department; and

c) Within five (5) days of discovery, the *MS4 Operator* must initiate track down procedures for *suspect illicit discharges*.

b. The training provisions for the *MS4 Operator*'s *illicit discharge* track down procedures (Part VI.C.2.a.).

i. If new staff are added, training on the *MS4 Operator*'s *illicit discharge* track down procedures (Part VI.C.2.a.) must be given prior to conducting *illicit discharge* track downs;

ii. For existing staff, training on the *MS4 Operator*'s *illicit discharge* track down procedures (Part VI.C.2.a.) must be given prior to *conducting illicit discharge* track downs and once every five (5) years, thereafter; and

iii. If the *illicit discharge* track down procedures (Part VI.C.2.a.) are updated (Part VI.C.2.d.), training on the updates must be given to all staff prior to conducting *illicit discharge* track downs.

c. The names, titles, and contact information for the individuals who have received *illicit discharge* track down procedures training and update annually; and

d. Annually, by April 1, the *MS4 Operator* must:

i. Review and update the *illicit discharge* track down procedures (Part VI.C.2.a.); and

ii. Document the completion of this requirement in the *SWMP Plan*.

3. *Illicit Discharge* Elimination Program

Within two (2) years of the EDC, the *MS4 Operator* must *develop* and implement an *illicit discharge* elimination program. The *illicit discharge* elimination program must be documented in the *SWMP Plan* specifying:

a. The *illicit discharge* elimination procedures including:

i. Provisions for escalating enforcement and tracking, both consistent with the ERP required in Part IV.F. of this *SPDES* general permit;

ii. Provisions to confirm the corrective actions have been taken;

iii. Steps taken for *illicit discharge* elimination procedures; and

iv. The following timeframes for *illicit discharge* elimination:

a) Within twenty-four (24) hours of identification of an *illicit discharge* that has a reasonable likelihood of adversely affecting human health or the environment, the *MS4 Operator* must eliminate the *illicit discharge*;

b) Within five (5) days of identification of an *illicit discharge* that does not have a reasonable likelihood of adversely affecting human health or the environment, the *MS4 Operator* must eliminate the *illicit discharge;* and

c) Where elimination of an *illicit discharge* within the specified timeframes (Part VI.C.3.a.iv.) is not possible, the *MS4 Operator* must notify the Regional Water Engineer.

b. The training provisions for the *MS4 Operator*'s *illicit discharge* elimination procedures (Part VI.C.3.a.).

i. If new staff are added, training on the *MS4 Operator*'s *illicit discharge* elimination procedures (Part VI.C.3.a.) must be given prior to conducting *illicit discharge* eliminations;

ii. For existing staff, training on the *MS4 Operator*'s *illicit discharge* elimination procedures (Part VI.C.3.a.) must be given prior to conducting *illicit discharge* eliminations and once every five (5) years, thereafter; and

iii. If the *illicit discharge* elimination procedures (Part VI.C.3.a.) are updated (Part VI.C.3.d.), training on the updates must be given to all staff prior to conducting *illicit discharge* eliminations.

c. The names, titles, and contact information for the individuals who have received *illicit discharge* elimination procedures training and update annually; and

d. Annually, by April 1, the *MS4 Operator* must:

i. Review and update the *illicit discharge* elimination procedures (Part VI.C.3.a.); and

ii. Document the completion of this requirement in the *SWMP Plan*.

D. MCM 4 - Construction Site *Stormwater* Runoff Control

The *MS4 Operator* must *develop*, implement, and enforce a program to ensure construction sites are effectively controlled. This MCM is designed to prevent *pollutants* from construction related activities,[23] as well as promote the proper planning and installation of post-construction *SMPs*.

1. Applicable Construction Activities/Projects/Sites

a. The construction site *stormwater* runoff control program must address *stormwater* runoff to the *MS4* from sites with *construction activities* that:

i. Result in a total land disturbance of greater than or equal to one acre; or

[23] Projects that comply with the terms and conditions of the CGP or an individual *SPDES* permit for *stormwater* for which they obtained coverage and local erosion and sediment control requirements are effectively controlled.

ii. Disturb less than one acre if part of a larger common plan of development or sale.

b. For *construction activities* where the *MS4 Operator* is listed as the owner/operator on the Notice of Intent for coverage under the CGP:

i. The *MS4 Operator* must ensure compliance with the CGP; and

ii. The additional requirements for construction oversight described in Part VI.D.6 through Part VI.D.9 are not required.

2. Public Reporting of Construction Site Complaints

a. Within six (6) months of the EDC, the *MS4 Operator* must establish and document in the *SWMP Plan* an email or phone number (with message recording capability) for the public to report complaints related to construction *stormwater* activity.

b. The *MS4 Operator* must document reports of construction site complaints in the *SWMP Plan* with the following information:

i. Date of the report;

ii. Location of the construction site;

iii. Nature of complaint;

iv. Follow up actions taken or needed; and

v. Inspection outcomes and any enforcement taken.

3. Construction Oversight Program

Within one (1) year of the EDC, the *MS4 Operator* must *develop* and implement a construction oversight program. The construction oversight program must be documented in the *SWMP Plan* specifying:

a. The construction oversight procedures including:

i. When the construction site *stormwater* control program applies (Part VI.D.1.);

ii. What types of *construction activity* require a SWPPP;

iii. The procedures for submission of SWPPPs;

iv. SWPPP review requirements (Part VI.D.6.)

v. Pre-construction oversight requirements (Part VI.D.7.)

vi. Construction site inspection requirements (Part VI.D.8.);

vii. Construction site close-out requirements (Part VI.D.9.);

viii. Enforcement process/expectations for compliance; and

ix. Other procedures associated with the control of *stormwater* runoff from applicable *construction activities*.

b. The training provisions for the *MS4 Operator*'s construction oversight procedures (Part VI.D.3.a.).
    i. If new staff are added, training on the *MS4 Operator*'s construction oversight procedures (Part VI.D.3.a.) must be given prior to conducting any construction oversight activities;
    ii. For existing staff, training on the *MS4 Operator*'s construction oversight procedures (Part VI.D.3.a.) must be given prior to conducting any construction oversight activities and once every five (5) years, thereafter; and
    iii. If the construction oversight procedures (Part VI.D.3.a.) are updated (Part VI.D.3.a.), training on the updates must be given to all staff prior to conducting construction oversight.
c. The names, titles, and contact information for the individuals who have received construction oversight training and update annually;
d. Procedures to ensure those involved in the *construction activity* itself (e.g., contractor, subcontractor, *qualified inspector*, SWPPP reviewers) have received four (4) hours of *Department* endorsed training in proper erosion and sediment control principles from a Soil & Water Conservation District, or other *Department* endorsed entity; and
e. Annually, by April 1, the *MS4 Operator* must:
    i. Review and update the construction oversight procedures (Part VI.D.3.a.); and
    ii. Document the completion of this requirement in the *SWMP Plan*.

4. Construction Site Inventory & Inspection Tracking

a. Within six (6) months of the EDC, the *MS4 Operator* must *develop* and maintain an inventory of all applicable construction sites (Part VI.D.1.a.) in the *SWMP Plan*. The following information must be included in the inventory:
    i. Location of the construction site;
    ii. Owner/operator contact information, if other than the *MS4 Operator*;
    iii. Receiving waterbody name and class (mapped in accordance with Part IV.D.1.e.ii.a));
    iv. Receiving waterbody WI/PWL Segment ID (mapped in accordance with Part IV.D.1.e.ii.b));
    v. Prioritization (high or low) (Part VI.D.5.);
    vi. Construction project *SPDES* identification number;
    vii. SWPPP approval date;
    viii. Inspection history, including dates and ratings (satisfactory, marginal, or unsatisfactory, when available); and

ix. Current status of the construction site/project (i.e., active, temporarily shut down, complete[24]).

b. Annually, the *MS4 Operator* must update the inventory if construction projects are approved or completed.

5. Construction Site Prioritization

a. Within one (1) year of the EDC, the *MS4 Operator* must prioritize all construction sites which are included in the construction site inventory (Part VI.D.4.) as follows:

i. High priority construction sites include construction sites:

a) With a direct conveyance (e.g., channel, ditch, storm sewer) to a *surface water of the State* that is:

i) Listed in Appendix C with silt/sediment, phosphorus, or nitrogen as the POC;

ii) Classified as AA-S, AA, or A (mapped in accordance with Part IV.D.1.e.ii.a)); or

iii) Classified with a trout (T) or trout spawning (TS) designation (mapped in accordance with Part IV.D.1.e.ii.a));

b) With greater than five (5) acres of disturbed earth at any one time;

c) With earth disturbance within one hundred (100) feet of any lake or pond (mapped in accordance with Part IV.D.1.e.ii.b)); and/or

d) Within fifty (50) feet of any rivers or streams (mapped in accordance with Part IV.D.1.e.ii.b));

ii. All other construction sites are considered low priority.

b. Within thirty (30) days of when a construction site becomes active, the *MS4 Operator* must prioritize those construction sites; and

c. Annually, after the initial prioritization (Part VI.D.5.a.), the *MS4 Operator* must update the construction site prioritization in the inventory (Part VI.D.4.a.) based on information gathered as part of the construction oversight program (Part VI.D.3.). The completion of this permit requirement must be documented in the *SWMP Plan*.

i. If the prioritization of the construction site changes priority based on information gathered as part of the construction oversight program, the *MS4 Operator* must comply with the requirements that apply to that prioritization.

[24] Construction projects listed on the inventory must be inspected and tracked as described in Part VI.D.8. until a final site inspection has been completed as specified in Part VI.D.9. and the construction site status changes to complete.

6. SWPPP Review

The *MS4 Operator* must:

a. Ensure individual(s), responsible for reviewing SWPPPs for acceptance, receive:

   i. Four (4) hours of *Department* endorsed training in proper erosion and sediment control principles from a Soil & Water Conservation District, or other *Department* endorsed entity. This training must be completed within three (3) years of the EDC and every three (3) years thereafter.

   ii. Document the completion of this requirement in the *SWMP Plan*.

b. Ensure SWPPP reviewers receive this training (Part VI.D.6.a.) prior to conducting SWPPP reviews for acceptance.

   i. Individuals without these trainings cannot review SWPPPs for acceptance.

   ii. Individuals who meet the definition of a *qualified professional* or *qualified inspector* are exempt from this requirement.

c. Ensure individuals responsible for reviewing SWPPPs review all SWPPPs for applicable *construction activities* (Part VI.D.1.) and for conformance with the requirements of the CGP, including:

   i. Erosion and sediment controls must be reviewed for conformance with the NYS E&SC 2016, or equivalent;

   ii. Individuals responsible for review of post-construction *SMPs* must be *qualified professionals* or under the supervision of a *qualified professional*; and

   iii. Post-construction *SMPs* must be reviewed for conformance with the NYS SWMDM 2015 or equivalent, including:

      a) All post-construction *SMPs* must meet the *sizing criteria* contained in the CGP and NYS SWMDM 2015.

      b) Deviations from the performance criteria of the NYS SWMDM 2015 must demonstrate that they are equivalent.

      c) The SWPPP must include an O&M plan that includes inspection and maintenance schedules and actions to ensure continuous and effective operation of each post-construction *SMP*. The SWPPP must identify the entity that will be responsible for the long-term operation and maintenance of each practice.

d. In the *SWMP Plan*, document and update annually the names, titles, and contact information for the individuals who have received the trainings listed in Part VI.D.6.a.

e. In the *SWMP Plan*, document the SWPPP review including the information found in Part III.B. of the CGP;

f. Prioritize new *construction activities* (Part VI.D.5.a.); and

g. Notify construction site owner/operators that their SWPPP has been accepted using the *MS4* SWPPP Acceptance Form[25] created by the *Department* and required by the CGP, signed in accordance with Part X.J.

7. Pre-Construction Meeting

Prior to commencement of *construction activities*, the *MS4 Operator* must ensure a pre-construction meeting is conducted. The date and content of the pre-construction inspection/meeting must be documented in the *SWMP Plan*. The owner/operator listed on the CGP NOI (if different from the *MS4 Operator*), the *MS4 Operator*, contractor(s) responsible for implementing the SWPPP for the *construction activity,* and the *qualified inspector* (if required for the *construction activity* by Part IV.C. the CGP) must attend the meeting in order to:

a. Confirm the approved project has received, or will receive[26], coverage under the CGP or an individual *SPDES* permit;

b. Verify contractors and subcontractors selected by the owner/operator of the *construction activity* have identified at least one individual that has received four (4) hours of *Department* endorsed training in proper erosion and sediment control principles from a Soil & Water Conservation District or other endorsed entity as required by the CGP and Part VI.D.3.d; and

c. Review the construction oversight program (Part VI.D.3.) and expectations for compliance.

8. Construction Site Inspections

The *MS4 Operator* must:

a. Ensure individuals(s), responsible for construction site inspections, receive:

   i. Four (4) hours of *Department* endorsed training in proper erosion and sediment control principles from a Soil & Water Conservation District, or other *Department* endorsed entity. This training must be complete, within three (3) years of the EDC and every three (3) years thereafter.

   ii. Document the completion of this requirement in the *SWMP Plan*.

b. Ensure all *MS4* Construction Site Inspectors receive this training prior to conducting construction site inspections.

   i. Individuals without these trainings cannot inspect construction sites.

   ii. Individuals who meet the definition of a *qualified professional* or *qualified inspector* are exempt from this requirement.

[25] The *MS4* SWPPP Acceptance Form can be found on the Department's website.

[26] Preconstruction meetings may occur prior to the issuance of the MS4 SWPP Acceptance Form, however, the MS4 Operator must confirm coverage under the CGP will be applied for by the construction site owner/operator prior to commencement of construction of *construction activities*.

c. Annually inspect all sites with *construction activity* identified in the inventory (Part VI.D.4.) during active construction after the pre-construction meeting (Part VI.D.7.), or sooner if deficiencies are noted that require attention.

   i. Follow up to construction site inspections must confirm corrective actions are completed within timeframes established by the CGP and the *MS4 Operator's* ERP (Part IV.F.1.).

d. In the *SWMP Plan*, document and update annually the names, titles, and contact information for the individuals who have received the trainings listed in Part VI.D.8.a.

e. Document all inspections using the Construction Site Inspection Report Form (Appendix D) or an equivalent form containing the same information. The *MS4 Operator* must include the completed Construction Site Inspection Reports in the *SWMP Plan*.

9. Construction Site Close-out

a. The *MS4 Operator* must ensure a final construction site inspection is conducted and documentation of the final construction site inspection must be maintained in the *SWMP Plan*. The final construction site inspection must be documented using the Construction Site Inspection Report Form (Appendix D), or an equivalent form containing the same information, or accept the construction site owner/operator's *qualified inspector* final inspection certification required by the CGP.

b. The Notice of Termination (NOT)[27] must be signed by the *MS4 Operator* as required by the CGP for projects determined to be complete. The NOT must be signed in accordance with Part X.J.

E. MCM 5 – Post-Construction *Stormwater* Management

The *MS4 Operator* must *develop*, implement, and enforce a program to ensure proper operation and maintenance of post construction *SMPs* for new or redeveloped sites. This MCM is designed to promote the long-term performance of post-construction *SMPs* in removing *pollutants* from *stormwater* runoff.

1. Applicable Post-Construction *SMPs*

The post-construction *SMP* program must address *stormwater* runoff to the *MS4* from *publicly owned/operated* and *privately owned/operated* post-construction *SMPs* that meet the following:

a. Post-construction *SMPs* that have been installed as part of any CGP covered construction site or individual *SPDES* permit (since March 10, 2003); and

[27] The NOT can be found on the Department's website.

b. All new post-construction *SMPs* constructed as part of the construction site *stormwater* runoff control program (Part VI.D.).

2. Post-Construction *SMP* Inventory & Inspection Tracking[28]

a. The *MS4 Operators* continuing coverage must:

   i. Maintain the inventory from previous iterations of this *SPDES* general permit for post-construction *SMPs* installed after March 10, 2003; and

   ii. *Develop* the inventory for post-construction *SMPs* installed after March 10, 2003 including post-construction *SMPs:*

      a) As they are approved or discovered; or

      b) After the owner/operator of the *construction activity* has filed the NOT with the *Department* (Part VI.D.9.b.).

b. The newly designated *MS4 Operators* must *develop* and maintain the inventory for post-construction *SMPs* installed after March 10, 2003 including post-construction *SMPs:*

   i. As they are approved or discovered; or

   ii. After the owner/operator of the *construction activity* has filed the NOT with the *Department* (Part VI.D.9.b.).

c. Annually, the MS4 Operator must update the inventory of post-construction SMPs to include the post-construction *SMPs* in Part VI.E.2.a. and Part VI.E.2.b.

d. Within five (5) years of the EDC, the following information must be included in the inventory either by using the *MS4 Operator* maintenance records or by verification of maintenance records provided by the owner of the post-construction *SMP*:

   i. Street address or tax parcel;

   ii. Type;[29]

   iii. Receiving waterbody name and class (mapped in accordance with Part IV.D.1.e.ii.a));

   iv. Receiving waterbody WI/PWL Segment ID (mapped in accordance with Part IV.D.1.e.ii.b));

   v. Date of installation (if available) or discovery;

   vi. Ownership;

   vii. Responsible party for maintenance;

[28] Post-construction *SMPs* can be found at a *municipal facility*.
[29] Post-construction *SMP* types are defined in the New York State Department of Environmental Conservation Maintenance Guidance: Stormwater Management Practices, March 31, 2017 (NYS DEC Maintenance Guidance 2017).

viii. Contact information for party responsible for maintenance;

ix. Location of documentation depicting O&M requirements and legal agreements for post-construction *SMP*;

x. Frequency for inspection of post-construction *SMP*, as specified in the New York State Department of Environmental Conservation Maintenance Guidance: Stormwater Management Practices, March 31, 2017 (NYS DEC Maintenance Guidance 2017) or as specified in the O&M plan contained in the approved SWPPP (Part VI.D.6.);

xi. Reason for installation (e.g., new development, redevelopment, *retrofit*, flood control), if known;

xii. Date of last inspection;

xiii. Inspection results; and

xiv. Any corrective actions identified and completed.

e. *MS4 Operators* must document the inventory of post-construction *SMPs* in the *SWMP Plan*.

3. SWPPP Review

For post-construction *SMP* SWPPP review requirements, see Part VI.D.6.

4. Post-Construction *SMP* Inspection & Maintenance Program

Within one (1) year of the EDC, the *MS4 Operator* must *develop* and implement a post-construction *SMP* inspection and maintenance program. The post-construction *SMP* inspection and maintenance program must be documented in the *SWMP Plan* specifying:

a. The post-construction *SMP* inspection and maintenance procedures including:

i. Provisions to ensure that each post-construction *SMP* identified in the post-construction *SMP* inventory (Part VI.E.2.) is inspected at the frequency specified in the NYS DEC Maintenance Guidance 2017 or as specified in the O&M plan contained in the approved SWPPP (Part VI.D.6.), if available;

a) The *MS4 Operator* can only accept Level 1 inspections (NYS DEC Maintenance Guidance 2017) by private owners inspecting post-construction *SMPs*.

ii. Documentation of post-construction *SMP* inspections using the Post-Construction SMP Inspection Checklist[30] or an equivalent form containing the same information. The *MS4 Operator* must include the completed

[30] The *Department* developed checklist forms specific to each post-construction *SMP* designed to assist *MS4 Operators* in conducting inspections and maintenance activities of standard practices. The Post-Construction SMP Inspection Checklist, March 31, 2017, can be found on the Department's website.

post-construction *SMP* inspections (i.e., the completed Post-Construction SMP Inspection Checklist) in the *SWMP Plan*;

iii. Provisions to initiate follow-up actions (i.e., maintenance, repair, or higher-level inspection) within thirty (30) days of post-construction *SMP* inspection; and

iv. Provisions to initiate enforcement within sixty (60) days of the inspection if follow-up actions are not complete.

b. The training provisions for the *MS4 Operator*'s post-construction *SMP* inspection and maintenance procedures (Part VI.E.4.a.).

i. If new staff are added, training on the *MS4 Operator*'s post-construction *SMP* inspection and maintenance procedures (Part VI.E.4.a.) and procedures outlined in the *Department* endorsed program must be given prior to conducting any post-construction *SMP* inspection and maintenance;

ii. For existing staff, training on the *MS4 Operator*'s post-construction *SMP* inspection and maintenance procedures (Part VI.E.4.a.) and procedures outlined in the *Department* endorsed program must be given prior to conducting any post-construction *SMP* inspection and maintenance and once every five (5) years, thereafter; and

iii. If the post-construction *SMP* inspection and maintenance procedures (Part VI.E.4.a.) are updated (Part VI.E.4.d.), training on the updates must be given to all staff prior to conducting post-construction *SMP* inspection and maintenance.

c. The names, titles, and contact information for the individuals who have received post-construction *SMP* inspection and maintenance procedures training and update annually; and

d. Annually, by April 1, the *MS4 Operator* must:

i. Review and update the post-construction *SMP* inspection and maintenance procedures (Part VI.E.4.a.); and

ii. Document the completion of this requirement in the *SWMP Plan*.

F. MCM 6 – Pollution Prevention and Good Housekeeping

The *MS4 Operator* must *develop* and implement a pollution prevention and good housekeeping program for *municipal facilities* and *municipal operations* to minimize *pollutant discharges*. This MCM is designed to ensure the *MS4 Operator*'s own activities do not contribute *pollutants* to *surface waters of the State*.

1. *Best Management Practices (BMPs)* for *Municipal Facilities & Operations*

Within three (3) years of the EDC, the *MS4 Operator* must incorporate *best management practices* (*BMPs*) into the *municipal facility* program *and municipal operations* program to minimize the *discharge* of *pollutants* associated with *municipal facilities* and *municipal operations, respectively*. The *BMPs* to be considered are as follows and must be documented in the *SWMP Plan*:

a. Minimize Exposure

i. Exposure of materials to rain, snow, snowmelt, and runoff must be minimized, unless not technologically possible or not economically practicable and achievable in light of best industry practices, including areas used for loading and unloading, storage, disposal, cleaning, maintenance, and fueling operations, with the following *BMP*s:

a) Locate materials and activities inside or protect them with storm resistant coverings;

b) Use grading, berming, or curbing to prevent runoff of contaminated flows and divert run-on away from these areas;

c) Locate materials, equipment, and activities so leaks and spills are contained in existing containment and diversion systems;

d) Clean up spills and leaks promptly using dry methods (e.g., absorbents) to prevent the *discharge* of *pollutants*;

e) Store leaky vehicles and equipment indoors or, if stored outdoors, use drip pans and absorbents;

f) Use spill/overflow protection equipment;

g) Perform all vehicle and/or equipment cleaning operations indoors, under cover, or in bermed areas that prevent runoff and run-on and also captures any overspray;

h) Drain fluids, indoors or under cover, from equipment and vehicles that will be decommissioned, and, for any equipment and vehicles that will remain unused for extended periods of time, inspect at least monthly for leaks; and/or

i) Minimize exposure of chemicals by replacing with a less toxic alternative (e.g., use non-hazardous cleaners).

ii. *No Exposure* Certification for High Priority *Municipal Facilities*

a) *Municipal facilities* may qualify for *No Exposure* Certification (Appendix D) when all activities and materials are completely sheltered from exposure to rain, snow, snowmelt and/or runoff.

b) High priority *municipal* facilities (Part VI.F.2.c.i.a)) with uncovered parking areas for vehicles awaiting maintenance may be considered a low priority *municipal facility* (Part VI.F.2.c.i.c)) if only routine maintenance is performed inside and all other n*o exposure* criteria are met.

c) *Municipal* facilities accepting or repairing disabled vehicles and/or vehicles that have been involved in accidents are not eligible for the *No Exposure* Certification.

d) *Municipal* facilities must maintain the *No Exposure* Certification and document in the *SWMP Plan*. The *No Exposure* Certification ceases to apply when activities or materials become exposed.

b. Follow a Preventive Maintenance Program

i. Implement a preventative maintenance program that includes routine inspection, testing, maintenance, and repair of all fueling areas, vehicles and equipment and systems to prevent leaks, spills and other releases. This includes:

a) Performing inspections and preventive maintenance of *stormwater* drainage, source controls, treatment systems, and plant equipment and systems;

b) Maintaining non-structural *BMPs* (e.g., keep spill response supplies available, personnel appropriately trained, containment measures, covering fuel areas); and

c) Ensure vehicle washwater is not *discharged* to the *MS4* or to *surface waters of the State*. Wash equipment/vehicles in a designated and/or covered area where washwater is collected to be recycled or *discharged* to the sanitary sewer (Part I.B.2.d.).

ii. Routine maintenance must be performed to ensure *BMPs* are operating properly.

iii. When a *BMP* is not functioning to its designed effectiveness and needs repair or replacement:

a) Maintenance must be performed before the next anticipated storm event, or as necessary to maintain the continued effectiveness of *stormwater* controls. If maintenance prior to the next anticipated storm event is impracticable, maintenance must be scheduled and accomplished as soon as practicable; and

b) Interim measures must be taken to prevent or minimize the *discharge* of *pollutants* until the final repair or replacement is implemented,

including cleaning up any contaminated surfaces so that the material will not be *discharged* during subsequent storm events.

c. Spill Prevention and Response Procedures

i. Minimize the potential for leaks, spills and other releases that may be exposed to *stormwater* and *develop* plans for effective response to such spills if or when they occur. At a minimum, the *MS4 Operator* must:
   a) Store materials in appropriate containers;
   b) Label containers (e.g., “Used Oil,” “Spent Solvents,” “Fertilizers and Pesticides”) that could be susceptible to spillage or leakage to encourage proper handling and facilitate rapid response if spills or leaks occur;
   c) Implement procedures for material storage and handling, including the use of secondary containment and barriers between material storage and traffic areas, or a similarly effective means designed to prevent the *discharge* of *pollutants* from these areas;
   d) *Develop* procedures for stopping, containing, and cleaning up leaks, spills, and other releases. As appropriate, execute such procedures as soon as possible;
   e) Keep spill kits on-site, located near areas where spills may occur or where a rapid response can be made;
   f) *Develop* procedures for notification of the appropriate facility personnel, emergency response agencies, and regulatory agencies when a leak, spill, or other release occurs. If possible, one of these individuals should be a member of the *stormwater* pollution prevention team (Part VI.F.2.d.i.a)). Any spills must be reported in accordance with 6 NYCRR 750-2.7; and
   g) Following any spill or release, the *MS4 Operator* must evaluate the adequacy of the *BMPs* identified in the *municipal facility* specific SWPPP. If the *BMPs* are inadequate, the SWPPP must be updated to identify new *BMPs* that will prevent reoccurrence and improve the emergency response to such releases.

ii. Measures for cleaning up spills or leaks must be consistent with applicable petroleum bulk storage, chemical bulk storage, or hazardous waste management regulations at 6 NYCRR Parts 596-599, 613 and 370-373.

iii. This *SPDES* general permit does not relieve the *MS4 Operator* of any reporting or other requirements related to spills or other releases of petroleum or hazardous substances. Any spill of a hazardous substance must be reported in accordance with 6 NYCRR 597.4. Any spill of petroleum must be reported in accordance with 6 NYCRR 613.6 or 17 NYCRR 32.3.

d. Erosion and Sediment Controls[31]

i. Stabilize exposed areas and control runoff using structural and/or non-structural controls to minimize onsite erosion and sedimentation.

ii. The *MS4 Operator* must consider:

a) Structural and/or non-structural controls found in the NYS E&SC 2016;

b) Areas that, due to topography, land disturbance (e.g., construction), or other factors, have potential for significant soil erosion;

c) Whether structural, vegetative, and/or stabilization *BMPs* are needed to limit erosion;

d) Whether velocity dissipation devices (or equivalent measures) are needed at *discharge* locations and along the length of any channel to provide a non-erosive flow velocity from the structure to a water course; and

e) Address erosion or areas with poor vegetative cover, especially if the erosion is within fifty (50) feet of a *surface water of the State*.

e. Manage Vegetated Areas and Open Space on *Municipal* Property

i. Maintain vegetated areas on *MS4 Operator* owned/operated property and right of ways:

a) Specify proper use, storage, and disposal of pesticides, herbicides, and fertilizers including minimizing the use of these products and using only in accordance manufacturer's instruction;

b) Use lawn maintenance and landscaping practices that are protective of water quality. Protective practices include: reduced mowing frequencies; proper disposal of lawn clippings; and use of alternative landscaping materials (e.g., drought resistant planting);

c) Place pet waste disposal containers and signage concerning the proper collection and disposal of pet waste at all parks and open space where pets are permitted; and

d) Address waterfowl congregation areas where needed to reduce waterfowl droppings from entering the *MS4*.

f. Salt[32] Storage Piles or Pile Containing Salt

Enclose or cover storage piles of salt, or piles containing salt, used for deicing or maintenance of paved surfaces, except during loading, unloading, and handling. Implement appropriate measures (e.g., good housekeeping, routine sweeping, diversions, containment) to minimize exposure resulting from adding to or removing materials from the pile.

[31] The use of the term "controls" in Part VI.F.1.d. aligns with the use of the term "controls" in the CGP.
[32] For purposes of this *SPDES* general permit, salt means any chloride-containing material used to treat paved surfaces for deicing, including sodium chloride, calcium chloride, magnesium chloride, and brine solutions.

g. Waste, Garbage, and Floatable Debris

i. Keep all dumpster lids closed when not in use. For dumpsters and roll off boxes that do not have lids and could leak, ensure that *discharges* have a control (e.g., secondary containment, treatment); and

ii. Keep exposed areas free of waste, garbage, and debris or intercept them before they are *discharged*:

a) Manage trash containers at parks and open space (scheduled cleanings; sufficient number);

b) Pick up trash and debris on *MS4 Operator* owned/operated property and rights of way; and

c) Clean out *catch basins* within the appropriate timeframes (Part VI.F.3.c.iii.).

h. Alternative Implementation Options

When alternative implementation options (Part IV.A.1.) are utilized, require the parties performing *municipal operations* as contracted services, including but not limited to street sweeping, snow removal, and lawn/grounds care, to meet permit requirements as the requirements apply to the activity performed.

2. *Municipal Facilities*[33]

a. *Municipal Facility* Program

Within three (3) years of the EDC, the *MS4 Operator* must *develop* and implement a *municipal facility* program. The *municipal facility* program must be documented in the *SWMP Plan* specifying:

i. The *municipal facility* procedures including:

a) The *BMPs* (Part VI.F.1.) incorporated into the *municipal facility* program;

b) The high priority *municipal facility* requirements (Part VI.F.2.d.) as applied to the specific *municipal facility*; and

c) The low priority *municipal facility* requirements (Part VI.F.2.e.) as applied to the specific *municipal facility*.

ii. The training provisions for the *MS4 Operator*'s *municipal facility* procedures (Part VI.F.2.a.i.).

a) If new staff are added, training on the *MS4 Operator*'s *municipal facility* procedures (Part VI.F.2.a.i.) must be given prior to conducting *municipal facility* procedures;

b) For existing staff, training on the *MS4 Operator*'s *municipal facility* procedures (Part VI.F.2.a.i.) must be given prior to conducting

[33] *Municipal facilities* that have coverage under a separate *SPDES* permit (either individual or MSGP) must comply with the terms and conditions of that permit and the requirements set forth in this Part are not applicable.

municipal facility procedures and once every five (5) years, thereafter; and

c) If the *municipal facility* procedures (Part VI.F.2.a.i.) are updated (Part VI.F.2.a.iv.), training on the updates must be given to all staff prior to conducting *municipal facility* procedures.

iii. The names, titles, and contact information for the individuals who have received *municipal facility* training and update annually; and

iv. Annually, by April 1, the *MS4 Operator* must:

a) Review and update the *municipal facility* procedures (Part VI.F.2.a.i.); and

b) Document the completion of this requirement in the *SWMP Plan*.

b. *Municipal Facility* Inventory

i. Within two (2) years of the EDC, the *MS4 Operator* must *develop* and maintain an inventory of all *municipal* facilities in the *SWMP* Plan. The following information must be included in the inventory:

a) Name of *municipal facility*;

b) Street address;

c) Type of *municipal facility*;

d) Prioritization (high or low) (Part VI.F.2.c.);

e) Receiving waterbody name and class (mapped in accordance with Part IV.D.1.e.ii.a)) ;

f) Receiving waterbody WI/PWL Segment ID (mapped in accordance with Part IV.D.1.e.ii.b));

g) Contact information;

h) Responsible department;

i) Location of SWPPP (if high priority; when completed);

j) Type of activities present on site;

k) Size of facility (acres);

l) Date of last assessment;

m) *BMPs* identified; and

n) Projected date of next comprehensive site assessment (Part VI.F.2.d.ii.c) or Part VI.F.2.e.ii.c), depending on the *municipal facility* prioritization (Part VI.F.2.c.)).

ii. Annually, the *MS4 Operator* must update the inventory if new *municipal* facilities are added.

c. *Municipal Facility* Prioritization

i. Within three (3) years of the EDC, the *MS4 Operator* must prioritize all known *municipal* facilities as follows:

a) High priority *municipal facilities* include *municipal* facilities that have one or more of the following on site and exposed to *stormwater*:

i) Storage of chemicals, salt, petroleum, pesticides, fertilizers, anti-freeze, lead-acid batteries, tires, waste/debris;

ii) Fueling stations; and/or

iii) Vehicle or equipment maintenance/repair.

b) Low priority *municipal facilities* include any *municipal* facilities that do not meet the criteria for a high priority (Part VI.F.2.c.i.a)) *municipal facility*.

c) High priority *municipal facilities* (Part IV.F.2.c.i.a)) which qualify for a *No Exposure* Certification (Part VI.F.1.a.ii.) are low priority *municipal* facilities.

ii. Within thirty (30) days of when a *municipal facility* is added to the inventory, the *MS4 Operator* must prioritize those *municipal* facilities; and

iii. Annually, after the initial prioritization (Part VI.F.2.c.i.), the *MS4 Operator* must update the *municipal facility* prioritization in the inventory (Part VI.F.2.b.i.) based on information gathered as part of the *municipal facility* program (Part VI.F.2.a.), including cases where a *No Exposure* Certification (Part VI.F.1.a.ii.) ceases to apply. The completion of this permit requirement must be documented in the *SWMP Plan*.

d. High Priority *Municipal Facility* Requirements

i. Municipal Facility Specific SWPPP

Within five (5) years of the EDC, *MS4 Operators* must *develop* and implement a *municipal facility* specific SWPPP for each high priority *municipal facility* (Part VI.F.2.c.i.a)) and retain a copy of the *municipal facility* specific SWPPP on site of the respective *municipal facility*. The SWPPP must contain:

a) *Stormwater* Pollution Prevention Team

The *municipal facility* specific SWPPP must identify the individuals (by name and/or title) and their role/responsibilities in *developing*, implementing, maintaining, and revising the *municipal facility* specific SWPPP. The activities and responsibilities of the team must address all aspects of the *municipal facility* specific SWPPP.

b) General Site Description

A written description of the nature of the activities occurring at the *municipal facility* with a potential to *discharge pollutants*, type of

pollutants expected, and location of key features as detailed in the site map (Part VI.F.2.d.i.e)).

c) Summary of potential *pollutant* sources

The *municipal facility* specific SWPPP must identify each area at the *municipal facility* where materials or activities are exposed to *stormwater* or from which authorized non-*stormwater discharges* (Part I.A.3.) originate, including any potential *pollutant* sources for which the *municipal facility* has reporting requirements under the Emergency Planning and Community Right-To-Know Act (EPCRA), Section 313.

i) Materials or activities include: machinery; raw materials; intermediate products; byproducts; final products or waste products; and, material handling activities which includes storage, loading and unloading, transportation or conveyance of any raw material, intermediate product, final product or waste product.

ii) For each separate area identified, the description must include:

(a) Activities - A list of the activities occurring in the area (e.g., material storage, equipment fueling and cleaning);

(b) *Pollutants* - A list of the associated *pollutant(s)* for each activity. The *pollutant(s)* list must include all materials that are exposed to *stormwater*; and

(c) Potential for presence in *stormwater* - For each area of the *municipal facility* that generates *stormwater discharges,* a prediction of the direction of flow, and the likelihood of the activity to contaminate the *stormwater discharge*. Factors to consider include the toxicity of chemicals, quantity of chemicals used, produced or *discharge*d, the likelihood of contact with *stormwater*; and history of leaks or spills of toxic or hazardous *pollutants*.

d) Spills and Releases

For areas that are exposed to precipitation or that otherwise drain to a *stormwater* conveyance to be covered under this *SPDES* general permit, the *municipal facility* specific SWPPP must include a list of spills or releases[34] of petroleum and hazardous substances or other *pollutants*, including unauthorized *non-stormwater discharges*, that may adversely affect water quality that occurred during the last three-year period. The list must be updated when spills or releases occur.

e) Site Map

[34] This may also include releases of petroleum or hazardous substances that are not in excess of reporting quantities but which may still cause or contribute to significant water quality impairment.

The *municipal facility* specific SWPPP must include a site map identifying the following, as applicable:

i) Property boundaries and size in acres;

ii) Location and extent of significant structures (including materials shelters), and impervious surfaces;

iii) Monitoring locations (mapped in accordance with Part IV.D.2.a.i.) with its approximate *sewershed*. Each monitoring location must be labeled with the monitoring location identification;

iv) Location of all post-construction *SMPs* (mapped in accordance with Part IV.D.2.a.iv.) and *MS4* infrastructure (mapped in accordance with Part IV.D.2.b.i.);

v) Locations of *discharges* authorized under other *SPDES* permits;

vi) Locations where potential spills or releases can contribute to *pollutants* in *stormwater discharges* and their accompanying drainage points;

vii) Locations of haul and access roads;

viii) Rail cars and tracks;

ix) Arrows showing direction of *stormwater* flow;

x) Location of all receiving waters in the immediate vicinity of the *municipal facility*, indicating if any of the waters are impaired and, if so, whether the waters have *TMDLs* established for them (mapped in accordance with Part IV.D.1.e.ii.);

xi) Locations where *stormwater* flows have significant potential to cause erosion;

xii) Location and source of run-on from adjacent property containing significant quantities of *pollutants* and/or volume of concern to the *municipal facility*; and

xiii) Locations of the following areas where such areas are exposed to precipitation or *stormwater*:

(a) Fueling stations;
(b) Vehicle and equipment maintenance and/or cleaning areas;
(c) Loading/unloading areas;
(d) Locations used for the treatment, storage or disposal of wastes;
(e) Liquid storage tanks;
(f) Processing and storage areas;
(g) Locations where significant materials, fuel or chemicals are stored and transferred;
(h) Locations where vehicles and/or machinery are stored when not in use
(i) Transfer areas for substances in bulk;

(j) Location and description of non-*stormwater discharges* (Part I.A.3.);
(k) Locations where spills[35] or leaks have occurred; and
(l) Locations of all existing structural *BMP*s.

f) *Stormwater Best Management Practices (BMPs)*

The *municipal facility* specific SWPPP must document the location and type of *BMPs* implemented at the *municipal facility* (Part VI.F.1.). The *municipal facility* specific SWPPP must describe how each *BMP* is being implemented for all the potential *pollutant* sources.

g) *Municipal facility* assessments
The *municipal facility* specific SWPPP must include a schedule for completing and recording results of routine and comprehensive site assessments (Part VI.F.2.d.ii.c)).

ii. *Municipal Facility Assessments*

a) Wet Weather Visual Monitoring

i) Once every five (5) years, the *MS4 Operator* must conduct wet weather visual monitoring of the monitoring locations (Part VI.C.1.b.) and other sites of *stormwater* leaving the site that are *discharging stormwater* from fueling areas, storage areas, vehicle and equipment maintenance/fueling areas, material handling areas and similar potential *pollutant* generating areas (Part VI.F.2.d.i.e)xiii)).

(a) All samples must be collected from *discharges* resulting from a *qualifying storm event*. The storm event must be documented using the Storm Event Data Form (Appendix D) and kept with the *municipal facility* specific SWPPP. The sample must be taken during the first thirty (30) minutes (or as soon as practical, but not to exceed one hour) of the *discharge* at the monitoring location.

(b) No analytical tests are required to be performed on the samples for the purpose of meeting the visual monitoring requirements.

(c) The visual examination must document observations of color, odor, clarity, floating solids, settled solids, suspended solids, foam, oil sheen, and any other obvious indicators of *stormwater* pollution.

(d) The visual examination of the sample must be conducted in a well-lit area.

[35] A spill includes: any spill of a hazardous substance that must be reported in accordance with 6 NYCRR 597.4 and any spill of petroleum that must be reported in accordance with 6 NYCRR 613.6 or 17 NYCRR 32.3.

(e) Where practicable, the same individual should carry out the collection and examination of *discharges* for the entire permit term for consistency.

(f) The *MS4 Operator* must document the visual examination using the Visual Monitoring Form (Appendix D) and keep it with the *municipal facility* specific SWPPP to record:

(i) Monitoring location ID;

(ii) Examination date and time;

(iii) Personnel conducting the examination;

(iv) Nature of the *discharge* (runoff or snowmelt);

(v) Visual quality of the *stormwater discharge* including observations of color, odor, clarity, floating solids, settled solids, suspended solids, foam, oil sheen, and other obvious indicators of *stormwater* pollution; and

(vi) Probable sources of any observed *stormwater* contamination.

(vii) Corrective and follow up actions – If the visual examination indicates the presence of color, odor, floating solids, settled solids, suspended solids, foam, oil sheen, or other indicators of *stormwater* pollution, the *MS4 Operator* must, at minimum, complete and document the following actions:

(1) Evaluate the facility for potential sources;

(2) Remedy the problems identified;

(3) Revise the *municipal facility* specific SWPPP; and

(4) Perform an additional visual inspection during the first *qualifying storm event* following implementation of the corrective action. If the first *qualifying storm event* does not occur until the next visual monitoring period, this follow up action may be used as the next visual inspection.

b) The monitoring locations inspection and sampling program must be implemented at the *municipal facility* (Part VI.C.1.e.).

c) Comprehensive Site Assessments

i) Once every five (5) years following the most recent assessment, the *MS4 Operator* must complete a comprehensive site assessment for each high priority *municipal facility* as identified in the inventory (Part VI.F.2.b.) using the Municipal Facility Assessment Form (Appendix D) or an equivalent form containing

the same information, and document in the *municipal facility* specific SWPPP and *SWMP Plan* that:

(a) The *municipal facility* is in compliance with the terms and conditions of this *SPDES* general permit;

(b) Deficiencies were identified and all reasonable steps will be taken to minimize any *discharge* in violation of the permit, which has a reasonable likelihood of adversely affecting human health or the environment;

(i) Within twenty-four (24) hours, the *MS4 Operator* must prepare a schedule that includes corrective actions and specific interim milestones to be implemented until the corrective action is implemented; or

(c) Deficiencies were identified and all reasonable steps will be taken to minimize any *discharge* in violation of the permit, which does not have a reasonable likelihood of adversely affecting human health or the environment;

(i) Within seven (7) days, the *MS4 Operator* must prepare a schedule that includes corrective actions and specific interim milestones to be implemented until the corrective action is implemented.

e. Low Priority *Municipal Facility* Requirements

i. The *MS4 Operator* must identify procedures outlining *BMPs* for the types of activities that occur at the low priority *municipal* facilities as described in Part VI.F.1. A *municipal facility* specific SWPPP is not required.

ii. *Municipal Facility* Assessments

a) Low priority *municipal* facilities are not required to conduct wet weather visual monitoring.

b) The monitoring locations inspection and sampling program must be implemented at the *municipal facility* (Part VI.C.1.e.).

c) Comprehensive Site Assessments

i) Once every five (5) years following the most recent assessment, the *MS4 Operator* must complete a comprehensive site assessment for each low priority *municipal facility* as identified in the inventory (Part VI.F.2.b.) using the Municipal Facility Assessment Form (Appendix D) or an equivalent form containing the same information, and document in the *SWMP Plan* that:

(a) The *municipal facility* is in compliance with the terms and conditions of this *SPDES* general permit;

(b) Deficiencies were identified and all reasonable steps will be taken to minimize any *discharge* in violation of the permit, which

has a reasonable likelihood of adversely affecting human health or the environment;

(i) Within twenty-four (24) hours, the *MS4 Operator* must prepare a schedule that includes corrective actions and specific interim milestones to be implemented until the corrective action is implemented; or

(c) Deficiencies were identified and all reasonable steps will be to minimize any *discharge* in violation of the permit, which does not have a reasonable likelihood of adversely affecting human health or the environment;

(i) Within seven (7) days, the *MS4 Operator* must prepare a schedule that includes corrective actions and specific interim milestones to be implemented until the corrective action is implemented.

3. *Municipal Operations* & Maintenance

a. *Municipal Operations* Program

Municipal operations are: street and bridge maintenance; winter road maintenance; *MS4* maintenance; open space maintenance; solid waste management; new construction and land disturbances; right-of-way maintenance; marine operations; or hydrologic habitat modification.

Within three (3) years of the EDC, the *MS4 Operator* must *develop* and implement a *municipal operations* program. The *municipal operations* program must be documented in the *SWMP Plan* specifying:

i. The *municipal operations* procedures including:

a) The *BMPs* (Part VI.F.1.) incorporated into the *municipal operations* program;

b) The *municipal operations* corrective actions requirements (Part VI.F.3.b.);

c) *Catch basin* inspection and maintenance requirements (Part VI.F.3.c.);

d) Roads, bridges, parking lots, and right of way maintenance requirements (Part VI.F.3.d.); and

e) All other *municipal operations* maintenance requirements.

ii. The training provisions for the *MS4 Operator*'s *municipal operations* procedures (Part VI.F.3.a.i.).

a) If new staff are added, training on the *MS4 Operator*'s *municipal operations* procedures (Part VI.F.3.a.i.) must be given prior to conducting *municipal operations* procedures;

b) For existing staff, training on the *MS4 Operator*'s *municipal operations* procedures (Part VI.F.3.a.i.) must be given prior to conducting *municipal operations* procedures and once every five (5) years, thereafter; and

c) If the *municipal operations* procedures (Part VI.F.3.a.i.) are updated (Part VI.F.3.a.iv.), training on the updates must be given to all staff prior to conducting *municipal operations* procedures.

iii. The names, titles, and contact information for the individuals who have received *municipal operations* training and update annually; and

iv. Annually, by April 1, the *MS4 Operator* must:

a) Review and update the *municipal operations* procedures (Part VI.F.3.a.i.); and

c) Document the completion of this requirement in the *SWMP Plan*.

b. *Municipal Operations* Corrective Actions

i. For *municipal operations*, *MS4 Operators* must either:

a) Ensure compliance with the terms and conditions of this *SPDES* general permit; or

b) Implement corrective actions according to the following schedule and, after implementation, ensure the operations are in compliance with the terms and conditions of this *SPDES* general permit:

i) Within twenty-four (24) hours of discovery for situations that have a reasonable likelihood of adversely affecting human health or the environment;

ii) Initiated within seven (7) days of inspection and completed within thirty (30) days of inspection for situations that do not have a reasonable likelihood of adversely affecting human health or the environment; and

iii) For corrective actions that require special funding or construction that will take longer than thirty (30) days to complete, a schedule must be prepared that specifies interim milestones that will ensure compliance in the shortest reasonable time.

c. *Catch Basin* Inspection and Maintenance

Within three (3) years of the EDC, the MS4 Operator must:

i. Identify when *catch basin* inspection is needed with consideration for:

a) Areas with *construction activities* (mapped in accordance with Part IV.D.2.a.iii.);

b) Residential, commercial, and industrial areas (mapped in accordance with Part IV.D.1.d.iii.);

c) Recurring or history of issues; or

d) Confirmed citizen complaints on three or more separate occasions in the last twelve (12) months.

ii. Inventory *catch basin* inspection information including:

a) Date of inspection;

b) Approximate level of trash, sediment, and/or debris captured at time of clean-out (no trash, sediment, and/or debris, <50% of the depth of the *sump*, >50% of the depth of the *sump*);

c) Depth of structure;

d) Depth of *sump*; and

e) Date of clean out, if applicable (Part VI.F.3.c.iii.).

iii. Based on inspection results, clean out *catch basins* within the following timeframes:

a) Within six (6) months after the *catch basin* inspection, *catch basins* which had trash, sediment, and/or debris exceeding 50% of the depth of the *sump* as a result of a *catch basin* inspection must be cleaned out;

b) Within one (1) year after the *catch basin* inspection, *catch basins* which had trash, sediment, and/or debris at less than 50% of the depth of the *sump* as a result of a *catch basin* inspection must be cleaned out; and

c) MS4 Operators are not required to clean out *catch basins* if the *catch basins* are operating properly and:

i. There is no trash, sediment, and/or debris in the *catch basin*; or

ii. The *sump* depth of the *catch basin* is less than or equal to two (2) feet.

iv. Properly manage (handling and disposal) materials removed from *catch basins* during clean out so that:

a) Water removed during the *catch basin* cleaning process will not reenter the *MS4* or *surface waters of the State*;

b) Material removed from *catch basins* is disposed of in accordance with any applicable environmental laws and regulations; and

c) Material removed during the *catch basin* cleaning process will not reenter the *MS4* or *surface waters of the State*.

v. Determine if there are signs/evidence of *illicit discharges* and procedures for referral/follow-up if *illicit discharges* are encountered.

d. Roads, Bridges, Parking Lots, & Right of Way Maintenance

i. Sweeping

Within six (6) months of the EDC, the *MS4 Operator* must *develop* and implement procedures for sweeping and/or cleaning *municipal* streets, bridges, parking lots, and right of ways owned/operated by the *MS4 Operator*. The procedures and completion of permit requirements must be documented in the *SWMP Plan* specifying:

a) All roads, bridges, parking lots, and right of ways must be swept and/or cleaned once every five (5) years in the spring (following winter activities such as sanding). This requirement is not applicable to:

   i) Uncurbed roads with no *catch basins*;

   ii) High-speed limited access highways; or

   iii) Roads defined as interstates, freeways and expressways, or arterials by the United States Department of Transportation, Federal Highway Administration, Highway Functional Classification Concepts, Criteria and Procedures, 2013.

b) Annually, from April 1 through October 31, roads in business and commercial areas must be swept. This requirement is not applicable to:

   i) Uncurbed roads with no *catch basins*;

   ii) High-speed limited access highways; or

   iii) Roads defined as interstates, freeways and expressways, or arterials by the USDOT 2013.

ii. Maintenance

Within five (5) years of the EDC, in addition to the *BMPs* (Part VI.F.1.), the *MS4 Operator* must implement the following provisions:

a) Pave, mark, and seal in dry conditions;

b) Stage road operations and maintenance activity (e.g., patching, potholes) to reduce the potential discharge of pollutants to the *MS4* or *surface waters of the State*;

c) Restrict the use of herbicides/pesticide application to roadside vegetation; and

d) Contain *pollutants* associated with bridge maintenance activities (e.g., paint chips, dust, cleaning products, other debris).

iii. Winter Road Maintenance

Within five (5) years of the EDC, in addition to the *BMPs* (Part VI.F.1.), the *MS4 Operator* must implement the following provisions:

a) Routinely calibrate equipment to control salt/sand application rates; and

b) Ensure that routine snow disposal activities comply with the Division of Water Technical and Operation Guidance Series 5.1.11, Snow Disposal.[36]

[36] The Division of Water Technical and Operation Guidance Series 5.1.11, Snow Disposal can be found on the Department's website.

Part VII. Minimum Control Measures (MCMs) for *Traditional Non-Land Use Control & Non-Traditional MS4 Operators*

In addition to the requirements contained in Part I. through Part V*, traditional non-land use* and *non-traditional MS4 Operators* must comply with the MCMs contained in this Part. These *MS4 Operators* should consider their public to be:

- Employees (i.e., staff, faculty);
- User population/visitors;
- Students;
- Tenants; and
- Contractors & developers working for *MS4 Operator*.

A. MCM1 – Public Education and Outreach Program

The *MS4 Operator* must *develop* and implement an education and outreach program to increase public awareness of *pollutant* generating activities and behaviors. This MCM is designed to inform the public about the impacts of *stormwater* on water quality, the general sources of *stormwater pollutants*, and the steps the general public can take to reduce *pollutants* in *stormwater* runoff.

1. Development

a. Focus Areas

Within three (3) years of the EDC, the *MS4 Operator* must identify and document the focus areas in the *SWMP Plan*. The focus areas to be considered are as follows:

i. Areas *discharging* to waters with Class AA-S, A-S, AA, A, B, SA, or SB (mapped in accordance with Part IV.D.1.e.ii.a));

ii. *Sewersheds* for impaired waters listed in Appendix C (subject to Part VIII. requirements; mapped in accordance with Part IV.D.1.c. for *MS4 Operators* continuing coverage and Part IV.D.2.a.ii. for newly designated *MS4 Operators*);

iii. *TMDL* watersheds (subject to Part IX. requirements; mapped in accordance with Part IV.D.1.e.ii.c));

iv. Areas with *construction activities*;

v. Areas with on-site wastewater systems (subject to Part VIII. or Part IX. requirements);

vi. Residential, commercial, and industrial areas (mapped in accordance with Part IV.D.1.e.iii.);

vii. *Stormwater hotspots*; and

viii. Areas with *illicit discharges*.

b. Target Audiences and Associated *Pollutant* Generating Activities

Within three (3) years of the EDC, the *MS4 Operator* must identify and document the applicable target audience(s) and associated *pollutant* generating activities that the outreach and education will address for each focus area identified by the *MS4 Operator* in Part VII.A.1.a. in the *SWMP Plan*. The target audiences are as follows:

i. Residents;

ii. Commercial:[37] Business owners and staff;

iii. Institutions:[38] Managers, staff, and students;

iv. Construction: Developers, contractors, and design professionals;

v. Industrial:[39] Owners and staff; and

vi. *MS4 Operator*'s *municipal* staff.

c. Education and Outreach Topics

Within three (3) years of the EDC, the *MS4 Operator* must identify and document in the *SWMP Plan* the education and outreach topics and how the education and outreach topics will reduce the potential for *pollutants* to be generated by the target audience(s) (Part VII.A.1.b.) for the focus area(s) (Part VII.A.1.a.).

e. *Illicit Discharge* Education

Within six (6) months of the EDC, the *MS4 Operator* must make information related to the prevention of *illicit discharges*, available to *municipal* employees, businesses, and the public and document the completion of this requirement in the *SWMP Plan*. The information related to the prevention of illicit discharges must include the following:

i. What types of *discharges* are allowable (Part I.A.3.);

ii. What is an *illicit discharge* and why is it prohibited (Part VII.C.);

iii. The environmental hazards associated with *illicit discharges* and improper disposal of waste;

iv. Proper handling and disposal practices for the most common behaviors within the community (e.g., septic care, car washing, household hazardous waste, swimming pool draining, or other activities resulting in *illicit discharges* to the *MS4*); and

v. How to report *illicit discharges* they may observe (Part VII.C.1.a.).

[37] Business, retail stores, and restaurants.
[38] Hospitals, churches, colleges, and schools.
[39] Factories, recyclers, auto-salvage, and mines.

2. Implementation and Frequency

a. Distribution Method of Educational Messages

Once every five (5) years, the *MS4 Operator* must identify and document in the *SWMP Plan* which of the following method(s) are used for the distribution of educational messages:

i. Printed materials (e.g., mail inserts, brochures, and newsletters);

ii. Electronic materials (e.g., websites, email listservs);

iii. Mass media (e.g., newspapers, public service announcements on radio or cable);

iv. Workshops or focus groups;

v. Displays in public areas (e.g., town halls, library, parks); or

vi. Social Media (e.g., Facebook, Twitter, blogs).

b. Frequency

Following the completion of Part VII.A.1.a, Part VII.A.1.b, and Part VII.A.1.c, within five (5) years of the EDC, and once every five (5) years, thereafter, the *MS4 Operator* must:

i. Deliver an educational message to each target audience(s) (Part VII.A.1.b.) for each focus area(s) (Part VII.A.1.a.) based on the defined education and outreach topic(s) (Part VII.A.1.c.); and

ii. Document the completion of this requirement in the *SWMP Plan*.

c. Updates to the Public Education and Outreach Program

Following the completion of Part VII.A.1.a, Part VII.A.1.b, and Part VII.A.1.c, annually, by April 1, the *MS4 Operator* must:

i. Review and update the focus areas, target audiences, and/or education and outreach topics; and

ii. Document the completion of this requirement in the *SWMP Plan*.

B. MCM 2 - Public Involvement/Participation

The *MS4 Operator* must provide opportunities to involve the public in the development, review, and implementation of the *SWMP*. This MCM is designed to give the public the opportunity to include their opinions in the implementation of this *SPDES* general permit.

1. Public Involvement/Participation

a. Annually, the *MS4 Operator* must provide an opportunity for public involvement/participation in the development and implementation of the *SWMP*. The *MS4 Operator* must document the public involvement/participation opportunities in the *SWMP* Plan. The opportunities for public involvement/participation are as follows:

i. Citizen advisory group on *stormwater* management;

ii. Public hearings or meetings;

iii. Citizen volunteers to educate other individuals about the *SWMP*;

iv. Coordination with other pre-existing public involvement/participation opportunities;

v. Reporting concerns about activities or behaviors observed; or

vi. Stewardship activities.

b. Annually, the *MS4 Operator* must inform the public of the opportunity (Part VII.B.1.a.) for their involvement/participation in the development and implementation of the *SWMP* and how they can become involved. The *MS4 Operator* must document the method for distribution of this information in the *SWMP Plan*. The methods for distribution are as follows:

i. Public notice;

ii. Printed materials (e.g., mail inserts, brochures and newsletters);

iii. Electronic materials (e.g., websites, email listservs);

iv. Mass media (e.g., newspapers, public service announcements on radio or cable);

v. Workshops or focus groups;

vi. Displays in public areas (e.g., town halls, library, parks); or

vii. Social Media (e.g., Facebook, Twitter, blogs).

c. Within six (6) months of the EDC, the *MS4 Operator* must identify a local point of contact to receive and respond to public concerns regarding *stormwater* management and compliance with permit requirements. The name or title of this individual, with contact information, must be published on public outreach and public participation materials and documented in the *SWMP Plan*.

2. Public Notice and Input Requirements

a. Public Notice and Input Requirements for *SWMP Plan*

Annually, the *MS4 Operator* must provide an opportunity for the public to review and comment on the publicly available *SWMP Plan* (Part IV.B.2.b.). The public must have the ability to ask questions and submit comments on the *SWMP Plan*. The completion of this permit requirement must be documented in the *SWMP Plan*. This requirement may be satisfied by Part VII.B.1.

b. Public Notice and Input Requirements for Draft Annual Report

i. Annually, the *MS4 Operator* must provide an opportunity for the public to review and comment on the draft Annual Report. The completion of this permit requirement must be documented in the *SWMP Plan*. This requirement may be satisfied by either:

a) Presentation of the draft Annual Report at a regular meeting of an existing board (e.g., administrative, planning, zoning) or a separate meeting specifically for *stormwater*, as designated by the *MS4* or if requested by the public. The public must have the ability to ask questions about and make comments on the draft annual report during that presentation; or

b) Posting of the draft Annual Report on a public website. The website must provide information on the timeframes and procedures to submit comments and/or request a meeting. However, if a public meeting is requested by two or more persons, the *MS4 Operator* must hold such a meeting.

c. Consideration of Public Input

i. Annually, the *MS4 Operator* must include a summary of comments received on the *SWMP Plan* and draft Annual Report in the *SWMP Plan*.

ii. Within thirty (30) days of when public input is received, the *MS4 Operator* must update the *SWMP Plan*, where appropriate, based on the public input received.

C. MCM 3 - *Illicit Discharge* Detection and Elimination

The *MS4 Operator* must *develop*, implement, and enforce a program which systematically detects, tracks down, and eliminates *illicit discharges* to the *MS4*. This MCM is designed to manage the *MS4* so it is not conveying *pollutants* associated with flows other than those directly attributable to *stormwater* runoff.

1. *Illicit Discharge* Detection

a. Public Reporting of *Illicit Discharges*

i. Within six (6) months of the EDC, the *MS4 Operator* must establish and document in the *SWMP Plan* an email or phone number (with message recording capability) for the public to report *illicit discharges*.

ii. Within thirty (30) days of an *illicit discharge*, the *MS4 Operator* must document each report of an *illicit discharge* in the *SWMP Plan* with the following information:

a) Date of the report;

b) Location of the *illicit discharge;*

c) Nature of the *illicit discharge;*

d) Follow up actions taken or needed (including response times); and

e) Inspection outcomes and any enforcement taken.

b. Monitoring Locations

The monitoring locations used to detect *illicit discharges* are identified as follows:

i. *MS4 outfalls;*[40]
ii. *Interconnections*;[41] and
iii. *Municipal facility intraconnections*.[42]

c. Monitoring Locations Inventory

i. Within three (3) years of the EDC, the *MS4 Operator* must *develop* and maintain an inventory of the monitoring locations in the *SWMP Plan*. The following information must be included in the inventory:[43]

a) Inventory information for *MS4 outfall*s

i) ID;
ii) Prioritization (high or low) (Part VII.C.1.d.);
iii) Type of monitoring location (Part VII.C.1.b.);
iv) Name of *MS4 Operator's municipal facility*, if located at a *municipal facility*;[44]
v) Receiving waterbody name and class (mapped in accordance with Part IV.D.1.e.ii.a));
vi) Receiving waterbody WI/PWL Segment ID (mapped in accordance with Part IV.D.1.e.ii.b));
vii) Land use in drainage area;
viii) Type of conveyance (open drainage or closed pipe);
ix) Material;
x) Shape;
xi) Dimensions;
xii) Submerged in water; and
xiii) Submerged in sediment.

b) Inventory information for *interconnections*

i) ID;
ii) Prioritization (high or low) (Part VII.C.1.d.);
iii) Type of monitoring location (Part VII.C.1.b.);
iv) Name of *MS4 Operator* receiving *discharge* or private storm system;

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[40] *MS4 outfall*s can be found at a *municipal facility*.
[41] *Interconnections* can be found a *municipal facility*.
[42] *Municipal facility intraconnections* can be found only at a *municipal facility*.
[43] The information included in the inventory is collected during inspections on the Monitoring Locations Inspection and Sampling Field Sheet (Appendix D) unless otherwise specified by the permit conditions.
[44] This information is collected as part of the *municipal facility* inventory.

v) Name of *MS4 Operator*'s *municipal facility*, if located at a *municipal facility*; and
vi) Receiving waterbody name and class (mapped in accordance with Part IV.D.1.e.ii.a)).

c) Inventory information for *municipal facility intraconnections*

i) ID;
ii) Prioritization (high or low) (Part VII.C.1.d.);
iii) Type of monitoring location (Part VII.C.1.b.);
iv) Name of *MS4 Operator*'s *municipal facility*; and
v) Receiving waterbody name and class (mapped in accordance with Part IV.D.1.e.ii.a)).

ii. Annually, the *MS4 Operator* must update the inventory if monitoring locations are created or discovered.

d. Monitoring Locations Prioritization

i. Within three (3) years of the EDC, the *MS4 Operator* must prioritize monitoring locations which are included in the monitoring locations inventory (Part VII.C.1.c.) as follows:

a) High priority monitoring locations include monitoring locations:

vi) At a high priority *municipal facility*, as defined in Part VII.F.2.c;

vii) *Discharging* to impaired waters (subject to Part VIII. requirements; mapped in accordance with Part IV.D.1.e.ii.b));

viii) *Discharging* within a TMDL watershed (subject to Part IX. requirements; mapped in accordance with Part IV.D.1.e.ii.c));

ix) *Discharging* to waters with Class AA-S, A-S, AA, A, B, SA, or SB (mapped in accordance with Part IV.D.1.e.ii.a)); and/or

x) Confirmed citizen complaints on three or more separate occasions in the last twelve (12) months.

b) All other monitoring locations are considered low priority.

ii. Within thirty (30) days of when a monitoring location is constructed or the *MS4 Operator* discovers it, the *MS4 Operator* must prioritize those monitoring locations; and

iii. Annually, after the initial prioritization (Part VII.C.1.d.i.), the *MS4 Operator* must update the monitoring location prioritization in the inventory (Part VII.C.1.c.) based on information gathered as part of the monitoring location inspection and sampling program (Part VII.C.1.e.). The completion of this permit requirement must be documented in the *SWMP Plan*.

e. Monitoring Locations Inspection and Sampling Program

Within two (2) years of the EDC, the *MS4 Operator* must *develop* and implement a monitoring locations inspection and sampling program. The monitoring locations inspection and sampling program must be documented in the *SWMP Plan* specifying:

i. The monitoring locations inspection and sampling procedures including:

a) During *dry weather,*[45] one (1) inspection of each monitoring location identified in the inventory (Part VII.C.1.c.) every five (5) years following the most recent inspection;

b) Documentation of all monitoring location inspections, including any sampling results, using the Monitoring Locations Inspection and Sampling Field Sheet (Appendix D) or an equivalent form containing the same information and include the completed monitoring location inspections and sampling results in the *SWMP Plan* (e.g., the completed Monitoring Locations Inspection and Sampling Field Sheets);

c) Provisions to sample all monitoring locations which had inspections which resulted in a *suspect* or *obvious illicit discharge* characterization. The sampling requirement is based on the number and severity of *physical indicators present in the flow* to better inform track down procedures (Part VII.C.2.). If the source of the *illicit discharge* is clear and discernable (e.g., sewage), sampling is not necessary;

d) Sampling may be done with field test kits or field instrumentation that are sufficiently sensitive to detect the parameter below the sampling action level used[46] and are not subject to 40 CFR Part 136 requirements for approved methods and certified laboratories;

e) Provisions to initiate, or cause to initiate,[47] track down procedures (Part VII.C.2.a.), in accordance with the timeframes specified in Part VII.C.2.a.iii, for monitoring locations with an overall characterization[48] as *suspect illicit discharge* or *obvious illicit discharge* or that exceed any sampling action level used;

f) Provisions to re-inspect the monitoring location within thirty (30) days of initial inspection if there is a *physical indicator not related to flow*, potentially indicative of *intermittent* or *transitory discharges,* utilizing techniques described in Chapter 12.6 of the Center for Watershed

[45] MS4 Operators can reference the Center for Watershed Protection Illicit Discharge Detection and Elimination: A Guidance Manual for Program Development and Technical Assistance, October 2004 (CWP 2004) for other factors to consider when determining when to conduct monitoring location inspection and sampling.
[46] Refer to Chapter 12 of the CWP 2004 for parameters, sampling action levels, and procedures.
[47] If track down is conducted by individuals or entities other than those conducting the monitoring locations inspections.
[48] Reference to the Monitoring Locations Inspection and Sampling Field Sheet, adapted from CWP 2004, Section 6: Overall Monitoring Location Characterization based on the Relative Severity Index of physical indicators for flowing monitoring locations only.

Protection Illicit Discharge Detection and Elimination: A Guidance Manual for Program Development and Technical Assistance, October 2004 (CWP 2004) or equivalent.

i) If those same physical indicators persist, the *MS4 Operator* must initiate *illicit discharge* track down procedures (Part VII.C.2.a.).

ii. The training provisions for the *MS4 Operator*'s monitoring locations inspection and sampling procedures (Part VII.C.1.e.i.).

a) If new staff are added, training on the *MS4 Operator*'s monitoring locations inspection and sampling procedures (Part VII.C.1.e.i.) must be given prior to conducting monitoring locations inspections and sampling procedures;

b) For existing staff, training on the *MS4 Operator*'s monitoring locations inspection and sampling procedures (Part VII.C.1.e.i.) must be given prior to conducting monitoring locations inspections and sampling and once every five (5) years, thereafter; and

c) If the monitoring locations inspection and sampling procedures (Part VII.C.1.e.i.) are updated (Part VII.C.1.e.iv.), training on the updates must be given to all staff prior to conducting monitoring locations inspections and sampling.

iii. The names, titles, and contact information for the individuals who have received monitoring locations inspection and sampling procedures training and update annually; and

iv. Annually, by April 1, the *MS4 Operator* must:

a) Review and update the monitoring location inspection and sampling procedures (Part VII.C.1.e.i.) based on monitoring location inspection results (e.g., trends, patterns, areas with *illicit discharges*, and common problems); and

b) Document the completion of this requirement in the *SWMP Plan*.

2. *Illicit Discharge* Track Down Program

Within two (2) years of the EDC, the *MS4 Operator* must *develop* and implement an *illicit discharge* track down program to identify the source of *illicit discharges* and the responsible party. The *illicit discharge* track down program must be documented in the *SWMP Plan* specifying:

a. The *illicit discharge* track down procedures including:

i. Procedures as described in Chapter 13 of CWP 2004 or equivalent;

ii. Steps taken for *illicit discharge* track down procedures;

iii. The following timeframes to initiate *illicit discharge* track down:

a) Within twenty-four (24) hours of discovery, the *MS4 Operator* must initiate track down procedures for flowing *MS4* monitoring locations with *obvious illicit discharges;*[49]

b) Within two (2) hours of discovery, the *MS4 Operator* must initiate track down procedures for *obvious illicit discharges* of sanitary wastewater that would affect bathing areas during bathing season, shell fishing areas or public water intakes and report orally or electronically to the Regional Water Engineer and local health department; and

c) Within five (5) days of discovery, the *MS4 Operator* must initiate track down procedures for *suspect illicit discharges*.

b. The training provisions for the *MS4 Operator*'s *illicit discharge* track down procedures (Part VII.C.2.a.).

i. If new staff are added, training on the *MS4 Operator*'s *illicit discharge* track down procedures (Part VII.C.2.a.) must be given prior to conducting *illicit discharge* track downs;

ii. For existing staff, training on the *MS4 Operator*'s *illicit discharge* track down procedures (Part VII.C.2.a.) must be given prior to *conducting illicit discharge* track downs and once every five (5) years, thereafter; and

iii. If the *illicit discharge* track down procedures (Part VII.C.2.a.) are updated (Part VII.C.2.d.), training on the updates must be given to all staff prior to conducting *illicit discharge* track downs.

c. The names, titles, and contact information for the individuals who have received *illicit discharge* track down procedures training and update annually; and

d. Annually, by April 1, the *MS4 Operator* must:

i. Review and update the *illicit discharge* track down procedures (Part VII.C.2.a.); and

ii. Document the completion of this requirement in the *SWMP Plan*.

3. *Illicit Discharge* Elimination Program

Within two (2) years of the EDC, the *MS4 Operator* must *develop* and implement an *illicit discharge* elimination program. The *illicit discharge* elimination program must be documented in the *SWMP Plan* specifying:

a. The *illicit discharge* elimination procedures including:

i. Provisions for escalating enforcement and tracking, both consistent with the ERP required in Part IV.F. of this *SPDES* general permit;

ii. Provisions to confirm the corrective actions have been taken;

[49] Reference to the Monitoring Locations Inspection and Sampling Field Sheet, adapted from CWP 2004, Section 6: Overall Monitoring Location Characterization based on the Relative Severity Index of physical indicators for flowing monitoring locations only.

iii. Steps taken for *illicit discharge* elimination procedures; and

iv. The following timeframes for *illicit discharge* elimination:

a) Within twenty-four (24) hours of identification of an *illicit discharge* that has a reasonable likelihood of adversely affecting human health or the environment, the *MS4 Operator* must eliminate the *illicit discharge*;

b) Within five (5) days of identification of an *illicit discharge* that does not have a reasonable likelihood of adversely affecting human health or the environment, the *MS4 Operator* must eliminate the *illicit discharge;* and

c) Where elimination of an *illicit discharge* within the specified timeframes (Part VII.C.3.a.iv.) is not possible, the *MS4 Operator* must notify the Regional Water Engineer.

b. The training provisions for the *MS4 Operator*'s *illicit discharge* elimination procedures (Part VII.C.3.a.).

i. If new staff are added, training on the *MS4 Operator*'s *illicit discharge* elimination procedures (Part VII.C.3.a.) must be given prior to conducting *illicit discharge* eliminations;

ii. For existing staff, training on the *MS4 Operator*'s *illicit discharge* elimination procedures (Part VII.C.3.a.) must be given prior to conducting *illicit discharge* eliminations and once every five (5) years, thereafter; and

iii. If the *illicit discharge* elimination procedures (Part VII.C.3.a.) are updated (Part VII.C.3.d.), training on the updates must be given to all staff prior to conducting *illicit discharge* eliminations.

c. The names, titles, and contact information for the individuals who have received *illicit discharge* elimination procedures training and update annually; and

d. Annually, by April 1, the *MS4 Operator* must:

i. Review and update the *illicit discharge* elimination procedures (Part VII.C.3.a.); and

ii. Document the completion of this requirement in the *SWMP Plan*.

D. MCM 4 - Construction Site *Stormwater* Runoff Control

The *MS4 Operator* must *develop*, implement, and enforce a program to ensure construction sites are effectively controlled. This MCM is designed to prevent *pollutants* from construction related activities,[50] as well as promote the proper planning and installation of post-construction *SMPs*.

[50] Projects that comply with the terms and conditions of the CGP or an individual *SPDES* permit for *stormwater* for which they obtained coverage and local erosion and sediment control requirements are effectively controlled.

1. Applicable Construction Activities/Projects/Sites

a. The construction site *stormwater* runoff control program must address *stormwater* runoff to the *MS4* from sites with *construction activities* permitted, approved, funded, or owned/operated by the *MS4 Operator* that:

i. Result in a total land disturbance of greater than or equal to one acre; or,

ii. Disturb less than one acre if part of a larger common plan of development or sale.

b. For *construction activities* where the *MS4 Operator* is listed as the owner/operator on the Notice of Intent for coverage under the CGP:

i. The *MS4 Operator* must ensure compliance with the CGP; and

ii. The additional requirements for construction oversight described in Part VII.D.6 through Part VII.D.9 are not required.

2. Public Reporting of Construction Site Complaints

a. Within six (6) months of the EDC, the *MS4 Operator* must establish and document in the *SWMP Plan* an email or phone number (with message recording capability) for the public to report complaints related to construction *stormwater* activity.

b. The *MS4 Operator* must document reports of construction site complaints in the *SWMP Plan* with the following information:

i. Date of the report;

ii. Location of the construction site;

iii. Nature of complaint;

iv. Follow up actions taken or needed; and

v. Inspection outcomes and any enforcement taken.

3. Construction Oversight Program

Within one (1) year of the EDC, the *MS4 Operator* must *develop* and implement a construction oversight program. The construction oversight program must be documented in the *SWMP Plan* specifying:

a. The construction oversight procedures including:

i. When the construction site *stormwater* control program applies (Part VII.D.1.);

ii. What types of *construction activity* require a SWPPP;

iii. The procedures for submission of SWPPPs;

iv. SWPPP review requirements (Part VII.D.6.)

v. Pre-construction oversight requirements (Part VII.D.7.)

vi. Construction site inspection requirements (Part VII.D.8.);

vii. Construction site close-out requirements (Part VII.D.9.);

viii. Enforcement process/expectations for compliance; and

ix. Other procedures associated with the control of *stormwater* runoff from applicable *construction activities*.

b. The training provisions for the *MS4 Operator*'s construction oversight procedures (Part VII.D.3.a.).

i. If new staff are added, training on the *MS4 Operator*'s construction oversight procedures (Part VII.D.3.a.) must be given prior to conducting any construction oversight activities;

ii. For existing staff, training on the *MS4 Operator*'s construction oversight procedures (Part VII.D.3.a.) must be given prior to conducting any construction oversight activities and once every five (5) years, thereafter; and

iii. If the construction oversight procedures (Part VII.D.3.a.) are updated (Part VII.D.3.a.), training on the updates must be given to all staff prior to conducting construction oversight.

c. The names, titles, and contact information for the individuals who have received construction oversight training and update annually;

d. Procedures to ensure those involved in the *construction activity* itself (e.g., contractor, subcontractor, *qualified inspector*, SWPPP reviewers) have received four (4) hours of *Department* endorsed training in proper erosion and sediment control principles from a Soil & Water Conservation District, or other *Department* endorsed entity; and

e. Annually, by April 1, the *MS4 Operator* must:

i. Review and update the construction oversight procedures (Part VII.D.3.a.); and

ii. Document the completion of this requirement in the *SWMP Plan*.

4. Construction Site Inventory & Inspection Tracking

a. Within six (6) months of the EDC, the *MS4 Operator* must *develop* and maintain an inventory of all applicable construction sites (Part VII.D.1.a.) in the *SWMP Plan*. The following information must be included in the inventory:

i. Location of the construction site;

ii. Owner/operator contact information, if other than the *MS4 Operator*;

iii. Receiving waterbody name and class (mapped in accordance with Part IV.D.1.e.ii.a));

iv. Receiving waterbody WI/PWL Segment ID (mapped in accordance with Part IV.D.1.e.ii.b));

v. Prioritization (high or low) (Part VII.D.5.);

vi. Construction project *SPDES* identification number;

vii. SWPPP approval date;

viii. Inspection history, including dates and ratings (satisfactory, marginal, or unsatisfactory, when available); and

ix. Current status of the construction site/project (i.e., active, temporarily shut down, complete[51]).

b. Annually, the *MS4 Operator* must update the inventory if construction projects are approved or completed.

5. Construction Site Prioritization

a. Within one (1) year of the EDC, the *MS4 Operator* must prioritize all construction sites which are included in the construction site inventory (Part VII.D.4.) as follows:

i. High priority construction sites include construction sites:

a) With a direct conveyance (e.g., channel, ditch, storm sewer) to a *surface water of the State* that is:

i) Listed in Appendix C with silt/sediment, phosphorus, or nitrogen as the POC;

ii) Classified as AA-S, AA, or A (mapped in accordance with Part IV.D.1.e.ii.a)); or

iii) Classified with a trout (T) or trout spawning (TS) designation (mapped in accordance with Part IV.D.1.e.ii.a));

b) With greater than five (5) acres of disturbed earth at any one time;

c) With earth disturbance within one hundred (100) feet of any lake or pond (mapped in accordance with Part IV.D.1.e.ii.b)); and/or

d) Within fifty (50) feet of any rivers or streams (mapped in accordance with Part IV.D.1.e.ii.b));

ii. All other construction sites are considered low priority.

b. Within thirty (30) days of when a construction site becomes active, the *MS4 Operator* must prioritize those construction sites; and

c. Annually, after the initial prioritization (Part VII.D.5.a.), the *MS4 Operator* must update the construction site prioritization in the inventory (Part VII.D.4.a.) based on information gathered as part of the construction oversight program (Part VII.D.3.). The completion of this permit requirement must be documented in the *SWMP Plan*.

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[51] Construction projects listed on the inventory must be inspected and tracked as described in Part VII.D.8. until a final site inspection has been completed as specified in Part VII.D.9. and the construction site status changes to complete.

i. If the prioritization of the construction site changes priority based on information gathered as part of the construction oversight program, the *MS4 Operator* must comply with the requirements that apply to that prioritization.

6. SWPPP Review

The *MS4 Operator* must:

a. Ensure individual(s), responsible for reviewing SWPPPs for acceptance, receive:

i. Four (4) hours of *Department* endorsed training in proper erosion and sediment control principles from a Soil & Water Conservation District, or other *Department* endorsed entity. This training must be completed within three (3) years of the EDC and every three (3) years thereafter.

ii. Document the completion of this requirement in the *SWMP Plan*.

b. Ensure SWPPP reviewers receive this training (Part VII.D.6.a.) prior to conducting SWPPP reviews for acceptance.

i. Individuals without these trainings cannot review SWPPPs for acceptance.

ii. Individuals who meet the definition of a *qualified professional* or *qualified inspector* are exempt from this requirement.

c. Ensure individuals responsible for reviewing SWPPPs review all SWPPPs for applicable *construction activities* (Part VII.D.1.) and for conformance with the requirements of the CGP, including:

i. Erosion and sediment controls must be reviewed for conformance with the NYS E&SC 2016, or equivalent;

ii. Individuals responsible for review of post-construction *SMPs* must be *qualified professionals* or under the supervision of a *qualified professional*; and

iii. Post-construction *SMPs* must be reviewed for conformance with the NYS SWMDM 2015 or equivalent, including:

a) All post-construction *SMPs* must meet the *sizing criteria* contained in the CGP and NYS SWMDM 2015.

b) Deviations from the performance criteria of the NYS SWMDM 2015 must demonstrate that they are equivalent.

c) The SWPPP must include an O&M plan that includes inspection and maintenance schedules and actions to ensure continuous and effective operation of each post-construction *SMP*. The SWPPP must identify the entity that will be responsible for the long-term operation and maintenance of each practice.

d. In the *SWMP Plan*, document and update annually the names, titles, and contact information for the individuals who have received the trainings listed in Part VII.D.6.a.

e. In the *SWMP Plan*, document the SWPPP review including the information found in Part III.B. of the CGP;

f. Prioritize new *construction activities* (Part VII.D.5.a.); and

g. Notify construction site owner/operators that their SWPPP has been accepted using the *MS4* SWPPP Acceptance Form[52] created by the *Department* and required by the CGP, signed in accordance with Part X.J.

7. Pre-Construction Meeting

Prior to commencement of *construction activities*, the *MS4 Operator* must ensure a pre-construction meeting is conducted. The date and content of the pre-construction inspection/meeting must be documented in the *SWMP Plan*. The owner/operator listed on the CGP NOI (if different from the *MS4 Operator*), the *MS4 Operator*, contractor(s) responsible for implementing the SWPPP for the *construction activity,* and the *qualified inspector* (if required for the *construction activity* by Part IV.C. the CGP) must attend the meeting in order to:

a. Confirm the approved project has received, or will receive[53], coverage under the CGP or an individual *SPDES* permit;

b. Verify contractors and subcontractors selected by the owner/operator of the *construction activity* have identified at least one individual that has received four (4) hours of *Department* endorsed training in proper erosion and sediment control principles from a Soil & Water Conservation District or other endorsed entity as required by the CGP and Part VII.D.3.d; and

c. Review the construction oversight program (Part VII.D.3.) and expectations for compliance.

8. Construction Site Inspections

The *MS4 Operator* must:

a. Ensure individuals(s), responsible for construction site inspections, receive:

   i. Four (4) hours of *Department* endorsed training in proper erosion and sediment control principles from a Soil & Water Conservation District, or other *Department* endorsed entity. This training must be complete, within three (3) years of the EDC and every three (3) years thereafter.

   ii. Document the completion of this requirement in the *SWMP Plan*.

[52] The *MS4* SWPPP Acceptance Form can be found on the Department's website.

[53] Preconstruction meetings may occur prior to the issuance of the MS4 SWPP Acceptance Form, however, the MS4 Operator must confirm coverage under the CGP will be applied for by the construction site owner/operator prior to commencement of construction of *construction activities*.

b. Ensure all *MS4* Construction Site Inspectors receive this training prior to conducting construction site inspections.

   i. Individuals without these trainings cannot inspect construction sites.

   ii. Individuals who meet the definition of a *qualified professional* or *qualified inspector* are exempt from this requirement.

c. Annually inspect all sites with *construction activity* identified in the inventory (Part VII.D.4.) during active construction after the pre-construction meeting (Part VII.D.7.), or sooner if deficiencies are noted that require attention.

   i. Follow up to construction site inspections must confirm corrective actions are completed within timeframes established by the CGP and the MS4 Operator's ERP (Part IV.F.1.).

d. In the *SWMP Plan*, document and update annually the names, titles, and contact information for the individuals who have received the trainings listed in Part VII.D.8.a.

e. Document all inspections using the Construction Site Inspection Report Form (Appendix D) or an equivalent form containing the same information. The *MS4 Operator* must include the completed Construction Site Inspection Reports in the *SWMP Plan*.

9. Construction Site Close-out

a. The *MS4 Operator* must ensure a final construction site inspection is conducted and documentation of the final construction site inspection must be maintained in the *SWMP Plan*. The final construction site inspection must be documented using the Construction Site Inspection Report Form (Appendix D), or an equivalent form containing the same information, or accept the construction site owner/operator's *qualified inspector* final inspection certification required by the CGP.

b. The Notice of Termination (NOT)[54] must be signed by the *MS4 Operator* as required by the CGP for projects determined to be complete. The NOT must be signed in accordance with Part X.J.

E. MCM 5 – Post-Construction *Stormwater* Management

The *MS4 Operator* must *develop*, implement, and enforce a program to ensure proper operation and maintenance of post-construction *SMPs* for new or redeveloped sites. This MCM is designed to promote the long-term performance of post-construction *SMPs* in removing *pollutants* from *stormwater* runoff.

[54] The NOT can be found on the Department's website.

1. Applicable Post-Construction *SMPs*

The post-construction *SMP program* must address *stormwater* runoff to the *MS4* from *publicly owned/operated* post-construction *SMPs* that meet the following:

a. Post-construction *SMPs* that have been installed as part of any CGP covered construction site or individual *SPDES* permit (since March 10, 2003); and

b. All new post-construction *SMPs* constructed as part of the construction site *stormwater* runoff control program (Part VII.D.).

2. Post-Construction *SMP* Inventory & Inspection Tracking[55]

a. The *MS4 Operators* continuing coverage must:

   i. Maintain the inventory from previous iterations of this *SPDES* general permit for post-construction *SMPs* installed after March 10, 2003; and

   ii. *Develop* the inventory for post-construction *SMPs* installed after March 10, 2003 including post-construction *SMPs:*

      a) As they are approved or discovered; or

      b) After the owner/operator of the *construction activity* has filed the NOT with the *Department* (Part VII.D.9.b.).

b. The newly designated *MS4 Operators* must *develop* and maintain the inventory for post-construction *SMPs* installed after March 10, 2003 including post-construction *SMPs:*

   i. As they are approved or discovered; or

   ii. After the owner/operator of the *construction activity* has filed the NOT with the *Department* (Part VII.D.9.b.).

c. Annually, the MS4 Operator must update the inventory of post-construction SMPs to include the post-construction *SMPs* in Part VII.E.2.a. and Part VII.E.2.b.

d. Within five (5) years of the EDC, the following information must be included in the inventory either by using the *MS4 Operator* maintenance records or by verification of maintenance records provided by the owner of the post-construction *SMP*:

   i. Street address or tax parcel;

   ii. Type;[56]

   iii. Receiving waterbody name and class (mapped in accordance with Part IV.D.1.e.ii.a));

[55] Post-construction *SMPs* can be found at a *municipal facility*.
[56] Post-construction *SMP* types are defined in the New York State Department of Environmental Conservation Maintenance Guidance: Stormwater Management Practices, March 31, 2017 (NYS DEC Maintenance Guidance 2017).

iv. Receiving waterbody WI/PWL Segment ID (mapped in accordance with Part IV.D.1.e.ii.b));

v. Date of installation (if available) or discovery;

vi. Ownership;

vii. Responsible party for maintenance;

viii. Contact information for party responsible for maintenance;

ix. Location of documentation depicting O&M requirements and legal agreements for post-construction *SMP*;

x. Frequency for inspection of post-construction *SMP*, as specified in the New York State Department of Environmental Conservation Maintenance Guidance: Stormwater Management Practices, March 31, 2017 (NYS DEC Maintenance Guidance 2017) or as specified in the O&M plan contained in the approved SWPPP (Part VII.D.6.);

xi. Reason for installation (e.g., new development, redevelopment, *retrofit*, flood control), if known;

xii. Date of last inspection;

xiii. Inspection results; and

xiv. Any corrective actions identified and completed.

e. *MS4 Operators* must document the inventory of post-construction *SMPs* in the *SWMP Plan*.

3. SWPPP Review

For post-construction *SMP* SWPPP review requirements, see Part VII.D.6.

4. Post-Construction *SMP* Inspection & Maintenance Program

Within one (1) year of the EDC, the *MS4 Operator* must *develop* and implement a post-construction *SMP* inspection and maintenance program. The post-construction *SMP* inspection and maintenance program must be documented in the *SWMP Plan* specifying:

a. The post-construction *SMP* inspection and maintenance procedures including:

i. Provisions to ensure that each post-construction *SMP* identified in the post-construction *SMP* inventory (Part VII.E.2.) is inspected at the frequency specified in the NYS DEC Maintenance Guidance 2017 or as specified in the O&M plan contained in the approved SWPPP (Part VII.D.6.), if available;

ii. Documentation of post-construction *SMP* inspections using the Post-Construction SMP Inspection Checklist[57] or an equivalent form containing the same information. The *MS4 Operator* must include the completed post-construction *SMP* inspections (i.e., the completed Post-Construction SMP Inspection Checklist) in the *SWMP Plan*;

iii. Provisions to initiate follow-up actions (i.e., maintenance, repair, or higher-level inspection) within thirty (30) days of post-construction *SMP* inspection; and

iv. Provisions to initiate enforcement within sixty (60) days of the inspection if follow-up actions are not complete.

b. The training provisions for the *MS4 Operator*'s post-construction *SMP* inspection and maintenance procedures (Part VII.E.4.a.).

i. If new staff are added, training on the *MS4 Operator*'s post-construction *SMP* inspection and maintenance procedures (Part VII.E.4.a.) and procedures outlined in the *Department* endorsed program must be given prior to conducting any post-construction *SMP* inspection and maintenance;

ii. For existing staff, training on the *MS4 Operator*'s post-construction *SMP* inspection and maintenance procedures (Part VII.E.4.a.) and procedures outlined in the *Department* endorsed program must be given prior to conducting any post-construction *SMP* inspection and maintenance and once every five (5) years, thereafter; and

iii. If the post-construction *SMP* inspection and maintenance procedures (Part VII.E.4.a.) are updated (Part VII.E.4.d.), training on the updates must be given to all staff prior to conducting post-construction *SMP* inspection and maintenance.

c. The names, titles, and contact information for the individuals who have received post-construction *SMP* inspection and maintenance procedures training and update annually; and

d. Annually, by April 1, the *MS4 Operator* must:

i. Review and update the post-construction *SMP* inspection and maintenance procedures (Part VII.E.4.a.); and

ii. Document the completion of this requirement in the *SWMP Plan*.

F. MCM 6 – Pollution Prevention and Good Housekeeping

The *MS4 Operator* must *develop* and implement a pollution prevention and good housekeeping program for *municipal facilities* and *municipal operations* to minimize

[57] The *Department* developed checklist forms specific to each post-construction *SMP* designed to assist *MS4 Operators* in conducting inspections and maintenance activities of standard practices. The Post-Construction SMP Inspection Checklist, March 31, 2017, can be found on the Department's website.

pollutant discharges. This MCM is designed to ensure the *MS4 Operator*'s own activities do not contribute *pollutants* to *surface waters of the State*.

1. *Best Management Practices (BMPs)* for *Municipal Facilities & Operations*

Within three (3) years of the EDC, the *MS4 Operator* must incorporate *best management practices* (*BMPs*) into the *municipal facility* program *and municipal operations* program to minimize the *discharge* of *pollutants* associated with *municipal facilities* and *municipal operations, respectively*. The *BMPs* to be considered are as follows and must be documented in the *SWMP Plan*:

a. Minimize Exposure

i. Exposure of materials to rain, snow, snowmelt, and runoff must be minimized, unless not technologically possible or not economically practicable and achievable in light of best industry practices, including areas used for loading and unloading, storage, disposal, cleaning, maintenance, and fueling operations, with the following *BMP*s:

a) Locate materials and activities inside or protect them with storm resistant coverings;

b) Use grading, berming, or curbing to prevent runoff of contaminated flows and divert run-on away from these areas;

c) Locate materials, equipment, and activities so leaks and spills are contained in existing containment and diversion systems;

d) Clean up spills and leaks promptly using dry methods (e.g., absorbents) to prevent the *discharge* of *pollutants*;

e) Store leaky vehicles and equipment indoors or, if stored outdoors, use drip pans and absorbents;

f) Use spill/overflow protection equipment;

g) Perform all vehicle and/or equipment cleaning operations indoors, under cover, or in bermed areas that prevent runoff and run-on and also captures any overspray;

h) Drain fluids, indoors or under cover, from equipment and vehicles that will be decommissioned, and, for any equipment and vehicles that will remain unused for extended periods of time, inspect at least monthly for leaks; and/or

i) Minimize exposure of chemicals by replacing with a less toxic alternative (e.g., use non-hazardous cleaners).

ii. *No Exposure* Certification for High Priority *Municipal Facilities*

a) *Municipal facilities* may qualify for *No Exposure* Certification (Appendix D) when all activities and materials are completely sheltered from exposure to rain, snow, snowmelt and/or runoff.

b) High priority *municipal facilities* (Part VII.F.2.c.i.a)) with uncovered parking areas for vehicles awaiting maintenance may be considered a low priority *municipal facility* (Part VII.F.2.c.i.c)) if only routine maintenance is performed inside and all other n*o exposure* criteria are met.

c) *Municipal facilities* accepting or repairing disabled vehicles and/or vehicles that have been involved in accidents are not eligible for the *No Exposure* Certification.

d) *Municipal facilities* must maintain the *No Exposure* Certification and document in the *SWMP Plan*. The *No Exposure* Certification ceases to apply when activities or materials become exposed.

b. Follow a Preventive Maintenance Program

i. Implement a preventative maintenance program that includes routine inspection, testing, maintenance, and repair of all fueling areas, vehicles and equipment and systems to prevent leaks, spills and other releases. This includes:

a) Performing inspections and preventive maintenance of *stormwater* drainage, source controls, treatment systems, and plant equipment and systems;

b) Maintaining non-structural *BMPs* (e.g., keep spill response supplies available, personnel appropriately trained, containment measures, covering fuel areas); and

c) Ensure vehicle washwater is not *discharged* to the *MS4* or to *surface waters of the State*. Wash equipment/vehicles in a designated and/or covered area where washwater is collected to be recycled or *discharged* to the sanitary sewer (Part I.B.2.d.).

ii. Routine maintenance must be performed to ensure *BMPs* are operating properly.

iii. When a *BMP* is not functioning to its designed effectiveness and needs repair or replacement:

a) Maintenance must be performed before the next anticipated storm event, or as necessary to maintain the continued effectiveness of *stormwater* controls. If maintenance prior to the next anticipated storm event is impracticable, maintenance must be scheduled and accomplished as soon as practicable; and

b) Interim measures must be taken to prevent or minimize the *discharge* of *pollutants* until the final repair or replacement is implemented, including cleaning up any contaminated surfaces so that the material will not be *discharged* during subsequent storm events.

c. Spill Prevention and Response Procedures

i. Minimize the potential for leaks, spills and other releases that may be exposed to *stormwater* and *develop* plans for effective response to such spills if or when they occur. At a minimum, the *MS4 Operator* must:
   a) Store materials in appropriate containers;
   b) Label containers (e.g., "Used Oil," "Spent Solvents," "Fertilizers and Pesticides") that could be susceptible to spillage or leakage to encourage proper handling and facilitate rapid response if spills or leaks occur;
   c) Implement procedures for material storage and handling, including the use of secondary containment and barriers between material storage and traffic areas, or a similarly effective means designed to prevent the *discharge* of *pollutants* from these areas;
   d) *Develop* procedures for stopping, containing, and cleaning up leaks, spills, and other releases. As appropriate, execute such procedures as soon as possible;
   e) Keep spill kits on-site, located near areas where spills may occur or where a rapid response can be made;
   f) *Develop* procedures for notification of the appropriate facility personnel, emergency response agencies, and regulatory agencies when a leak, spill, or other release occurs. If possible, one of these individuals should be a member of the *stormwater* pollution prevention team (Part VII.F.2.d.i.a)). Any spills must be reported in accordance with 6 NYCRR 750-2.7; and
   g) Following any spill or release, the *MS4 Operator* must evaluate the adequacy of the *BMPs* identified in the *municipal facility* specific SWPPP. If the *BMPs* are inadequate, the SWPPP must be updated to identify new *BMPs* that will prevent reoccurrence and improve the emergency response to such releases.

ii. Measures for cleaning up spills or leaks must be consistent with applicable petroleum bulk storage, chemical bulk storage, or hazardous waste management regulations at 6 NYCRR Parts 596-599, 613 and 370-373.

iii. This *SPDES* general permit does not relieve the *MS4 Operator* of any reporting or other requirements related to spills or other releases of petroleum or hazardous substances. Any spill of a hazardous substance must be reported in accordance with 6 NYCRR 597.4. Any spill of petroleum must be reported in accordance with 6 NYCRR 613.6 or 17 NYCRR 32.3.

d. Erosion and Sediment Controls[58]

i. Stabilize exposed areas and control runoff using structural and/or non-structural controls to minimize onsite erosion and sedimentation.

[58] The use of the term "controls" in Part VII.F.1.d. aligns with the use of the term "controls" in the CGP.

ii. The *MS4 Operator* must consider:

a) Structural and/or non-structural controls found in the NYS E&SC 2016;

b) Areas that, due to topography, land disturbance (e.g., construction), or other factors, have potential for significant soil erosion;

c) Whether structural, vegetative, and/or stabilization *BMPs* are needed to limit erosion;

d) Whether velocity dissipation devices (or equivalent measures) are needed at *discharge* locations and along the length of any channel to provide a non-erosive flow velocity from the structure to a water course; and

e) Address erosion or areas with poor vegetative cover, especially if the erosion is within fifty (50) feet of a *surface water of the State*.

e. Manage Vegetated Areas and Open Space on *Municipal* Property

i. Maintain vegetated areas on *MS4 Operator* owned/operated property and right of ways:

a) Specify proper use, storage, and disposal of pesticides, herbicides, and fertilizers including minimizing the use of these products and using only in accordance manufacturer's instruction;

b) Use lawn maintenance and landscaping practices that are protective of water quality. Protective practices include: reduced mowing frequencies; proper disposal of lawn clippings; and use of alternative landscaping materials (e.g., drought resistant planting);

c) Place pet waste disposal containers and signage concerning the proper collection and disposal of pet waste at all parks and open space where pets are permitted; and

d) Address waterfowl congregation areas where needed to reduce waterfowl droppings from entering the *MS4*.

f. Salt[59] Storage Piles or Pile Containing Salt

Enclose or cover storage piles of salt, or piles containing salt, used for deicing or maintenance of paved surfaces, except during loading, unloading, and handling. Implement appropriate measures (e.g., good housekeeping, routine sweeping, diversions, containment) to minimize exposure resulting from adding to or removing materials from the pile.

g. Waste, Garbage, and Floatable Debris

i. Keep all dumpster lids closed when not in use. For dumpsters and roll off boxes that do not have lids and could leak, ensure that *discharges* have a control (e.g., secondary containment, treatment); and

[59] For purposes of this *SPDES* general permit, salt means any chloride-containing material used to treat paved surfaces for deicing, including sodium chloride, calcium chloride, magnesium chloride, and brine solutions.

ii. Keep exposed areas free of waste, garbage, and debris or intercept them before they are *discharged*:

a) Manage trash containers at parks and open space (scheduled cleanings; sufficient number);

b) Pick up trash and debris on *MS4 Operator* owned/operated property and rights of way; and

c) Clean out *catch basins* within the appropriate timeframes (Part VII.F.3.c.iii.).

h. Alternative Implementation Options

When alternative implementation options (Part IV.A.1.) are utilized, require the parties performing *municipal operations* as contracted services, including but not limited to street sweeping, snow removal, and lawn/grounds care, to meet permit requirements as the requirements apply to the activity performed.

2. *Municipal Facilities*[60]

a. *Municipal Facility* Program

Within three (3) years of the EDC, the *MS4 Operator* must *develop* and implement a *municipal facility* program. The *municipal facility* program must be documented in the *SWMP Plan* specifying:

i. The *municipal facility* procedures including:

a) The *BMPs* (Part VII.F.1.) incorporated into the *municipal facility* program;

b) The high priority *municipal facility* requirements (Part VII.F.2.d.) as applied to the specific *municipal facility*; and

c) The low priority *municipal facility* requirements (Part VII.F.2.e.) as applied to the specific *municipal facility*.

ii. The training provisions for the *MS4 Operator*'s *municipal facility* procedures (Part VII.F.2.a.i.).

a) If new staff are added, training on the *MS4 Operator*'s *municipal facility* procedures (Part VII.F.2.a.i.) must be given prior to conducting *municipal facility* procedures;

b) For existing staff, training on the *MS4 Operator*'s *municipal facility* procedures (Part VII.F.2.a.i.) must be given prior to conducting *municipal facility* procedures and once every five (5) years, thereafter; and

[60] *Municipal facilities* that have coverage under a separate *SPDES* permit (either individual or MSGP) must comply with the terms and conditions of that permit and the requirements set forth in this Part are not applicable.

c) If the *municipal facility* procedures (Part VII.F.2.a.i.) are updated (Part VII.F.2.a.iv.), training on the updates must be given to all staff prior to conducting *municipal facility* procedures.

iii. The names, titles, and contact information for the individuals who have received *municipal facility* training and update annually; and

iv. Annually, by April 1, the *MS4 Operator* must:

a) Review and update the *municipal facility* procedures (Part VII.F.2.a.i.); and

b) Document the completion of this requirement in the *SWMP Plan*.

b. *Municipal Facility* Inventory

i. Within two (2) years of the EDC, the *MS4 Operator* must *develop* and maintain an inventory of all *municipal* facilities in the *SWMP* Plan. The following information must be included in the inventory:

a) Name of *municipal facility*;

b) Street address;

c) Type of *municipal facility*;

d) Prioritization (high or low) (Part VII.F.2.c.);

e) Receiving waterbody name and class (mapped in accordance with Part IV.D.1.e.ii.a));

f) Receiving waterbody WI/PWL Segment ID (mapped in accordance with Part IV.D.1.e.ii.b));

g) Contact information;

h) Responsible department;

i) Location of SWPPP (if high priority; when completed);

j) Type of activities present on site;

k) Size of facility (acres);

l) Date of last assessment;

m) *BMPs* identified; and

n) Projected date of next comprehensive site assessment (Part VII.F.2.d.ii.c) or Part VII.F.2.e.ii.c), depending on the *municipal facility* prioritization (Part VII.F.2.c.)).

ii. Annually, the *MS4 Operator* must update the inventory if new *municipal* facilities are added.

c. *Municipal Facility* Prioritization

i. Within three (3) years of the EDC, the *MS4 Operator* must prioritize all known *municipal* facilities as follows:

a) High priority *municipal* facilities include *municipal* facilities that have one or more of the following on site and exposed to *stormwater*:

i) Storage of chemicals, salt, petroleum, pesticides, fertilizers, anti-freeze, lead-acid batteries, tires, waste/debris;

ii) Fueling stations; and/or

iii) Vehicle or equipment maintenance/repair.

b) Low priority *municipal* facilities include any *municipal* facilities that do not meet the criteria for a high priority (Part VII.F.2.c.i.a)) *municipal facility*.

c) High priority *municipal* facilities (Part IV.F.2.c.i.a)) which qualify for a *No Exposure* Certification (Part VII.F.1.a.ii.) are low priority *municipal* facilities.

ii. Within thirty (30) days of when a *municipal facility* is added to the inventory, the *MS4 Operator* must prioritize those *municipal* facilities; and

iii. Annually, after the initial prioritization (Part VII.F.2.c.i.), the *MS4 Operator* must update the *municipal facility* prioritization in the inventory (Part VII.F.2.b.i.) based on information gathered as part of the *municipal facility* program (Part VII.F.2.a.), including cases where a *No Exposure* Certification (Part VII.F.1.a.ii.) ceases to apply. The completion of this permit requirement must be documented in the *SWMP Plan*.

d. High Priority *Municipal Facility* Requirements

i. Municipal Facility Specific SWPPP

Within five (5) years of the EDC, *MS4 Operators* must *develop* and implement a *municipal facility* specific SWPPP for each high priority *municipal facility* (Part VII.F.2.c.i.a)) and retain a copy of the *municipal facility* specific SWPPP on site of the respective *municipal facility*. The SWPPP must contain:

a) *Stormwater* Pollution Prevention Team

The *municipal facility* specific SWPPP must identify the individuals (by name and/or title) and their role/responsibilities in *developing*, implementing, maintaining, and revising the *municipal facility* specific SWPPP. The activities and responsibilities of the team must address all aspects of the *municipal facility* specific SWPPP.

b) General Site Description

A written description of the nature of the activities occurring at the *municipal facility* with a potential to *discharge pollutants*, type of *pollutants* expected, and location of key features as detailed in the site map (Part VII.F.2.d.i.e)).

c) Summary of potential *pollutant* sources

The *municipal facility* specific SWPPP must identify each area at the *municipal facility* where materials or activities are exposed to *stormwater* or from which authorized non-*stormwater discharges* (Part I.A.3.) originate, including any potential *pollutant* sources for which the *municipal facility* has reporting requirements under the Emergency Planning and Community Right-To-Know Act (EPCRA), Section 313.

i) Materials or activities include: machinery; raw materials; intermediate products; byproducts; final products or waste products; and material handling activities which includes storage, loading and unloading, transportation or conveyance of any raw material, intermediate product, final product or waste product.

ii) For each separate area identified, the description must include:

(a) Activities - A list of the activities occurring in the area (e.g., material storage, equipment fueling and cleaning);

(b) *Pollutants* - A list of the associated *pollutant(s)* for each activity. The *pollutant(s)* list must include all materials that are exposed to *stormwater*; and

(c) Potential for presence in *stormwater* - For each area of the *municipal facility* that generates *stormwater discharges,* a prediction of the direction of flow, and the likelihood of the activity to contaminate the *stormwater discharge*. Factors to consider include the toxicity of chemicals, quantity of chemicals used, produced or *discharge*d, the likelihood of contact with *stormwater*; and history of leaks or spills of toxic or hazardous *pollutants*.

d) Spills and Releases

For areas that are exposed to precipitation or that otherwise drain to a *stormwater* conveyance to be covered under this *SPDES* general permit, the *municipal facility* specific SWPPP must include a list of spills or releases[61] of petroleum and hazardous substances or other *pollutants*, including unauthorized *non-stormwater discharges,* that may adversely affect water quality that occurred during the last three-year period. The list must be updated when spills or releases occur.

e) Site Map

The *municipal facility* specific SWPPP must include a site map identifying the following, as applicable:

i) Property boundaries and size in acres;

[61] This may also include releases of petroleum or hazardous substances that are not in excess of reporting quantities but which may still cause or contribute to significant water quality impairment.

ii) Location and extent of significant structures (including materials shelters), and impervious surfaces;

iii) Monitoring locations (mapped in accordance with Part IV.D.2.a.i.) with its approximate *sewershed*. Each monitoring location must be labeled with the monitoring location identification;

iv) Location of all post-construction *SMPs* (mapped in accordance with Part IV.D.2.a.iv.) and *MS4* infrastructure (mapped in accordance with Part IV.D.2.b.i.);

v) Locations of *discharges* authorized under other *SPDES* permits;

vi) Locations where potential spills or releases can contribute to *pollutants* in *stormwater discharges* and their accompanying drainage points;

vii) Locations of haul and access roads;

viii) Rail cars and tracks;

ix) Arrows showing direction of *stormwater* flow;

x) Location of all receiving waters in the immediate vicinity of the *municipal facility*, indicating if any of the waters are impaired and, if so, whether the waters have *TMDLs* established for them (mapped in accordance with Part IV.D.1.e.ii.);

xi) Locations where *stormwater* flows have significant potential to cause erosion;

xii) Location and source of run-on from adjacent property containing significant quantities of *pollutants* and/or volume of concern to the *municipal facility*; and

xiii) Locations of the following areas where such areas are exposed to precipitation or *stormwater*:

(a) Fueling stations;
(b) Vehicle and equipment maintenance and/or cleaning areas;
(c) Loading/unloading areas;
(d) Locations used for the treatment, storage or disposal of wastes;
(e) Liquid storage tanks;
(f) Processing and storage areas;
(g) Locations where significant materials, fuel or chemicals are stored and transferred;
(h) Locations where vehicles and/or machinery are stored when not in use
(i) Transfer areas for substances in bulk;
(j) Location and description of non-*stormwater discharges* (Part I.A.3.);

(k) Locations where spills[62] or leaks have occurred; and
(l) Locations of all existing structural *BMP*s.

f) *Stormwater Best Management Practices (BMPs)*

The *municipal facility* specific SWPPP must document the location and type of *BMPs* implemented at the *municipal facility* (Part VII.F.1). The *municipal facility* specific SWPPP must describe how each *BMP* is being implemented for all the potential *pollutant* sources.

g) *Municipal facility* assessments
The *municipal facility* specific SWPPP must include a schedule for completing and recording results of routine and comprehensive site assessments (Part VII.F.2.d.ii.c)).

ii. Municipal Facility Assessments

a) Wet Weather Visual Monitoring

i) Once every five (5) years, the *MS4 Operator* must conduct wet weather visual monitoring of the monitoring locations (Part VII.C.1.b.) and other sites of *stormwater* leaving the site that are *discharging stormwater* from fueling areas, storage areas, vehicle and equipment maintenance/fueling areas, material handling areas and similar potential *pollutant* generating areas (Part VII.F.2.d.i.e)xiii)).

(a) All samples must be collected from *discharges* resulting from a *qualifying storm event*. The storm event must be documented using the Storm Event Data Form (Appendix D) and kept with the *municipal facility* specific SWPPP. The sample must be taken during the first thirty (30) minutes (or as soon as practical, but not to exceed one hour) of the *discharge* at the monitoring location.

(b) No analytical tests are required to be performed on the samples for the purpose of meeting the visual monitoring requirements.

(c) The visual examination must document observations of color, odor, clarity, floating solids, settled solids, suspended solids, foam, oil sheen, and any other obvious indicators of *stormwater* pollution.

(d) The visual examination of the sample must be conducted in a well-lit area.

(e) Where practicable, the same individual should carry out the collection and examination of *discharges* for the entire permit term for consistency.

[62] A spill includes: any spill of a hazardous substance that must be reported in accordance with 6 NYCRR 597.4 and any spill of petroleum that must be reported in accordance with 6 NYCRR 613.6 or 17 NYCRR 32.3.

(f) The *MS4 Operator* must document the visual examination using the Visual Monitoring Form (Appendix D) and keep it with the *municipal facility* specific SWPPP to record:

(i) Monitoring location ID;

(ii) Examination date and time;

(iii) Personnel conducting the examination;

(iv) Nature of the *discharge* (runoff or snowmelt);

(v) Visual quality of the *stormwater discharge* including observations of color, odor, clarity, floating solids, settled solids, suspended solids, foam, oil sheen, and other obvious indicators of *stormwater* pollution; and

(vi) Probable sources of any observed *stormwater* contamination.

(vii) Corrective and follow up actions – If the visual examination indicates the presence of color, odor, floating solids, settled solids, suspended solids, foam, oil sheen, or other indicators of *stormwater* pollution, the *MS4 Operator* must, at minimum, complete and document the following actions:

(1) Evaluate the facility for potential sources;

(2) Remedy the problems identified;

(3) Revise the *municipal facility* specific SWPPP; and

(4) Perform an additional visual inspection during the first *qualifying storm event* following implementation of the corrective action. If the first *qualifying storm event* does not occur until the next visual monitoring period, this follow up action may be used as the next visual inspection.

b) The monitoring locations inspection and sampling program must be implemented at the *municipal facility* (Part VII.C.1.e.).

c) Comprehensive Site Assessments

i) Once every five (5) years following the most recent assessment, the *MS4 Operator* must complete a comprehensive site assessment for each high priority *municipal facility* as identified in the inventory (Part VII.F.2.b.) using the Municipal Facility Assessment Form (Appendix D) or an equivalent form containing the same information, and document in the *municipal facility* specific SWPPP and *SWMP Plan* that:

(a) The *municipal facility* is in compliance with the terms and conditions of this *SPDES* general permit;

(b) Deficiencies were identified and all reasonable steps will be taken to minimize any *discharge* in violation of the permit, which has a reasonable likelihood of adversely affecting human health or the environment;

(i) Within twenty-four (24) hours, the *MS4 Operator* must prepare a schedule that includes corrective actions and specific interim milestones to be implemented until the corrective action is implemented; or

(c) Deficiencies were identified and all reasonable steps will be taken to minimize any *discharge* in violation of the permit, which does not have a reasonable likelihood of adversely affecting human health or the environment;

(i) Within seven (7) days, the *MS4 Operator* must prepare a schedule that includes corrective actions and specific interim milestones to be implemented until the corrective action is implemented.

e. Low Priority *Municipal Facility* Requirements

i. The *MS4 Operator* must identify procedures outlining *BMPs* for the types of activities that occur at the low priority *municipal* facilities as described in Part VII.F.1. A *municipal facility* specific SWPPP is not required.

ii. *Municipal Facility* Assessments

a) Low priority *municipal* facilities are not required to conduct wet weather visual monitoring.

b) The monitoring locations inspection and sampling program must be implemented at the *municipal facility* (Part VII.C.1.e.).

c) Comprehensive Site Assessments

i) Once every five (5) years following the most recent assessment, the *MS4 Operator* must complete a comprehensive site assessment for each low priority *municipal facility* as identified in the inventory (Part VII.F.2.b.) using the Municipal Facility Assessment Form (Appendix D) or an equivalent form containing the same information, and document in the *SWMP Plan* that:

(a) The *municipal facility* is in compliance with the terms and conditions of this *SPDES* general permit;

(b) Deficiencies were identified and all reasonable steps will be taken to minimize any *discharge* in violation of the permit, which has a reasonable likelihood of adversely affecting human health or the environment;

(i) Within twenty-four (24) hours, the *MS4 Operator* must prepare a schedule that includes corrective actions and specific interim milestones to be implemented until the corrective action is implemented; or

(c) Deficiencies were identified and all reasonable steps will be to minimize any *discharge* in violation of the permit, which does not have a reasonable likelihood of adversely affecting human health or the environment;

(i) Within seven (7) days, the *MS4 Operator* must prepare a schedule that includes corrective actions and specific interim milestones to be implemented until the corrective action is implemented.

3. *Municipal Operations* & Maintenance

a. *Municipal Operations* Program

Municipal operations are: street and bridge maintenance; winter road maintenance; *MS4* maintenance; open space maintenance; solid waste management; new construction and land disturbances; right-of-way maintenance; marine operations; or hydrologic habitat modification.

Within three (3) years of the EDC, the *MS4 Operator* must *develop* and implement a *municipal operations* program. The *municipal operations* program must be documented in the *SWMP Plan* specifying:

i. The *municipal operations* procedures including:

a) The *BMPs* (Part VII.F.1.) incorporated into the *municipal operations* program;

b) The *municipal operations* corrective actions requirements (Part VII.F.3.b.);

c) *Catch basin* inspection and maintenance requirements (Part VII.F.3.c.);

d) Roads, bridges, parking lots, and right of way maintenance requirements (Part VII.F.3.d.); and

e) All other *municipal operations* maintenance requirements.

ii. The training provisions for the *MS4 Operator*'s *municipal operations* procedures (Part VII.F.3.a.i.).

a) If new staff are added, training on the *MS4 Operator*'s *municipal operations* procedures (Part VII.F.3.a.i.) must be given prior to conducting *municipal operations* procedures;

b) For existing staff, training on the *MS4 Operator*'s *municipal operations* procedures (Part VII.F.3.a.i.) must be given prior to conducting

municipal operations procedures and once every five (5) years, thereafter; and

c) If the *municipal operations* procedures (Part VII.F.3.a.i.) are updated (Part VII.F.3.a.iv.), training on the updates must be given to all staff prior to conducting *municipal operations* procedures.

iii. The names, titles, and contact information for the individuals who have received *municipal operations* training and update annually; and

iv. Annually, by April 1, the *MS4 Operator* must:

a) Review and update the *municipal operations* procedures (Part VII.F.3.a.i.); and

b) Document the completion of this requirement in the *SWMP Plan*.

b. *Municipal Operations* Corrective Actions

i. For *municipal operations*, *MS4 Operators* must either:

a) Ensure compliance with the terms and conditions of this *SPDES* general permit; or

b) Implement corrective actions according to the following schedule and, after implementation, ensure the operations are in compliance with the terms and conditions of this *SPDES* general permit:

i) Within twenty-four (24) hours of discovery for situations that have a reasonable likelihood of adversely affecting human health or the environment;

ii) Initiated within seven (7) days of inspection and completed within thirty (30) days of inspection for situations that do not have a reasonable likelihood of adversely affecting human health or the environment; and

iii) For corrective actions that require special funding or construction that will take longer than thirty (30) days to complete, a schedule must be prepared that specifies interim milestones that will ensure compliance in the shortest reasonable time.

c. *Catch Basin* Inspection and Maintenance

Within three (3) years of the EDC, the MS4 Operator must:

i. Identify when *catch basin* inspection is needed with consideration for:

a) Areas with *construction activities* (mapped in accordance with Part IV.D.2.a.iii.);

b) Residential, commercial, and industrial areas (mapped in accordance with Part IV.D.1.d.iii.);

c) Recurring or history of issues; or

d) Confirmed citizen complaints on three or more separate occasions in the last twelve (12) months.

ii. Inventory *catch basin* inspection information including:

a) Date of inspection;

b) Approximate level of trash, sediment, and/or debris captured at time of clean-out (no trash, sediment, and/or debris, <50% of the depth of the *sump*, >50% of the depth of the *sump*);

c) Depth of structure;

d) Depth of *sump*; and

e) Date of clean out, if applicable (Part VII.F.3.c.iii.).

iii. Based on inspection results, clean out *catch basins* within the following timeframes:

a) Within six (6) months after the *catch basin* inspection, *catch basins* which had trash, sediment, and/or debris exceeding 50% of the depth of the *sump* as a result of a *catch basin* inspection must be cleaned out;

b) Within one (1) year after the *catch basin* inspection, *catch basins* which had trash, sediment, and/or debris at less than 50% of the depth of the *sump* as a result of a *catch basin* inspection must be cleaned out; and

c) MS4 Operators are not required to clean out *catch basins* if the *catch basins* are operating properly and:

i. There is no trash, sediment, and/or debris in the *catch basin*; or

ii. The *sump* depth of the *catch basin* is less than or equal to two (2) feet.

iv. Properly manage (handling and disposal) materials removed from *catch basins* during clean out so that:

a) Water removed during the *catch basin* cleaning process will not reenter the *MS4* or *surface waters of the State*;

b) Material removed from *catch basins* is disposed of in accordance with any applicable environmental laws and regulations; and

c) Material removed during the *catch basin* cleaning process will not reenter the *MS4* or *surface waters of the State*.

v. Determine if there are signs/evidence of *illicit discharges* and procedures for referral/follow-up if *illicit discharges* are encountered.

d. Roads, Bridges, Parking Lots, & Right of Way Maintenance

i. Sweeping

Within six (6) months of the EDC, the *MS4 Operator* must *develop* and implement procedures for sweeping and/or cleaning *municipal* streets, bridges, parking lots, and right of ways owned/operated by the *MS4 Operator*. The procedures and completion of permit requirements must be documented in the *SWMP Plan* specifying:

a) All roads, bridges, parking lots, and right of ways must be swept and/or cleaned once every five (5) years in the spring (following winter activities such as sanding). This requirement is not applicable to:

   i) Uncurbed roads with no *catch basins*;

   ii) High-speed limited access highways; or

   iii) Roads defined as interstates, freeways and expressways, or arterials by the United States Department of Transportation, Federal Highway Administration, Highway Functional Classification Concepts, Criteria and Procedures, 2013.

b) Annually, from April 1 through October 31, roads in business and commercial areas must be swept. This requirement is not applicable to:

   i) Uncurbed roads with no *catch basins*;

   ii) High-speed limited access highways; or

   iii) Roads defined as interstates, freeways and expressways, or arterials by the USDOT 2013.

ii. Maintenance

Within five (5) years of the EDC, in addition to the *BMPs* (Part VII.F.1.), the *MS4 Operator* must implement the following provisions:

a) Pave, mark, and seal in dry conditions;

b) Stage road operations and maintenance activity (e.g., patching, potholes) to reduce the potential discharge of pollutants to the *MS4* or *surface waters of the State*;

c) Restrict the use of herbicides/pesticide application to roadside vegetation; and

d) Contain *pollutants* associated with bridge maintenance activities (e.g., paint chips, dust, cleaning products, other debris).

iii. Winter Road Maintenance

Within five (5) years of the EDC, in addition to the *BMPs* (Part VII.F.1.), the *MS4 Operator* must implement the following provisions:

a) Routinely calibrate equipment to control salt/sand application rates; and

b) Ensure that routine snow disposal activities comply with the Division of Water Technical and Operation Guidance Series 5.1.11, Snow Disposal.[63]

[63] The Division of Water Technical and Operation Guidance Series 5.1.11, Snow Disposal can be found on the Department's website.

Part VIII. Enhanced Requirements for Impaired Waters

Part VIII. requirements must be implemented in addition to the applicable requirements of the six (6) MCMs in Part VI. or Part VII, depending on the *MS4 Operator* type. Part VIII. requirements apply in the *sewersheds* which *discharge* to waters impaired for phosphorus, silt/sediment, pathogens, nitrogen, or floatables (Appendix C). *MS4 outfalls* are in the *automatically designated area*. *ADA MS4 outfalls* are in the *additionally designated area* subject to Criterion 3 of the Additional Designation Criteria (Appendix B).

MS4 Operator's subject to Part VIII. that implement pollutant specific *BMPs* after the EDC but prior to *MS4* infrastructure and *sewershed* mapping can use those *BMPs* to satisfy the permit requirements in this section.

The Part VIII. requirements, applicable to the *POC*, must be incorporated in the *MS4 Operator*'s *SWMP* and *SWMP Plan*.

A. *Pollutant* Specific BMPs for Phosphorus

Part VIII.A. must be implemented for all phosphorus impaired waters listed in Appendix C.

1. Mapping

In accordance with the timeframes listed below, the *MS4 Operator* must update, in geographic information system (GIS) format with a scale of 1:24,000 or finer, the comprehensive system mapping (Part IV.D.) to include:

a. Within three (3) years of the EDC, *MS4* infrastructure mapping requirements (Part IV.D.2.b.i.) and *sewersheds* for each:
   i. *MS4 outfall;* and
   ii. *ADA MS4 outfall.*
b. Within three (3) years of the EDC, the following information for each *MS4 outfall*:
   i. Retail and wholesale plant nurseries (including big box stores);
   ii. Commercial lawn care facilities; and
   iii. Golf courses.
c. Within three (3) years of the EDC, *ADA MS4 outfalls.*

2. Public Education and Outreach

a. Within six (6) months of the EDC, the *MS4 Operator* must make available information on how the impairment is being addressed by implementation of the MS4 Operator's local law or legal mechanism with content equivalent to the model local law (Part IV.E.1 and Part IV.E.2.). *MS4 Operators* must document the completion of this requirement in the *SWMP Plan*.

b. Following the completion of Part VIII.A.1, twice a year, once from March to August and once from September to February, the *MS4 Operator* must provide educational messages with information specific to phosphorus to the applicable target audiences within the *sewersheds* for impaired waters listed in Appendix C focus area, identified in Part VI.A.1.b. or Part VII.A.1.b, depending on the MS4 Operator type. The *SWMP Plan* must be updated with changes made to public education and outreach program (Part VI.A or Part VII.A, depending on the *MS4 Operator* type). *MS4 Operators* must document the completion of this requirement in the *SWMP Plan*.

3. Public Involvement/Participation

No additional requirements.

4. *Illicit Discharge* Detection and Elimination

Following the completion of Part VIII.A.1, within five (5) years of the EDC, the MS4 Operator must include on the *MS4 outfall* inventory (Part VI.C.1.c. or Part VII.C.1.c, depending on the MS4 Operator type) the number of each item identified in Part VIII.A.1.b. for each associated *MS4 outfall*.

5. Construction Site *Stormwater* Runoff Control

For Following the completion of Part VIII.A.1, high priority construction sites must be inspected during active construction after the pre-construction meeting (Part VI.D.7. or Part VII.D.7, depending on the *MS4 Operator* type).

a. If the *MS4 Operator* is completing the inspection, the construction site must be inspected every ninety (90) days; or

b. If the *MS4 Operator* utilizes the *qualified inspector's* weekly inspection reports, as required by the CGP, to satisfy this requirement, the *MS4 Operator* must inspect the construction site once every six (6) months, or sooner if any deficiencies are noted that require attention.

MS4 Operators must document the construction site inspections in the *SWMP Plan*.

6. Post-Construction *Stormwater* Management

No additional requirements.

7. Pollution Prevention and Good Housekeeping

Following the completion of Part VIII.A.1:

a. Annually, from April 1 through October 31, all streets located in *sewersheds discharging* to phosphorus impaired segments must be swept. *MS4 Operators* must document the completion of this requirement in the *SWMP Plan*. This requirement is not applicable to:

   i. Uncurbed roads with no *catch basins*;

ii. High-speed limited access highways; or

iii. Roads defined as interstates, freeways and expressways, or arterials by the United States Department of Transportation, Federal Highway Administration, Highway Functional Classification Concepts, Criteria and Procedures, 2013.

b. Within six (6) months of *MS4 outfall* inspection, the *MS4 Operator* must initiate actions to repair all *MS4 outfall* protection and/or bank stability problems identified during the inspection. Repairs must be completed in accordance with the NYS E&SC 2016. *MS4 Operators* must document the completion of this requirement in the *SWMP Plan*.

8. Planned Upgrades to *Municipal Facilities* in *Sewersheds* to Impaired Waters

Incorporate, where feasible,[64] cost-effective runoff reduction techniques[65] during planned *municipal* upgrades including *municipal* right of ways (e.g., bioswales, green streets, porous pavement, replacement of closed drainage with grass swales, replacement of the existing islands in the parking lots with bioretention or curb cuts to route the flow through below-grade infiltration areas or other low-cost improvements that provide runoff treatment or reduction).

B. *Pollutant* Specific BMPs for Silt/Sediment

Part VIII.B. must be implemented for all silt/sediment impaired waters listed in Appendix C.

1. Mapping

In accordance with the timeframes listed below, the *MS4 Operator* must update, in geographic information system (GIS) format with a scale of 1:24,000 or finer, the comprehensive system mapping (Part IV.D.) to include:

a. Within three (3) years of the EDC, *MS4* infrastructure mapping requirements (Part IV.D.2.b.i.) and *sewersheds* for each:

i. *MS4 outfall;* and

ii. *ADA MS4 outfall.*

b. Within three (3) years of the EDC, facilities with *SPDES* permit coverage under the MSGP with *stormwater discharges* applicable under Sector C, E, L, or J with facility contact.

c. Within three (3) years of the EDC, *ADA MS4 outfalls.*

[64] Consideration of feasibility should include type of land use or *municipal operation*, suitability of soils, presence of utilities, potential for exacerbating existing contamination problems, safety issues, maintenance requirements, and expected lifespans of available technologies.

[65] Runoff reduction techniques can be found in Chapters 4 and 5 of the NYS SWMDM 2015.

2. Public Education and Outreach

a. Within six (6) months of the EDC, the *MS4 Operator* must make available information on how the impairment is being addressed by implementation of the MS4 Operator's local law or legal mechanism with content equivalent to the model local law (Part IV.E.1 and Part IV.E.2.). *MS4 Operators* must document the completion of this requirement in the *SWMP Plan*.

b. Following the completion of Part VIII.B.1, each year of active construction, the *MS4 Operator* must educate individuals involved in *construction activity* (e.g., contractor, subcontractor, qualified inspector, SWPPP reviewers) within the *sewershed* boundary on the use of post-construction *SMPs* that are intended to collect and separate silt and sediment debris from *stormwater* before *discharging* to waters of the State (e.g., sediment forebays) as detailed in the NYS SWMDM 2015. *MS4 Operators* must document the completion of this requirement in the *SWMP Plan*.

3. Public Involvement/Participation

No additional requirements.

4. *Illicit Discharge* Detection and Elimination

Following the completion of Part VIII.B.1, within five (5) years of the EDC, the MS4 Operator must include on the *MS4 outfall* inventory (Part VI.C.1.c. or Part VII.C.1.c, depending on the MS4 Operator type) the number of each item identified in Part VIII.B.1.b. for each associated *MS4 outfall*.

5. Construction Site *Stormwater* Runoff Control

Following the completion of Part VIII.B.1, high priority construction sites must be inspected during active construction after the pre-construction meeting (Part VI.D.7. or Part VII.D.7, depending on the *MS4 Operator* type).

a. If the *MS4 Operator* is completing the inspection, the construction site must be inspected every ninety (90) days; or

b. If the *MS4 Operator* utilizes the *qualified inspector's* weekly inspection reports, as required by the CGP, to satisfy this requirement, the *MS4 Operator* must inspect the construction site once every six (6) months, or sooner if any deficiencies are noted that require attention.

MS4 Operators must document the construction site inspections in the *SWMP Plan*.

6. Post-Construction *Stormwater* Management

No additional requirements.

7. Pollution Prevention and Good Housekeeping

Following the completion of Part VIII.B.1:

a. Annually, from April 1 through October 31, all streets located in *sewersheds discharging* to silt/sediment impaired segments must be swept. *MS4 Operators* must document the completion of this requirement in the *SWMP Plan*. This requirement is not applicable to:

   i. Uncurbed roads with no *catch basins*;

   ii. High-speed limited access highways; or

   iii. Roads defined as interstates, freeways and expressways, or arterials by the United States Department of Transportation, Federal Highway Administration, Highway Functional Classification Concepts, Criteria and Procedures, 2013.

b. For areas within the *sewershed* that are compacted, poorly drained, contain areas of exposed soil, or nutrient deficient, the *MS4 Operator* must:

   i. Refer to Section 4 of the NYS E&SC 2016 for Soil Stabilization practices, and follow BMP procedures; and

   ii. *Develop* and implement procedures for watering and maintenance of implemented BMPs appropriate to establish root and vegetative cover, utilizing products which provide critical support to vegetation and soil stabilization.

   MS4 Operators must document the completion of this requirement in the *SWMP Plan*.

c. Within six (6) months of *MS4 outfall* inspection, the *MS4 Operator* must initiate actions to repair all *MS4 outfall* protection and/or bank stability problems identified during the inspection. Repairs must be completed in accordance with the NYS E&SC 2016. *MS4 Operators* must document the completion of this requirement in the *SWMP Plan*.

8. Planned Upgrades to *Municipal Facilities* in *Sewersheds* to Impaired Waters

Incorporate, where feasible,[66] cost-effective runoff reduction techniques[67] during planned *municipal* upgrades including *municipal* right of ways (e.g., bioswales, green streets, porous pavement, replacement of closed drainage with grass swales, replacement of the existing islands in the parking lots with bioretention or curb cuts to route the flow through below-grade infiltration areas or other low-cost improvements that provide runoff treatment or reduction).

[66] Consideration of feasibility should include type of land use or *municipal operation*, suitability of soils, presence of utilities, potential for exacerbating existing contamination problems, safety issues, maintenance requirements, and expected lifespans of available technologies.

[67] Runoff reduction techniques can be found in Chapters 4 and 5 of the NYS SWMDM 2015.

C. *Pollutant* Specific BMPs for Pathogens

Part VIII.C. must be implemented for all pathogen impaired waters listed in Appendix C.

1. Mapping

In accordance with the timeframes listed below, the *MS4 Operator* must update, in geographic information system (GIS) format with a scale of 1:24,000 or finer, the comprehensive system mapping (Part IV.D.) to include:

a. Within three (3) years of the EDC, *MS4* infrastructure mapping requirements (Part IV.D.2.b.i.) and *sewersheds* for each:

   i. *MS4 outfall;* and

   ii. *ADA MS4 outfall.*

b. Within three (3) years of the EDC, the following information for each *MS4 outfall*:

   i. Areas with a history of sanitary sewer overflows;

   ii. Waterfowl congregation areas on *municipal* property or right of way;

   iii. Areas where pets/domestic animals may frequent (i.e., public trails, dog parks, and zoos); and

   iv. Waste disposal areas (e.g., active landfills, transfer stations).

c. Within three (3) years of the EDC, *ADA MS4 outfalls.*

2. Public Education and Outreach

a. Within six (6) months of the EDC, the *MS4 Operator* must make available information on any how the impairment is being addressed by implementation of the MS4 Operator's local law or legal mechanism with content equivalent to the model local law (Part IV.E.1 and Part IV.E.2.). *MS4 Operators* must document the completion of this requirement in the *SWMP Plan*.

b. Following the completion of Part VIII.C.1, twice a year, once from March to August and once from September to February, the *MS4 Operator* must provide educational messages with information specific to pathogens to the applicable target audiences within the *sewersheds* for impaired waters listed in Appendix C focus area, identified in Part VI.A.1.b. or Part VII.A.1.b, depending on the MS4 Operator type. The *SWMP Plan* must be updated with changes made to public education and outreach program (Part VI.A. or Part VII.A, depending on the *MS4 Operator* type). *MS4 Operators* must document the completion of this requirement in the *SWMP Plan*.

3. Public Involvement/Participation

No additional requirements.

4. *Illicit Discharge* Detection and Elimination

Following the completion of Part VIII.C.1, within five (5) years of the EDC, the MS4 Operator must include on the *MS4 outfall* inventory (Part VI.C.1.c. or Part VII.C.1.c, depending on the MS4 Operator type) the number of each item identified in Part VIII.C.1.b. for each associated *MS4 outfall*.

5. Construction Site *Stormwater* Runoff Control

No additional requirements.

6. Post-Construction *Stormwater* Management

No additional requirements.

7. Pollution Prevention and Good Housekeeping

Following the completion of Part VIII.C.1:

a. *Infrastructure Maintenance*

i. Annually, from April 1 through October 31, all streets located in *sewersheds discharging* to pathogen impaired segments must be swept. *MS4 Operators* must document the completion of this requirement in the *SWMP Plan*. This requirement is not applicable to:

a) Uncurbed roads with no *catch basins*;

b) High-speed limited access highways; or

c) Roads defined as interstates, freeways and expressways, or arterials by the United States Department of Transportation, Federal Highway Administration, Highway Functional Classification Concepts, Criteria and Procedures, 2013.

ii. Within six (6) months of *MS4 outfall* inspection, the *MS4 Operator* must initiate actions to repair all *MS4 outfall* protection and/or bank stability problems identified during the inspection. Repairs must be completed in accordance with the NYS E&SC 2016. *MS4 Operators* must document the completion of this requirement in the *SWMP Plan*.

b. *Wildlife Control*

i. Within six (6) months of the EDC, the *MS4 Operator* must identify *municipal facilities* with nuisance bird populations that have the potential to contribute pathogens (e.g., Canada Geese) and document those *municipal facilities* in the *SWMP Plan*.

ii. Within six (6) months of the EDC, signage must be available at these municipal facilities, instructing the public not to feed wildlife. *MS4 Operators* must document the completion of this requirement in the *SWMP Plan*.

iii. Within six (6) months of the EDC, the *MS4 Operator* must remove accumulated trash and debris from *municipal* facilities when necessary to

eliminate potential food sources for wildlife. *MS4 Operators* must document the completion of this requirement in the *SWMP Plan*.

iv. Within one (1) year of the EDC, *MS4 Operators* must evaluate the effectiveness of deterrents, population controls, and other measures that may reduce bird related pathogen contributions and document the results of the evaluation in the *SWMP Plan*.

c. Animal Waste Control

Within one (1) year of the EDC, the *MS4 Operator* must make dog waste receptacles available in areas where pets/domestic animals may frequent (e.g., public trails, dog parks). *MS4 Operators* must document the completion of this requirement in the *SWMP Plan*.

8. Planned Upgrades to *Municipal Facilities* in *Sewersheds* to Impaired Waters

Incorporate, where feasible,[68] cost-effective runoff reduction techniques[69] during planned *municipal* upgrades including *municipal* right of ways (e.g., bioswales, green streets, porous pavement, replacement of closed drainage with grass swales, replacement of the existing islands in the parking lots with bioretention or curb cuts to route the flow through below-grade infiltration areas or other low-cost improvements that provide runoff treatment or reduction).

D. *Pollutant* Specific BMPs for Nitrogen

Part VIII.D. must be implemented for all nitrogen impaired waters listed in Appendix C.

1. Mapping

In accordance with the timeframes listed below, the *MS4 Operator* must update, in geographic information system (GIS) format with a scale of 1:24,000 or finer, the comprehensive system mapping (Part IV.D.) to include:

a. Within three (3) years of the EDC, *MS4* infrastructure mapping requirements (Part IV.D.2.b.i.) and *sewersheds* for each:

i. *MS4 outfall;* and

ii. *ADA MS4 outfall.*

b. Within three (3) years of the EDC, the following information for each *MS4 outfall*:

i. Retail and wholesale plant nurseries (including big box stores);

ii. Commercial lawn care facilities; and

[68] Consideration of feasibility should include type of land use or *municipal operation*, suitability of soils, presence of utilities, potential for exacerbating existing contamination problems, safety issues, maintenance requirements, and expected lifespans of available technologies.

[69] Runoff reduction techniques can be found in Chapters 4 and 5 of the NYS SWMDM 2015.

iii. Golf courses.

c. Within three (3) years of the EDC, *ADA MS4 outfalls.*

2. Public Education and Outreach

a. Within six (6) months of the EDC, the *MS4 Operator* must make available information on any how the impairment is being addressed by implementation of the MS4 Operator's local law or legal mechanism with content equivalent to the model local law (Part IV.E.1 and Part IV.E.2.). *MS4 Operators* must document the completion of this requirement in the *SWMP Plan*.

b. Following the completion of Part VIII.D.1, twice a year, once from March to August and once from September to February, the *MS4 Operator* must provide educational messages with information specific to nitrogen to the applicable target audiences within the *sewersheds* for impaired waters listed in Appendix C focus area, identified in Part VI.A.1.b. or Part VII.A.1.b, depending on the MS4 Operator type. The *SWMP Plan* must be updated with changes made to public education and outreach program (Part VI.A or Part VII.A, depending on the *MS4 Operator* type). *MS4 Operators* must document the completion of this requirement in the *SWMP Plan*.

3. Public Involvement/Participation

No additional requirements.

4. *Illicit Discharge* Detection and Elimination

Following the completion of Part VIII.D.1 , within five (5) years of the EDC, the MS4 Operator must include on the *MS4 outfall* inventory (Part VI.C.1.c. or Part VII.C.1.c, depending on the MS4 Operator type) the number of each item identified in Part VIII.D.1.b for each associated *MS4 outfall*.

5. Construction Site *Stormwater* Runoff Control

Following the completion of Part VIII.D.1, high priority construction sites must be inspected during active construction after the pre-construction meeting (Part VI.D.7. or Part VII.D.7, depending on the *MS4 Operator* type).

a. If the *MS4 Operator* is completing the inspection, the construction site must be inspected every ninety (90) days; or

b. If the *MS4 Operator* utilizes the *qualified inspector's* weekly inspection reports, as required by the CGP, to satisfy this requirement, the *MS4 Operator* must inspect the construction site once every six (6) months, or sooner if any deficiencies are noted that require attention.

MS4 Operators must document the construction site inspections in the *SWMP Plan*.

6. Post-Construction *Stormwater* Management

No additional requirements.

7. Pollution Prevention and Good Housekeeping

Following the completion of Part VIII.D.1:

a. Annually, from April 1 through October 31, all streets located in *sewersheds discharging* to nitrogen impaired segments must be swept. *MS4 Operators* must document the completion of this requirement in the *SWMP Plan*. This requirement is not applicable to:

   i. Uncurbed roads with no *catch basins*;

   ii. High-speed limited access highways; or

   iii. Roads defined as interstates, freeways and expressways, or arterials by the United States Department of Transportation, Federal Highway Administration, Highway Functional Classification Concepts, Criteria and Procedures, 2013.

b. Within six (6) months of *MS4 outfall* inspection, the *MS4 Operator* must initiate actions to repair all *MS4 outfall* protection and/or bank stability problems identified during the inspection. Repairs must be completed in accordance with the NYS E&SC 2016. *MS4 Operators* must document the completion of this requirement in the *SWMP Plan*.

8. Planned Upgrades to *Municipal Facilities* in *Sewersheds* to Impaired Waters

Incorporate, where feasible,[70] cost-effective runoff reduction techniques[71] during planned *municipal* upgrades including *municipal* right of ways (e.g., bioswales, green streets, porous pavement, replacement of closed drainage with grass swales, replacement of the existing islands in the parking lots with bioretention or curb cuts to route the flow through below-grade infiltration areas or other low-cost improvements that provide runoff treatment or reduction).

E. *Pollutant* Specific BMPs for Floatables

Part VIII.E. must be implemented for all floatable impaired waters listed in Appendix C.

1. Mapping

In accordance with the timeframes listed below, the *MS4 Operator* must update, in geographic information system (GIS) format with a scale of 1:24,000 or finer, the comprehensive system mapping (Part IV.D.) to include:

a. Within three (3) years of the EDC, *MS4* infrastructure mapping requirements (Part IV.D.2.b.i.) and *sewersheds* for each:

[70] Consideration of feasibility should include type of land use or *municipal operation*, suitability of soils, presence of utilities, potential for exacerbating existing contamination problems, safety issues, maintenance requirements, and expected lifespans of available technologies.

[71] Runoff reduction techniques can be found in Chapters 4 and 5 of the NYS SWMDM 2015.

i. *MS4 outfall;* and

ii. *ADA MS4 outfall.*

b. Within three (3) years of the EDC, *ADA MS4 outfalls.*

2. Public Education and Outreach

a. Within six (6) months of the EDC, the *MS4 Operator* must make available information on any how the impairment is being addressed by implementation of the MS4 Operator's local law or legal mechanism with content equivalent to the model local law (Part IV.E.1 and Part IV.E.2.). *MS4 Operators* must document the completion of this requirement in the *SWMP Plan*.

b. Following the completion of Part VIII.E.1, twice a year, once from March to August and once from September to February, the *MS4 Operator* must provide educational messages with information specific to floatables to the applicable target audiences within the *sewersheds* for impaired waters listed in Appendix C focus area, identified in Part VI.A.1.b. or Part VII.A.1.b, depending on the MS4 Operator type. The *SWMP Plan* must be updated with changes made to public education and outreach program (Part VI.A or Part VII.A, depending on the *MS4 Operator* type). *MS4 Operators* must document the completion of this requirement in the *SWMP Plan*.

3. Public Involvement/Participation

No additional requirements.

4. *Illicit Discharge* Detection and Elimination

No additional requirements.

5. Construction Site *Stormwater* Runoff Control

No additional requirements.

6. Post-Construction *Stormwater* Management

No additional requirements.

7. Pollution Prevention and Good Housekeeping

Following completion of Part VIII.E.1:

a. Annually, from April 1 through October 31, all streets located in *sewersheds discharging* to floatables impaired segments must be swept. *MS4 Operators* must document the completion of this requirement in the *SWMP Plan*. This requirement is not applicable to:

i. Uncurbed roads with no *catch basins*;

ii. High-speed limited access highways; or

iii. Roads defined as interstates, freeways and expressways, or arterials by the United States Department of Transportation, Federal Highway Administration, Highway Functional Classification Concepts, Criteria and Procedures, 2013.

b. Within six (6) months of *MS4 outfall* inspection, the *MS4 Operator* must initiate actions to repair all *MS4 outfall* protection and/or bank stability problems identified during the inspection. Repairs must be completed in accordance with the NYS E&SC 2016. *MS4 Operators* must document the completion of this requirement in the *SWMP Plan*.

8. Planned Upgrades to *Municipal Facilities* in *Sewersheds* to Impaired Waters

Incorporate, where feasible,[72] cost-effective runoff reduction techniques[73] during planned *municipal* upgrades including *municipal* right of ways (e.g., bioswales, green streets, porous pavement, replacement of closed drainage with grass swales, replacement of the existing islands in the parking lots with bioretention or curb cuts to route the flow through below-grade infiltration areas or other low-cost improvements that provide runoff treatment or reduction).

[72] Consideration of feasibility should include type of land use or *municipal operation*, suitability of soils, presence of utilities, potential for exacerbating existing contamination problems, safety issues, maintenance requirements, and expected lifespans of available technologies.

[73] Runoff reduction techniques can be found in Chapters 4 and 5 of the NYS SWMDM 2015.

Part IX. Watershed Improvement Strategy Requirements for TMDL Implementation

Part IX. requirements must be implemented in addition to the applicable requirements of the six (6) MCMs in Part VI. or Part VII, depending on the *MS4 Operator* type. Part IX. requirements apply in the watersheds where the *Department* developed implementation plans for which USEPA has approved a TMDL (Table 3). Finalized TMDL implementation plans referenced in this Part are incorporated into and enforceable under this *SPDES* general permit.

MS4 Operator's subject to Part IX. that implement TMDL specific *BMPs* after the EDC but prior to *MS4* infrastructure and *sewershed* mapping can use those *BMPs* to satisfy the permit requirements in this section.

The Part IX. requirements must be incorporated in the *MS4 Operator*'s *SWMP* and *SWMP Plan*.

A. NYC East of Hudson Phosphorus Impaired Watershed *MS4*s

Table 4. Phosphorus Impaired Watershed(s)			
Areas where requirements apply	**New York City East of Hudson (EOH)**		
EPA Approved TMDL	*Phase II Phosphorus TMDLs for Reservoirs in the NYC Watershed, June 2000*	*Total Maximum Daily Load (TMDL) for Phosphorus in Lake Carmel, October 2016*	*Total Maximum Daily Load (TMDL) for Phosphorus in Palmer Lake,*[2] *March 2015*
Implementation Plan	Croton Watershed Phase II TMDL Implementation Plan (January 2009)		
POC	Phosphorus		
Area where requirements Apply	NYC EOH Watershed		
Achievement of *Pollutant* Load Reduction	Continued *retrofit* implementation to achieve the pollutant load reduction specified in that Phase II Implementation Plan		

MS4 Operators located within the watersheds listed in Table 4 must *develop* and implement the following phosphorus-specific *BMPs* in addition to the Croton Watershed Phase II TMDL Implementation Plan (January 2009) and the applicable requirements in Part VI. or Part VII, depending on the *MS4 Operator* type.

1. Mapping

In accordance with the timeframes listed below, the *MS4 Operator* must update, in geographic information system (GIS) format with a scale of 1:24,000 or finer, the comprehensive system mapping (Part IV.D.) to include:

a. Within three (3) years of the EDC, areas with potential to contribute phosphorus to the TMDL waterbody, which include:
   i. Retail and wholesale plant nurseries (including big box stores);
   ii. Commercial lawn care facilities;
   iii. Golf courses;
   iv. Commercial or industrial yard waste storage areas (e.g., yard waste composting and disposal areas); and
   v. *MS4* infrastructure with a history of issues (e.g., clogged infrastructure, infiltration and inflow (I/I)).

b. Within three (3) years of the EDC, the following information for all post-construction *SMPs* as identified in the post-construction *SMP* inventory (Part VI.E.2. or Part VII.E.2, depending on the *MS4 Operator* type):
   i. Type;[74] and
   ii. Ownership.

2. Public Education and Outreach on *Stormwater* Impacts

a. Within six (6) months of the EDC, the *MS4 Operator* must make available information on how the impairment is being addressed by implementation of the MS4 Operator's local law or legal mechanism with content equivalent to the model local law (Part IV.E.1 and Part IV.E.2.). *MS4 Operators* must document the completion of this requirement in the *SWMP Plan*.

b. Following the completion of Part IX.A.1, twice a year, once from March to August and once from September to February, the *MS4 Operator* must provide educational messages with information specific to phosphorus to the applicable target audiences within the TMDL watershed focus area, identified in Part VI.A.1.b. or Part VII.A.1.b, depending on the MS4 Operator type. The *SWMP Plan* must be updated with changes made to public education and outreach program (Part VI.A. or Part VII.A, depending on the *MS4 Operator* type). *MS4 Operators* must document the completion of this requirement in the *SWMP Plan*.

3. Public Involvement/Participation

No additional requirements.

[74] Post-construction *SMP* types are defined in the New York State Department of Environmental Conservation Maintenance Guidance: Stormwater Management Practices, March 31, 2017 (NYS DEC Maintenance Guidance 2017).

4. *Illicit Discharge* Detection and Elimination

a. Inventory of Potential Phosphorus Sources

Following the completion of Part IX.A.1, within five (5) years of the EDC, the MS4 Operator must include on the *MS4 outfall* inventory (Part VI.C.1.c. or Part VII.C.1.c, depending on the MS4 Operator type) the number of each item identified in Part IX.A.1.a. for each associated *MS4 outfall*.

b. On-site wastewater systems

The *MS4 Operator* must *develop*, implement, and enforce a program that ensures on-site wastewater systems (i.e., septic tanks, cesspools, absorption fields or distribution systems) are properly operated and do not contribute *pollutants* to the *MS4*. To ensure this, the *MS4 Operator* must:

i. Once every five (5) years, ensure that residential septic tanks/cesspools are pumped out and system components (i.e., septic tanks, cesspools and installed absorption field) are inspected;

ii. Ensure the following information is collected and document the completion of this requirement in the *SWMP Plan*:

   a) Individual performing inspection;

   b) Inspection date;

   c) Address;

   d) Location of system on property; and

   e) Evidence of failed systems.

iii. Refer failures to the appropriate agency to ensure corrective actions are taken; and

iv. Eliminate *illicit discharges* from on-site wastewater systems to the *MS4* in accordance with the time frames specified in Part VI.C.3. or Part VII.C.3, depending on the *MS4 Operator* type.

5. Construction Site *Stormwater* Runoff Control

a. The *MS4 Operator* must include construction projects that disturb between 5000 square feet (sf) and one (1) acre in the construction site runoff control program as described in Part VI.D. or Part VII.D, depending on the *MS4 Operator* type. Construction projects meeting this threshold are low priority construction sites.

b. The legal authority used to satisfy Part IV.E.2.b. must include the following language:

"Land activity is defined as *construction activity* including clearing, grading, excavating, soil disturbance or placement of fill that results in land disturbance of equal to or greater than 5000 sf and activities disturbing less

than 5000 sf of total land area that are part of a *larger common plan of development or sale* and will occur under one plan."

c. High priority construction sites must be inspected during active construction after the pre-construction meeting (Part VI.D.7. or Part VII.D.7, depending on the *MS4 Operator* type).

   i. If the *MS4 Operator* is completing the inspection, the construction site must be inspected every ninety (90) days; or

   ii. If the *MS4 Operator* utilizes the *qualified inspector's* weekly inspection reports, as required by the CGP, to satisfy this requirement, the *MS4 Operator* must inspect the construction site once every six (6) months, or sooner if any deficiencies are noted that require attention.

MS4 Operators must document the construction site inspections in the *SWMP Plan*.

6. Post-Construction *Stormwater* Management

a. The *MS4 Operator* must require the use of the Enhanced Phosphorus Removal design standards contained in Chapter 10 of the NYS SWMDM 2015 for all new development and redevelopment projects that disturb greater than or equal to one (1) acre and construction projects less than one acre that are part of a larger common plan of development or sale.

b. The legal authority used to satisfy Part IV.E. must also meet the following provisions:

   Land development activities requiring water quantity and quality controls (post-construction *stormwater* runoff controls) must include: "Single-family home construction located in the NYC East of Hudson watershed" and "Single-family residential subdivisions located in the NYC East of Hudson watershed."

c. Requirements for SWPPPs that include post-construction *stormwater* controls must include: "Post-construction *SMPs* in the SWPPP must be designed in conformance with Chapter 10 of the NYS SWMDM 2015 for Enhanced Phosphorus Removal Design Standards."

d. Performance Standards must include the following enhanced stabilization requirements: "For construction sites located in the NYC East of Hudson watershed, where soil disturbance activity has temporarily or permanently ceased, the application of soil stabilization measures must be initiated by the end of the next business day and completed within seven (7) days from the date the current soil disturbance activity ceased. The soil stabilization measures selected must be in conformance with the NYS E&SC 2016."

e. Inspections of land development activities during construction must include requirements for a *qualified inspector* to conduct two (2) site inspections every seven (7) calendar days for single-family homes, and single-family residential, subdivisions within the NYC East of Hudson watersheds.

f. *Retrofit* program

i. All *MS4 Operators* identified within the Croton Watershed Phase II TMDL Implementation Plan, January 2009, must continue to implement the *retrofit* program according to the following schedule:

a) Within one (1) year of the EDC, the *MS4 Operator* must submit to the *Department* a *retrofit* plan that identifies the following:

i) Project name;

ii) Location;

iii) Proposed *retrofit* type;

iv) Anticipated date for construction;

v) Estimated phosphorus reduction (using the criteria in the Croton Watershed Phase II TMDL Implementation Plan, January 2009); and

vi) Estimated total phosphorus reduction for all projects demonstrating they will meet the reduction specified in the Croton Watershed Phase II TMDL Implementation Plan, January 2009.

b) Within five (5) years of the EDC, all *retrofit* projects must be constructed to achieve the five (5) year phosphorus reduction assigned to the *MS4 Operator*, as required by the Croton Watershed Phase II TMDL Implementation Plan, January 2009.

ii. Annually, by December 31, *MS4 Operators* (or *RSE* representing *MS4 Operators* as described in Part III.B.2.b.) must submit to the *Department* any changes made to the *retrofit* plan including the information in Part IX.A.6.e.i.

iii. *MS4 Operators* must document the retrofit program in the *SWMP Plan* specifying:

a) Progress on *retrofit* projects already commenced; and

b) Identification of *retrofit* projects for the upcoming construction season; and

c) Certification that completed retrofit projects have been constructed in accordance with the *retrofit* plans.

7. Pollution Prevention/Good Housekeeping

a. Twice a year, once from March to August and once from September to February, all *catch basins* located in the TMDL watershed(s) must be inspected (Part VI.F.3.c. or Part VII.F.3.c, depending on the MS4 Operator type). *MS4 Operators* must document the completion of this requirement in the *SWMP Plan*.

b. Following the completion of Part IX.A.1, annually, from April 1 through October 31, all streets located in the TMDL watershed(s) must be swept. *MS4 Operators* must document the completion of this requirement in the *SWMP Plan*. This requirement is not applicable to:

   i. Uncurbed roads with no *catch basins*;

   ii. High-speed limited access highways;

   iii. Roads defined as interstates, freeways and expressways, or arterials by the United States Department of Transportation, Federal Highway Administration, Highway Functional Classification Concepts, Criteria and Procedures, 2013.

c. Within six (6) months of *MS4 outfall* inspection, the *MS4 Operator* must initiate actions to repair all *MS4 outfall* protection and/or bank stability problems identified during the inspection. Repairs must be completed in accordance with the NYS E&SC 2016. *MS4 Operators* must document the completion of this requirement in the *SWMP Plan.* Within thirty (30) days of inspection, the *MS4 Operator* must initiate all necessary maintenance and repair activities discovered for *municipally* owned or operated post-construction *SMPs*. *MS4 Operators* must document the completion of this requirement in the *SWMP Plan*.

8. Planned Upgrades to *Municipal Facilities* in Watersheds to Impaired Waters

Incorporate, where feasible,[75] cost-effective runoff reduction techniques[76] during planned *municipal* upgrades including *municipal* right of ways (e.g., bioswales, green streets, porous pavement, replacement of closed drainage with grass swales, replacement of the existing islands in the parking lots with bioretention or curb cuts to route the flow through below-grade infiltration areas or other low-cost improvements that provide runoff treatment or reduction).

[75] Consideration of feasibility should include type of land use or *municipal operation*, suitability of soils, presence of utilities, potential for exacerbating existing contamination problems, safety issues, maintenance requirements, and expected lifespans of available technologies.

[76] Runoff reduction techniques can be found in Chapters 4 and 5 of the NYS SWMDM 2015.

B. Other Phosphorus Impaired Watershed *MS4*s

Table 5. Other Phosphorus Impaired Watersheds			
Area where Requirements Apply	**Greenwood Lake**	**Onondaga Lake**	**Oscawana Lake**
EPA Approved TMDL	*Impaired Waters Restoration Plan for Greenwood Lake – Total Maximum Daily Load for Total Phosphorus, Sept 2005*	*Updated Phosphorus Total Maximum Daily Load for Onondaga Lake, June 2012*	*Total Maximum Daily Load (TMDL) for Phosphorus in Lake Oscawana, September 2008*
Implementation Plan	Greenwood Lake Watershed Phosphorus TMDL Implementation Plan, October 2019	None	None
POC	Phosphorus		
Achievement of *Pollutant* Load Reduction	In accordance with Implementation Plan	In accordance with approved TMDL	In accordance with approved TMDL

MS4 Operators located in the watersheds listed in Table 5 must *develop* and implement the following phosphorus-specific *BMPs* in addition to the applicable Implementation Plan and applicable requirements in Part VI. or Part VII, depending on the *MS4* Operator type:

1. Mapping

In accordance with the timeframes listed below, the *MS4 Operator* must update, in geographic information system (GIS) format with a scale of 1:24,000 or finer, the comprehensive system mapping (Part IV.D.) to include:

a. Within three (3) years of the EDC, include areas with potential to contribute phosphorus to the TMDL waterbody, which include:

   i. Retail and wholesale plant nurseries (including big box stores);

   ii. Commercial lawn care facilities;

   iii. Golf courses; and

   iv. Commercial or industrial yard waste storage areas (e.g., yard waste composting and disposal areas).

b. Within three (3) years of the EDC, include the following information for all post-construction *SMPs* as identified in the post-construction *SMP* inventory (Part VI.E.2. or Part VII.E.2, depending on the *MS4 Operator* type):

i. Type[77]; and

ii. Ownership.

2. Public Education and Outreach on Stormwater Impacts

a. Within six (6) months of the EDC, the *MS4 Operator* must make available information on any how the impairment is being addressed by implementation of the MS4 Operator's local law or legal mechanism with content equivalent to the model local law (Part IV.E.1 and Part IV.E.2.). *MS4 Operators* must document the completion of this requirement in the *SWMP Plan*.

b. Following the completion of Part IX.B.1, twice a year, once from March to August and once from September to February, the *MS4 Operator* must provide educational messages with information specific to phosphorus to the applicable target audiences within the TMDL watershed focus area, identified in Part VI.A.1.b. or Part VII.A.1.b, depending on the MS4 Operator type. The *SWMP Plan* must be updated with changes made to public education and outreach program (Part VI.A. or Part VII.A, depending on the *MS4 Operator* type). *MS4 Operators* must document the completion of this requirement in the *SWMP Plan*.

c. Twice a permit term, separated by a minimum of one (1) year, the *MS4 Operator* must educate residential on-site wastewater system users on the on-site wastewater inspection program described in Part IX.B.4.c and proper maintenance practices. The *SWMP Plan* must be updated with changes made to public education and outreach program (Part VI.A or Part VII.A, depending on the *MS4 Operator* type). *MS4 Operators* must document the completion of this requirement in the *SWMP Plan*.

3. Public Involvement/Participation

No additional requirements.

4. *Illicit Discharge* Detection and Elimination

a. Inventory of Potential Phosphorus Sources

Following the completion of Part IX.B.1, within five (5) years of the EDC, the MS4 Operator must include on the *MS4 outfall* inventory (Part VI.C.1.c. or Part VII.C.1.c, depending on the MS4 Operator type) the number of each item identified in Part VIII.B.1.a. for each associated MS4 outfall.

b. On-site wastewater systems

The *MS4 Operator* (with the exclusion of *MS4 Operators* located in the Onondaga Lake watershed) must *develop*, implement, and enforce a program that ensures residential on-site wastewater systems (i.e., septic tanks,

[77] Post-construction *SMP* types are defined in the New York State Department of Environmental Conservation Maintenance Guidance: Stormwater Management Practices, March 31, 2017 (NYS DEC Maintenance Guidance 2017).

cesspools, absorption fields or distribution systems) are properly operated and do not contribute *pollutants* to the *MS4*. The *MS4 Operator* must:

i. Once every five (5) years, ensure that residential septic tanks/cesspools are pumped out and system components (i.e., septic tanks, cesspools and installed absorption field) are inspected;

ii. Ensure the following information is collected and document the completion of this requirement in the *SWMP Plan*:

a) Individual performing inspection;

b) Inspection date;

c) Address;

d) Location of system on property;

e) Inspection rating (pass/fail);

f) Evidence of failed systems;

iii. Refer failures to the appropriate agency to ensure corrective actions are taken; and

iv. Eliminate *illicit discharges* from on-site wastewater systems to the *MS4* in accordance with the time frames specified in Part VI.C.3. or Part VII.C.3, depending on the *MS4 Operator* type.

5. Construction Site *Stormwater* Runoff Control

High priority construction sites must be inspected during active construction after the pre-construction meeting (Part VI.D.7. or Part VII.D.7, depending on the *MS4 Operator* type).

a. If the *MS4 Operator* is completing the inspection, the construction site must be inspected every ninety (90) days; or

b. If the *MS4 Operator* utilizes the *qualified inspector's* weekly inspection reports, as required by the CGP, to satisfy this requirement, the *MS4 Operator* must inspect the construction site once every six (6) months, or sooner if any deficiencies are noted that require attention.

MS4 Operators must document the construction site inspections in the *SWMP Plan*.

6. Post Construction *Stormwater* Management

a. The *MS4 Operator* must require the use of the Enhanced Phosphorus Removal design standards contained in Chapter 10 of the NYS SWMDM 2015 for all new development and redevelopment projects within the listed watersheds.

b. The legal authority used to satisfy Part IV.E.2.b. must also include the following language requiring the use of the Enhanced Phosphorus Removal

Design Standards in accordance with the NYS SWMDM 2015 for the applicable watershed:

"Land development activities requiring water quantity and quality controls (post-construction *stormwater* runoff controls) must include: "Single-family home construction located in the <insert watershed name> watershed" and "Single-family residential subdivisions located in the <insert watershed name> watershed."

c. Requirements for SWPPPs that include post-construction *stormwater* controls must include: "Post-construction *SMPs* in the SWPPP must be designed in conformance with the Enhanced Phosphorus Removal Design Standards in the NYS SWMDM 2015."

d. Performance Standards must include the following enhanced stabilization requirements: "Where soil disturbance activity has temporarily or permanently ceased, the construction site is located in the <*insert watershed name*> watershed, the application of soil stabilization measures must be initiated by the end of the next business day and completed within seven (7) days from the date the current soil disturbance activity ceased. The soil stabilization measures selected must be in conformance with the Erosion Control Manual."

e. Inspections of land development activities during construction must include requirements for a *qualified inspector* to conduct two (2) site inspections every seven (7) calendar days for single-family homes and subdivisions within the <*insert watershed name*> watersheds.

f. *Retrofit* program

   i. All *MS4 Operators* identified within the Greenwood Lake Watershed Phosphorus TMDL Implementation Plan, October 2019, must continue to implement the *retrofit* program according to the following schedule:

      a) Within one (1) year of the EDC, the *MS4 Operator* must submit to the *Department* a *retrofit* plan that identifies the following:

         i) Project name;

         ii) Location;

         iii) Proposed *retrofit* type;

         iv) Anticipated date for construction;

         v) Estimated phosphorus reduction (using the criteria in the Greenwood Lake Watershed Phosphorus TMDL Implementation Plan, October 2019); and

         vi) Estimated total phosphorus reduction for all projects demonstrating they will meet the reduction specified in the Greenwood Lake Watershed Phosphorus TMDL Implementation Plan, October 2019.

      b) Within five (5) years of the EDC, all *retrofit* projects must be constructed to achieve the five (5) year phosphorus reduction assigned

to the *MS4 Operator*, as required by the Greenwood Lake Watershed Phosphorus TMDL Implementation Plan, October 2019.

ii. Annually, by December 31, *MS4 Operators* (or *RSE* representing *MS4 Operators* as described in Part III.B.2.b.) must submit to the *Department* any changes made to the *retrofit* plan including the information in Part IX.A.6.e.i.

iii. *MS4 Operators* must document the retrofit program in the *SWMP Plan* specifying:

a) Progress on *retrofit* projects already commenced; and

b) Identification of *retrofit* projects for the upcoming construction season; and

c) Certification that completed retrofit projects have been constructed in accordance with the *retrofit* plans.

7. Pollution Prevention/Good Housekeeping

Following the completion of Part IX.B.1:

a. Annually, from April 1 through October 31, all streets located in the TMDL watershed(s) must be swept. *MS4 Operators* must document the completion of this requirement in the *SWMP Plan*. This requirement is not applicable to:

i. Uncurbed roads with no *catch basins*;

ii. High-speed limited access highways; or

iii. Roads defined as interstates, freeways and expressways, or arterials by the United States Department of Transportation, Federal Highway Administration, Highway Functional Classification Concepts, Criteria and Procedures, 2013.

b. Within six (6) months of *MS4 outfall* inspection, the *MS4 Operator* must initiate actions to repair all *MS4 outfall* protection and/or bank stability problems identified during the inspection. Repairs must be completed in accordance with the NYS E&SC 2016. *MS4 Operators* must document the completion of this requirement in the *SWMP Plan*.

c. Within thirty (30) days of inspection, the *MS4 Operator* must initiate all necessary maintenance and repair activities discovered for *municipally* owned or operated post-construction *SMPs*. *MS4 Operators* must document the completion of this requirement in the *SWMP Plan*.

8. Planned Upgrades to *Municipal Facilities* in Watersheds to Impaired Waters

Incorporate, where feasible,[78] cost-effective runoff reduction techniques[79] during planned *municipal* upgrades including *municipal* right of ways (e.g., bioswales, green streets, porous pavement, replacement of closed drainage with grass swales, replacement of the existing islands in the parking lots with bioretention or curb cuts to route the flow through below-grade infiltration areas or other low-cost improvements that provide runoff treatment or reduction).

C. Pathogen Impaired Watersheds *MS4*s

No Pathogen TMDL requirements.

D. Nitrogen Impaired Watershed *MS4*s

Table 6. Nitrogen Impaired Watershed(s)	
Area where Requirements Apply	**Peconic**
EPA Approved TMDL	*TMDL for Nitrogen in the Peconic Estuary Program Study Area, Including Waterbodies Currently Impaired Due to Low Dissolved Oxygen: the Lower Peconic River and Tidal Tributaries; Western Flanders Bay and Lower Sawmill Creek; and Meetinghouse Creek, Terry Creek and Tributaries (September 2007)*
Implementation Plan	*TMDL for Nitrogen in the Peconic Estuary Program Study Area, Including Waterbodies Currently Impaired Due to Low Dissolved Oxygen: the Lower Peconic River and Tidal Tributaries; Western Flanders Bay and Lower Sawmill Creek; and Meetinghouse Creek, Terry Creek and Tributaries (September 2007)*
POC	Nitrogen
Pollutant Load Reduction	In accordance with approved TMDL
Waterbodies	Terrys Creek & Tributaries
	Meetinghouse Creek
	Western Flanders Bay & Lower Sawmill Creek
	Lower Peconic River and tidal tributaries

[78] Consideration of feasibility should include type of land use or *municipal operation*, suitability of soils, presence of utilities, potential for exacerbating existing contamination problems, safety issues, maintenance requirements, and expected lifespans of available technologies.

[79] Runoff reduction techniques can be found in Chapters 4 and 5 of the NYS SWMDM 2015.

MS4 Operators located in the watersheds listed in Table 6 must *develop* and implement the following nitrogen-specific *BMPs* in addition to the applicable Implementation Plan and applicable requirements in Part VI. or Part VII, depending on the *MS4 Operator* type:

1. Mapping

Within three (3) years of the EDC, the *MS4 Operator* must update, in geographic information system (GIS) format with a scale of 1:24000 or finer, the comprehensive system mapping (Part IV.D.) to include:

a. Areas with potential to contribute nitrogen to the *TMDL* waterbody, which include:

   i. Retail and wholesale plant nurseries (including big box stores);

   ii. Commercial lawn care facilities;

   iii. Golf courses; and

   iv. Commercial or Industrial yard waste storage areas (e.g., yard waste composting and disposal areas).

b. Information for all post-construction *SMPs* as identified in the post-construction *SMP* inventory (Part VI.E.2. or Part VII.E.2, depending on the *MS4 Operator* type):

   i. Type;[80] and

   ii. Ownership of *SMP*.

2. Public Education and Outreach on *Stormwater* Impacts

a. Within six (6) months of the EDC, the *MS4 Operator* must make available information on any how the impairment is being addressed by implementation of the MS4 Operator's local law or legal mechanism with content equivalent to the model local law (Part IV.E.1 and Part IV.E.2.). *MS4 Operators* must document the completion of this requirement in the *SWMP Plan*.

b. Following the completion of Part IX.D.1, twice a year, once from March to August and once from September to February, the *MS4 Operator* must provide educational messages with information specific to nitrogen to the applicable target audiences within the TMDL watershed focus area, identified in Part VI.A.1.b. or Part VII.A.1.b, depending on the MS4 Operator type. The *SWMP Plan* must be updated with changes made to public education and outreach program (Part VI.A. or Part VII.A, depending on the *MS4 Operator* type). *MS4 Operators* must document the completion of this requirement in the *SWMP Plan*.

[80] Post-construction *SMP* types are defined in the New York State Department of Environmental Conservation Maintenance Guidance: Stormwater Management Practices, March 31, 2017 (NYS DEC Maintenance Guidance 2017).

3. Public Involvement/Participation

No additional requirements.

4. *Illicit Discharge* Detection and Elimination

Following the completion of Part IX.D.1, within five (5) years of the EDC, the MS4 Operator must include on the *MS4 outfall* inventory (Part VI.C.1.c. or Part VII.C.1.c, depending on the MS4 Operator type) the number of each item identified in Part VIII.D.1.a. for each associated MS4 outfall.

5. Construction Site *Stormwater* Runoff Control

High priority construction sites must be inspected during active construction after the pre-construction meeting (Part VI.D.7. or Part VII.D.7, depending on the *MS4 Operator* type).

a. If the *MS4 Operator* is completing the inspection, the construction site must be inspected every ninety (90) days; or

b. If the *MS4 Operator* utilizes the *qualified inspector's* weekly inspection reports, as required by the CGP, to satisfy this requirement, the *MS4 Operator* must inspect the construction site once every six (6) months, or sooner if any deficiencies are noted that require attention.

MS4 Operators must document the construction site inspections in the *SWMP Plan*.

6. Post-Construction *Stormwater* Management

The *MS4 Operator* must ensure on-site retention of the 1-year storm or greater from new development or redevelopment projects using runoff reduction techniques[81] selected from the NYS SWMDM 2015.

7. Pollution Prevention/Good Housekeeping

Following the completion of Part IX.D.1:

a. Annually, from April 1 through October 31, all streets located in the TMDL watershed(s) must be swept. *MS4 Operators* must document the completion of this requirement in the *SWMP Plan*. This requirement is not applicable to:

   i. Uncurbed roads with no *catch basins*;

   ii. High-speed limited access highways; or

   iii. Roads defined as interstates, freeways and expressways, or arterials by the United States Department of Transportation, Federal Highway Administration, Highway Functional Classification Concepts, Criteria and Procedures, 2013.

[81] Runoff reduction techniques can be found in Chapters 4 and 5 of the NYS SWMDM 2015.

b. Within six (6) months of *MS4 outfall* inspection, the *MS4 Operator* must initiate actions to repair all *MS4 outfall* protection and/or bank stability problems identified during the inspection. Repairs must be completed in accordance with the NYS E&SC 2016. *MS4 Operators* must document the completion of this requirement in the *SWMP Plan*.

c. Within thirty (30) days of inspection, the *MS4 Operator* must initiate all necessary maintenance and repair activities discovered for *municipally* owned or operated post-construction *SMPs*. *MS4 Operators* must document the completion of this requirement in the *SWMP Plan*.

8. Planned Upgrades to *Municipal Facilities* in Watersheds to Impaired Waters

Incorporate, where feasible,[82] cost-effective runoff reduction techniques[68] during planned *municipal* upgrades including *municipal* right of ways (e.g., bioswales, green streets, porous pavement, replacement of closed drainage with grass swales, replacement of the existing islands in the parking lots with bioretention or curb cuts to route the flow through below-grade infiltration areas or other low-cost improvements that provide runoff treatment or reduction).

[82] Consideration of feasibility should include type of land use or *municipal operation*, suitability of soils, presence of utilities, potential for exacerbating existing contamination problems, safety issues, maintenance requirements, and expected lifespans of available technologies.

Part X. Standard Permit Conditions

For the purposes of this *SPDES* general permit, examples of contractors and subcontractors include:

A. Duty to Comply

The owner/operator, and all contractors or subcontractors, must comply with all terms and conditions of this *SPDES* general permit. Any non-compliance with the terms and conditions of this *SPDES* general permit constitutes a violation of the New York State Environmental Conservation Law, and its implementing regulations, and is grounds for enforcement action. Filing of a request for transfer or termination of coverage under this *SPDES* general permit, or a notification of planned changes or anticipated non-compliance, does not limit, diminish or stay compliance with any terms and conditions of this *SPDES* general permit.

B. Need to Halt or Reduce Activity is Not a Defense

The necessity to halt or reduce the activity regulated by this *SPDES* general permit, in order to maintain compliance with the conditions of this *SPDES* general permit, shall not be a defense in an enforcement action.

C. Penalties

There are substantial criminal, civil, and administrative penalties associated with violating the terms and conditions of this *SPDES* general permit. Fines of up to $37,500 per day for each violation and imprisonment for up to fifteen (15) years may be assessed depending upon the nature and degree of the offense.

D. False Statements

Any person who knowingly makes any false material statement, representation, or certification in any application, record, report or other document filed or required to be maintained under this *SPDES* general permit, including monitoring reports or reports of compliance or noncompliance shall, upon conviction, be punished in accordance with New York State Environmental Conservation Law §71-1933 and or New York State Penal Law Articles 175 and 210.

E. Reopener Clause

Upon issuance of this *SPDES* general permit, a determination has been made on the basis of a submitted Notice of Intent, plans, or other available information, that compliance with the specified general permit terms and conditions will reasonably protect classified water use and assure compliance with applicable *water quality standards*. Satisfaction of the conditions of this *SPDES* general permit notwithstanding, if operation pursuant to this *SPDES* general permit causes or contributes to a condition in contravention of State *water quality standards* or guidance values, or if the *Department* determines that a modification is necessary to prevent impairment of the best use of the waters or to assure maintenance of *water*

quality standards or compliance with other provisions of New York State Environmental Conservation Law Article 17 or the Clean Water Act, or any regulations adopted pursuant thereto, the *Department* may require such modification and the Commissioner may require abatement action to be taken by the owner/operator and may also prohibit such operation until the modification has been implemented.

F. Duty to Mitigate

The owner/operator, and its contractors and subcontractors, shall take all reasonable steps to minimize or prevent any *discharge* in violation of this *SPDES* general permit which has a reasonable likelihood of adversely affecting human health or the environment.

G. Requiring Another General Permit or Individual *SPDES* Permit

The *Department* may require any discharger authorized to *discharge* in accordance with this *SPDES* general permit to apply for and obtain an individual *SPDES* permit or apply for authorization to *discharge* in accordance with another general permit.

(1) Cases where an individual *SPDES* permit or authorization to *discharge* in accordance with another general permit may be required include, but is not limited to the following:

(i) the discharger is not in compliance with the conditions of this *SPDES* general permit or does not meet the criteria for coverage under this *SPDES* general permit;

(ii) a change has occurred in the availability of demonstrated technology or practices for the control or abatement of *pollutants* applicable to the point source;

(iii) new effluent limitation guidelines or new source performance standards are promulgated that are applicable to point sources authorized to *discharge* in accordance with this *SPDES* general permit;

(iv) existing effluent limitation guidelines or new source performance standards that are applicable to point sources authorized to *discharge* in accordance with this *SPDES* general permit are modified;

(v) a water quality management plan containing requirements applicable to such point sources is approved by the *Department*;

(vi) circumstances have changed since the time of the request to be covered so that the discharger is no longer appropriately controlled under this *SPDES* general permit, or either a temporary or permanent reduction or elimination of the authorized *discharge* is necessary;

(vii) the *discharge* is in violation of section 17-0501 of the New York State Environmental Conservation Law;

(viii) the *discharge*(s) is a significant contributor of *pollutants*. In making this determination, the *Department* may consider the following factors:

(a) the location of the *discharge*(s) with respect to waters of New York State;
(b) the size of the *discharge*(s);
(c) the quantity and nature of the *pollutants discharged* to waters of New York State; and
(d) other relevant factors including compliance with other provisions of New York State Environmental Conservation Law Article 17, or the Clean Water Act.

(1) When the *Department* requires any discharger authorized by this *SPDES* general permit to apply for an individual *SPDES* permit as provided for in this subdivision, it shall notify the discharger in writing that a permit application is required. This notice shall include a brief statement of the reasons for this decision, an application form, a statement setting a time for the owner/operator to file the application for an individual *SPDES* permit, and a deadline, not sooner than 180 days from the owner/operator's receipt of the notification letter, whereby the authorization to discharge under this *SPDES* general permit shall be terminated. The *Department* may grant additional time upon demonstration, to the satisfaction of the Regional Water Engineer, that additional time to apply for an alternative authorization is necessary or where the *Department* has not provided a permit determination in accordance with 6 NYCRR Part 621.

(2) When an individual *SPDES* permit is issued to a discharger authorized to *discharge* under this *SPDES* general permit for the same *discharge*(s), this *SPDES* general permit authorization for outfalls authorized under the individual *SPDES* permit is automatically terminated on the effective date of the individual *SPDES* permit unless termination is earlier in accordance with 6 NYCRR Part 750.

H. Duty to Provide Information

The owner/operator shall furnish to the *Department*, within five (5) business days, unless otherwise set forth by the *Department*, any information that the *Department* may request to determine whether cause exists to determine compliance with this *SPDES* general permit or to determine whether cause exists for requiring an individual *SPDES* permit in accordance with 6 NYCRR 750-1.21l (see G. Requiring Another General Permit or Individual Permit). The owner/operator shall make available to the *Department*, for inspection and copying, or furnish to the *Department* within 25 business days of receipt of a *Department* request for such information, any information retained in accordance with this *SPDES* general permit. Where the owner/operator becomes aware that it failed to submit any relevant facts on the Notice of Intent, or submitted incorrect information in a Notice of Intent or in any report to the *Department*, the owner/operator shall promptly submit such facts or corrected information to the *Department*.

I. Extension

In the event a new *SPDES* general permit is not issued prior to the expiration of this *SPDES* general permit, and this *SPDES* general permit is extended pursuant to the State Administrative Procedure Act and 6 NYCRR Part 621, then the owner/operator

with coverage under this *SPDES* general permit may continue to operate and *discharge* in accordance with the terms and conditions of this *SPDES* general permit until a new *SPDES* general permit is issued.

J. Signatories and Certification

The Notice of Intent, Notice of Termination and reports required by this *SPDES* general permit shall be signed as provided in 40 CFR §122.22

(a) All Notices of Intent and Notices of Termination shall be signed as follows:

(1) For a corporation. By a responsible corporate officer. For the purpose of this section, a responsible corporate officer means:

(i) A president, secretary, treasurer, or vice-president of the corporation in charge of a principal business function, or any other person who performs similar policy- or decision-making functions for the corporation, or

(ii) The manager of one or more manufacturing, production, or operating facilities, provided, the manager is authorized to make management decisions which govern the operation of the regulated facility including having the explicit or implicit duty of making major capital investment recommendations, and initiating and directing other comprehensive measures to assure long term environmental compliance with environmental laws and regulations; the manager can ensure that the necessary systems are established or actions taken to gather complete and accurate information for Notice of Intent or Notice of Termination requirements; and where authority to sign documents has been assigned or delegated to the manager in accordance with corporate procedures.

Note: The *Department* does not require specific assignments or delegations of authority to responsible corporate officers identified in 40 CFR §122.22(a)(1)(i). The *Department* will presume that these responsible corporate officers have the requisite authority to sign the Notice of Intent or Notice of Termination unless the corporation has notified the *Department* to the contrary. Corporate procedures governing authority to sign a Notice of Intent or Notice of Termination may provide for assignment or delegation to applicable corporate positions under 40 CFR §122.22(a)(1)(ii) rather than to specific individuals.

(2) For a partnership or sole proprietorship. By a general partner or the proprietor, respectively; or

(3) For a *municipality*, State, Federal, or other public agency. By either a principal executive officer or ranking elected official. For purposes of this section, a principal executive officer of a Federal agency includes:

(i) The chief executive officer of the agency, or

(ii) A senior executive officer having responsibility for the overall operations of a principal geographic unit of the agency (e.g., Regional Administrators of EPA).

(b) All reports required by this *SPDES* general permit, and other information requested by the *Department* shall be signed by a person described in paragraph (a) of this section, or by a duly authorized representative of that person. A person is a duly authorized representative only if:
(1) The authorization is made in writing by a person described in (a);
(2) The authorization specifies either an individual or a position having responsibility for the overall operation of the regulated facility or activity, position of equivalent responsibility, or an individual or position having overall responsibility for environmental matters for the company (A duly authorized representative may thus be either a named individual or any individual occupying a named position.), and
(3) The written authorization is submitted to the *Department*.

(c) Changes to authorization. If an authorization under (b) is no longer accurate because a different individual or position has responsibility for the overall operation of the facility or activity, a new authorization satisfying the requirements of (b) must be submitted to the *Department* prior to or together with any reports, information, or applications to be signed by an authorized representative.

(d) Certification. Any person signing a document under (a) or (b) shall make the following certification:

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

(e) Electronic reporting. If documents described in (a) or (b) are submitted electronically by or on behalf of the activity with coverage under this *SPDES* general permit, any person providing the electronic signature for such documents shall meet all relevant requirements of this section, and shall ensure that all of the relevant requirements of 40 CFR Part 3 (including, in all cases, subpart D to Part 3) (Cross-Media Electronic Reporting) and 40 CFR Part 127 (NPDES Electronic Reporting Requirements) are met for that submission.

K. Inspection & Entry

The owner/operator shall allow the *Department*, the USEPA Regional Administrator, the applicable county health department, or any authorized representatives of those entities, upon the presentation of credentials and other documents as may be required by law, to:

(a) enter upon the owner/operator's premises where a regulated facility or activity is located or conducted, or where records must be kept under the conditions of this *SPDES* general permit;
(b) have access to and copy, at reasonable times, any records that must be kept under the conditions of this *SPDES* general permit, including records required to be maintained for purposes of operation and maintenance;
(c) inspect at reasonable times any facilities, equipment (including monitoring and control equipment), practices, or operations regulated or required under this *SPDES* general permit;
(d) sample or monitor at reasonable times, for the purposes of assuring *SPDES* general permit compliance or as otherwise authorized by the Clean Water Act or New York State Environmental Conservation Law, any substances or parameters at any location; and
(e) enter upon the property of any contributor to the regulated facility or activity under authority of the owner/operator.

L. Confidentiality of Information

The following shall not be held confidential: this *SPDES* general permit, the fact sheet for this *SPDES* general permit, the name and address of any owner/operator, effluent data, the Notice of Intent, and information regarding the need to obtain an individual permit or an alternative general permit. This includes information submitted on forms themselves and any attachments used to supply information required by the forms (except information submitted on usage of substances). Upon the request of the owner/operator, the *Department* shall make determinations of confidentiality in accordance with 6 NYCRR Part 616, except as set forth in the previous sentence. Any information accorded confidential status shall be disclosed to the Regional Administrator upon his or her written request. Prior to disclosing such information to the Regional Administrator, the *Department* will notify the Regional Administrator of the confidential status of such information.

M. Other Permits May Be Required

Nothing in this *SPDES* general permit relieves the owner/operator from a requirement to obtain any other permits required by law.

N. Property Rights

Coverage under this *SPDES* general permit does not convey any property rights in either real or personal property, or any exclusive privileges, nor does it authorize any injury to private property or any invasion of personal rights, nor any infringement of Federal, State or local laws or regulations, nor does it obviate the necessity of obtaining the assent of any other jurisdiction as required by law for the *discharge* authorized.

O. Compliance with Interstate Standards

If the activity covered by this *SPDES* general permit originates within the jurisdiction of an interstate water pollution control agency, then the activity must also comply

with any applicable effluent standards or *water quality standards* promulgated by that interstate agency and as set forth in this *SPDES* general permit for such activities.

P. Oil & Hazardous Substance Liability

Coverage under this *SPDES* general permit does not affect the imposition of responsibilities upon, or the institution of any legal action against, the owner or operator under section 311 of the Clean Water Act, which shall be in conformance with regulations promulgated pursuant to section 311 governing the applicability of section 311 of the Clean Water Act to *discharges* from facilities with NPDES permits, nor shall such issuance preclude the institution of any legal action or relieve the owner or operator from any responsibilities, liabilities, or penalties to which the owner or operator is or may be subject pursuant to the Comprehensive Environmental Response, Compensation and Liability Act of 1980, 42 U.S.C. section 9601 et seq. (CERCLA).

Q. Severability

The provisions of this *SPDES* general permit are severable, and if any provision of the permit, or the application of any provision of the permit to any circumstance, is held invalid, the application of such provision to other circumstances, and the remainder of the permit, shall not be affected thereby.

Appendix A. Acronyms and Definitions

Acronym List

BMP – Best Management Practice

CFR – Code of Federal Regulations

CGP – SPDES General Permit for Stormwater from Construction Activities, GP-0-20-001

CWA – Clean Water Act

ECL – Environmental Conservation Law

EDC – Effective Date of Coverage

EDP– Effective Date of the Permit

eNOI – Electronic Notice of Intent

EPCRA - Emergency Planning and Community Right-To-Know Act

ERP – Enforcement Response Plan

IDDE – Illicit Discharge Detection and Elimination

MCM – Minimum Control Measure

MS4 – Municipal Separate Storm Sewer System

MS4 GP – SPDES General Permit for Stormwater Discharges from the Municipal Separate Storm Sewer Systems, GP-0-24-001

MSGP – SPDES Multi-Sector General Permit for Stormwater Discharges Associated with Industrial Activity, GP-0-23-001

NOI – Notice of Intent

NPDES – National Pollutant Discharge Elimination System

NYCRR – New York Codes, Rules and Regulations

NYS DEC – New York State Department of Environmental Conservation

O&M – Operations and Maintenance

ORI – Outfall Reconnaissance Inventory

POC – Pollutant of Concern

RSE – Regional Stormwater Entity

SPDES – State Pollutant Discharge Elimination System

SMP – Stormwater Management Practice

SWMP – Stormwater Management Program

SWMP Plan – Stormwater Management Program Plan

SWPPP – Stormwater Pollution Prevention Plan

TMDL – Total Maximum Daily Load

USEPA – United States Environmental Protection Agency

Definitions

All definitions in this section are solely for the purposes of this permit. If a word is not defined below, use it how it is commonly defined.

Additionally Designated Areas – those areas that meet the additional designation criteria, Designation Criteria for Identifying Regulated Municipal Separate Storm Sewer Systems (*MS4*s), January 2010, revised January 2023 and found in Appendix B.

Additionally Designated Area MS4 Outfall (ADA MS4 outfall) – any point of *stormwater discharge* from pipes, ditches, and swales, as well as other points of concentrated flow*,* to impaired waters listed in Appendix C from an *MS4 Operator's MS4*. Areas of *sheet flow* which drain to impaired waters listed in Appendix C are not considered *ADA MS4 outfalls.*

Automatically Designated Areas – those areas served by *MS4*s that meet the automatic designation criteria, Designation Criteria for Identifying Regulated Municipal Separate Storm Sewer Systems (*MS4*s), January 2010, revised January 2023 and found in Appendix B.

Best Management Practice (BMP) – schedules of activities, practices, and prohibitions of practices, maintenance procedures, and other management practices to prevent or reduce the pollution of waters of the state. BMPs also include treatment requirements, operating procedures, and practices to control runoff, spillage and leaks, sludge or waste disposal, or drainage from areas that could contribute pollutants to *stormwater discharges*.

Catch Basin(s) – a cistern, vault, chamber, or well that is part of the MS4 and designed to capture trash, sediment, and/or debris in its *sump*.

Construction Activity(ies) – any clearing, grading, excavation, demolition or stockpiling activity that results in soil disturbance. Clearing activities can include but are not limited to logging equipment operation, the cutting and skidding of trees, stump removal and/or brush root removal. *Construction activity* does not include routine maintenance that is performed to maintain the original line and grade, hydraulic capacity, or original purpose of a facility.

Department – the New York State *Department* of Environmental Conservation as well as meaning the *Department*'s designated agent.

Develop (Developed) – for *MS4 Operators* continuing coverage, *develop* means to continue to implement their current SWMP and update the SWMP to comply with the permit requirement; for newly designated *MS4 Operators*, *develop* means to create that permit requirement.

Discharge (Discharging) – any addition of any pollutant to *surface waters of the State* through an outlet or point source (6 NYCRR 750-1.2(a)(28)).

Dry Weather – prolonged dry periods (at least 48 hours after the last runoff event).

Groundwater – waters in the saturated zone. The saturated zone is a subsurface zone in which all the interstices are filled with water under pressure greater than that of the atmosphere. Although the zone may contain gas-filled interstices or interstices filled with fluids other than water, it is still considered saturated.

Illicit Discharge – any *discharge* into an *MS4* that is not entirely composed of *stormwater*, except those identified in Part I.A.3. Examples of *illicit discharges* are non-permitted sanitary sewage, garage drain effluent, and waste motor oil. However, an *illicit discharge* could be any other non-permitted discharge which the *MS4 Operator* or *Department* has determined to be a substantial contributor of pollutants to the *MS4*. *Illicit discharges* can occur throughout the *MS4*, including at post-construction *SMPs*.

Industrial Activity – the eleven (11) categories of industrial activities included in the definition of "*stormwater discharges* associated with industrial activity," as defined in 40 CFR 122.26(b)(14)(i)-(ix) and (xi).

Interconnection – any point of *stormwater discharge* from pipes, ditches, and swales, as well as other points of concentrated flow*,* where the *MS4 Operator*'s *MS4* is *discharging* to another *MS4* or private storm sewer system. Areas of *sheet flow* which drain to another *MS4* or private storm sewer system are not considered *interconnections*.

Intermittent Discharge – a *discharge* which occurs over a shorter period of time (e.g., a few hours per day or a few days per year) (CWP 2004).

Larger Common Plan of Development or Sale – a contiguous area where multiple separate and distinct *construction activities* are occurring, or will occur, under one plan. The term **"**plan" in "larger common plan of development or sale" is broadly defined as any announcement or piece of documentation (including a sign, public notice or hearing, sales pitch, advertisement, drawing, permit application, State Environmental Quality Review Act Application, zoning request, computer design, etc.) or physical demarcation (including boundary signs, lot stakes, surveyor markings, etc.) indicating that *construction activities* may occur on a specific plot.

For discrete construction projects that are located within a *larger common plan of development or sale* that are at least 1/4 mile apart, each project can be treated as a separate plan of development or sale provided any interconnecting road, pipeline or utility project that is part of the same "common plan" is not concurrently being disturbed.

MS4 Operator – the person, persons, or legal entity that obtains coverage and is responsible for the *MS4*.

MS4 Outfall – any point of *stormwater discharge* from pipes, ditches, and swales, as well as other points of concentrated flow*,* to *surface waters of the State* from an *MS4 Operator's MS4*. Areas of *sheet flow* which drain to *surface waters of the State* are not considered *MS4 outfalls.*

Municipal (Municipally) – a county, town, city, village, district corporation, special improvement district, sewer authority or agency thereof. Examples of other public entities that are included in this program include State University Campuses, federal and State prisons, State and federal hospitals, Dormitory Authorities, public housing authorities, school and other special districts.

Municipal Facility – an *MS4 Operator* owned and/or operated facility with the potential to *discharge* pollutants to the *MS4* and/or *surface water of the State* of the State.

Municipal Facility Intraconnection – any point where stormwater is conveyed from the MS4 Operator's municipal facility to the MS4 Operator's own MS4. This is the most down-drainage end of the MS4 infrastructure located on the municipal facility prior to discharge to the MS4.

Municipal Operations (Operations) – activities conducted by the MS4 Operator with the potential to discharge pollutants to the *MS4* and/or *surface water of the State*.

Municipal Separate Storm Sewer System (*MS4*) – a conveyance or system of conveyances (including roads with drainage systems, *municipal* streets, *catch basins*, curbs, gutters, ditches, man-made channels, or storm drains):

1. owned or operated by a State, city, town, village, borough, county, parish, district, association, or other public body (created by or pursuant to State law) having jurisdiction over disposal of sewage, industrial wastes, *stormwater*, or other wastes, including special districts under State law such as a sewer district, flood control district or drainage district, or similar entity, or an Indian tribe or an authorized Indian tribal organization, or a designated and approved management agency under section 208 of the CWA, that *discharges* to *surface waters of the State*;
2. designed or used for collecting or conveying *stormwater*;
3. which is not a combined sewer; and
4. which is not part of a Publicly Owned Treatment Works (POTW) as defined at 40 CFR 122.2.

National Pollutant Discharge Elimination System – the national system for the issuance of wastewater and *stormwater* permits under the Federal Water Pollution Control Act (Clean Water Act).

No Exposure – all industrial materials or activities are protected by a storm-resistant shelter to prevent exposure to rain, snow, snowmelt, and/or runoff.

Non-traditional MS4 Operators– state, federal, county and other publicly owned properties such as state university campuses, prisons, office complexes, hospitals, military installations public housing authorities, school and other special districts.

Obvious Illicit Discharge –an *illicit discharge* from a flowing *MS4 outfall* that does not require sample collection for confirmation; this references the Monitoring Locations Inspection and Sampling Field Sheet, adapted from CWP 2004, Section 6: Overall Outfall Characterization.

Physical Indicator Present in the Flow – a sensory indicator present in the *discharge* from *monitoring location* including odor, color, turbidity and floatables; this references the Monitoring Locations Inspection and Sampling Field Sheet, adapted from CWP 2004, Section 4: Physical Indicators for Flowing Monitoring Locations Only.

Physical Indicator not Related to Flow – an indicator of past *discharges*, potentially *intermittent* or *transitory discharge,* including *monitoring location* damage, *monitoring location* deposits or stains, abnormal vegetation growth, poor pool quality or pipe benthic growth; this references the Monitoring Locations Inspection and Sampling Field Sheet, adapted from CWP 2004, Section 5: Physical Indicators for Both Flowing and Non-Flowing Monitoring Locations. These physical indicators can be present at both flowing and non-flowing monitoring locations.

Pollutant – dredged spoil, filter backwash, solid waste, incinerator residue, sewage, garbage, sewage sludge, munitions, chemical wastes, biological materials, radioactive materials, heat, wrecked or discarded equipment, rock, sand and industrial, *municipal*, agricultural waste and ballast *discharged* into water; which may cause or might reasonably be expected to cause pollution of the waters of the State in contravention of the standards or guidance values adopted as provided in Parts 700 et seq of this Title. For the purposes of this *SPDES* general permit, relevant pollutants include, but are not limited to, nitrogen, phosphorus, chloride, silt and sediment, pathogens, herbicides/pesticides, floatables, petroleum hydrocarbons, heavy metals, and polycyclic aromatic hydrocarbons (PAHs).

Pollutant of Concern (POC) – a pollutant causing the impairment of an impaired water segment with an approved TMDL and/or listed in Appendix C, including phosphorus, silt/sediment, pathogens, nitrogen, and floatables.

Privately Owned/Operated – not owned/operated by the *MS4 Operator* or another *MS4 Operator*.

Publicly Owned/Operated – owned/operated by the *MS4 Operator.*

Qualified Inspector – a person who is knowledgeable in the principles and practices of erosion and sediment control, such as a licensed Professional Engineer, Certified Professional in Erosion and Sediment Control (CPESC), Registered Landscape Architect, or other *Department* endorsed individual(s).

It can also mean someone working under the direct supervision of, and at the same company as, the licensed Professional Engineer or Registered Landscape Architect, provided that person has training in the principles and practices of erosion and sediment control. Training in the principles and practices of erosion and sediment control means that the individual working under the direct

supervision of the licensed Professional Engineer or Registered Landscape Architect has received four (4) hours of *Department* endorsed training in proper erosion and sediment control principles from a Soil and Water Conservation District, or other *Department* endorsed entity. After receiving the initial training, the individual working under the direct supervision of the licensed Professional Engineer or Registered Landscape Architect must receive four (4) hours of training every three (3) years.

It can also mean a person that meets the *qualified professional* qualifications in addition to the *qualified inspector* qualifications.

Note: Inspections of any post-construction *SMPs* that include structural components, such as a dam for an impoundment, must be performed by a licensed Professional Engineer.

Qualified Professional – a person who is knowledgeable in the principles and practices of *stormwater* management and treatment, such as a licensed Professional Engineer, Registered Landscape Architect, or other *Department* endorsed individual(s). Individuals preparing SWPPPs that require the post-construction *SMP* component must have an understanding of the principles of hydrology, water quality management practice design, water quantity control design, and, in many cases, the principles of hydraulics in order to prepare a SWPPP that conforms to the *Department's* technical standard. All components of the SWPPP that involve the practice of engineering, as defined by the NYS Education Law (see Article 145), must be prepared by, or under the direct supervision of, a professional engineer licensed to practice in the State of New York.

Qualifying Storm Event – a storm event with at least 0.1 inch of precipitation, providing the interval from the preceding measurable storm is at least 72 hours. The 72-hour storm interval is waived if the preceding measurable storm did not result in a *stormwater discharge* (e.g., a storm events in excess of 0.1 inches may not result in a *stormwater discharge* at some facilities), or if the *MS4 Operator* is able to document that less than a 72-hour interval is representative for local storm events during the sampling period.

Regional Stormwater Entity (RSE) – an organization made up of multiple cooperating regulated and/or nonregulated entities located in the same geographical region of the State who share resources to improve overall *stormwater* management in their area.

Retrofit – to modify or add to existing *stormwater* infrastructure for the purpose of reducing pollutant loadings.

Sheet Flow – *stormwater* runoff flowing in a thin layer over the ground surface.

Sizing Criteria – the criteria included in the CGP that are used to size post-construction *stormwater* management control practices. The criteria include; Water Quality Volume (WQv), Runoff Reduction Volume (RRv), Channel Protection Volume (Cpv), Overbank Flood (Qp), and Extreme Flood (Qf).

State Pollutant Discharge Elimination System (SPDES) – the system established pursuant to Article 17 of the ECL and 6 NYCRR Part 750 for issuance of permits authorizing *discharges* to the waters of the State.

Stormwater – that portion of precipitation that, once having fallen to the ground, is in excess of the evaporative or infiltrative capacity of soils, or the retentive capacity of surface features, which flows or will flow off the land by surface runoff to waters of the State.

Stormwater Hotspots - a land use or activity that generates higher concentrations of hydrocarbons, trace metals or toxicants than are found in typical *stormwater* runoff, based on monitoring studies. For further detail, see Section 4.11 of the NYS SWMDM 2015.

Stormwater Management Practices (SMPs) – measures, either structural or nonstructural, that are constructed as part of new development or redevelopment projects and are intended to capture, treat, reduce and/or retain *stormwater* runoff.

Stormwater Management Program (SWMP) – the program *developed* and implemented by the *MS4 Operator* which provides a comprehensive integrated planning approach involving public participation and, where necessary, intergovernmental coordination, to reduce the *discharge* of POCs and specified pollutants to the *MEP*, using management practices, control techniques and systems, design and engineering methods, and other appropriate provisions. *MS4 Operators* are required at a minimum to *develop*, implement, and enforce a *SWMP* designed to address POCs and reduce the *discharge* of pollutants from the *MS4* to the *MEP*, to protect water quality, and to satisfy the appropriate water quality requirements of the ECL and the Clean Water Act. The *SWMP* must address all permit requirements in this *SPDES* general permit.

Stormwater Management Program Plan (SWMP Plan) – is used by the *MS4 Operator* to document and detail the activities and measures that will be implemented to meet the terms and conditions of this *SPDES* general permit. The *SWMP Plan* must be updated during the permit term as the *MS4 Operator's* activities are modified to meet permit conditions. The *SWMP Plan* can be hardcopy or digital.

Storm-sewershed (sewershed) – the catchment that drains to a waterbody based on the *MS4* and surface topography. Adjacent catchment areas that drain to the same waterbody are not separate storm-*sewersheds*.

Sump – the part of the *catch basin* between the bottom interior of the *catch basin* and the invert of the deepest outlet of the *catch basin*.

Surface Water(s) of the State – must be construed to include lakes, bays, sounds, ponds, impounding reservoirs, springs, rivers, streams, creeks, estuaries, marshes, inlets, canals, the Atlantic ocean within the territorial seas of the state of New York and all other bodies of surface water, natural or artificial, inland or coastal, fresh or salt, public or private (except those private waters that

do not combine or effect a junction with natural surface or underground waters), which are wholly or partially within or bordering the state or within its jurisdiction.

Waters of the state are further defined in 6 NYCRR Parts 800 to 941. Storm sewers are not waters of the state unless they are classified in 6 NYCRR Parts 800 to 941. Nonetheless, a *discharge* to a storm sewer must be regulated as a *discharge* at the point where the storm sewer *discharges* to waters of the state.

Suspect Illicit Discharge – an *illicit discharge* from flowing monitoring locations with high severity (score of 3) on one or more physical indicators based on the relative severity index of physical indicators for flowing *MS4 outfall*s only; this references the Monitoring Locations Inspection and Sampling Field Sheet, adapted from CWP 2004, Section 6: Overall Outfall Characterization.

Total Maximum Daily Load (TMDL) – the sum of the allowable loads of a single pollutant from all contributing point and nonpoint sources. It is a calculation of the maximum amount of a pollutant that a waterbody can receive and still meet water quality standards, and an allocation of that amount to the pollutant's sources. A TMDL stipulates Waste Load Allocations (WLA) for point source *discharges*, Load Allocations (LA) for nonpoint sources, and a margin of safety (MOS).

Traditional Land Use Control *MS4 Operators* – a city, town, or village with land use control authority.

Traditional Non-land Use Control *MS4 Operators* – any county agency without land use control.

Transitory Discharge – a *discharge* which occurs rarely, usually in response to a singular event such as an industrial spill, ruptured tank, sewer break, transport accident or illegal dumping episode (CWP 2004).

Water Quality Standard – such measures of purity or quality for any waters in relation to their reasonable and necessary use as promulgated in 6 NYCRR Part 700 et seq.

Appendix B. Designation Criteria for Identifying Regulated *Municipal Separate Storm Sewer Systems* (*MS4*s), January 2010, revised January 2023

The universe of small *municipal* separate storm sewer systems (*MS4*s) is quite large. However, only a sub-set of small *MS4*s, referred to as "regulated" small *MS4*s, are covered by the Federal *stormwater* regulations. A small *MS4* can be designated as a regulated *MS4* through *automatic designation* by the USEPA or by meeting designation criteria developed by the NPDES permitting authority, the New York State Department of Environmental Conservation (*Department*) in New York State.

Automatic Designation Criteria Required by USEPA

The USEPA's automatic designation criteria are based strictly on population and density. An area is *automatically designated* if the population is at least 50,000 and has an overall population density of at least 1,000 people per square mile based on the 2000 and 2010 censuses.

Additional Designation Criteria

The USEPA requires the *Department* to develop a set of criteria for *additionally designated areas*. The following criteria, using a combination of population and environmental factors, have been adopted to designate additional *MS4*s in NYS.

Criterion 1: *MS4*s *discharging* to waters for which an USEPA-approved Total Maximum Daily Load (TMDL) requires reduction of a *pollutant of concern* beyond what can be achieved with existing programs (and the area is not already covered under automatic designation).

Criterion 2: *MS4*s, contiguous to *automatically designated areas* (municipal lines), that *discharge* to sensitive waters classified as AA-Special (fresh surface waters), AA (fresh surface waters) with filtration avoidance determination or SA (saline surface waters).

Criterion 3: *Automatically designated areas* are extended to town, village, or city boundaries, but only for town, village or city implementation of minimum control measure 4 construction site stormwater runoff control and minimum control measure 5 post-construction stormwater management in development and redevelopment. This additional designation may be waived, by written request to the *Department*, where the *automatically designated area* is a small portion of the total area of the town, village or city (less than 15 %) and where there is little or no *construction activity* in the area outside of the *automatically designated area* (less than 5 disturbed acres per year).

Appendix C. List of Impaired Waters

NOTES FOR THE TABLE BELOW:

1. *MS4 Operators* must implement Part VIII.A. Pollutant Specific BMPs for Phosphorus for waterbodies with the pollutant listed as "phosphorus."
2. *MS4 Operators* must implement Part VIII.B. Pollutant Specific BMPs for Silt/Sediment for waterbodies with the pollutant listed as "silt/sediment."
3. *MS4 Operators* must implement Part VIII.C. Pollutant Specific BMPs for Pathogens for waterbodies with the pollutant listed as "pathogens" or "fecal coliform."
4. *MS4 Operators* must implement Part VIII.D. Pollutant Specific BMPs for Nitrogen for waterbodies with the pollutant listed as "nitrogen" or "ammonia."
5. *MS4 Operators* must implement Part VIII.E. Pollutant Specific BMPs for Floatables for waterbodies with the pollutant listed as "garbage & refuse," "oil/grease," or "oil & floating substances."

County	Waterbody Inventory/Priority Waterbody List Name (WI/PWL Number)	Pollutant
Albany	Ann Lee (Shakers) Pond, Stump Pond (1201-0096)	Phosphorus
Bronx	Bronx River, Lower (1702-0006) 18	Fecal Coliform
Bronx	Bronx River, Lower (1702-0006) 18	Garbage & Refuse
Bronx	Bronx River, Middle, and tribs (1702-0106) 18	Fecal Coliform
Bronx	Bronx River, Middle, and tribs (1702-0106) 18	Garbage & Refuse
Bronx	Hutchinson River, Lower, and tribs (1702 0003) 18	Garbage & Refuse
Bronx	Long Island Sound, Western Portion (1702-0027)	Nitrogen
Bronx	Van Cortlandt Lake (1702-0008)	Phosphorus
Bronx	Westchester Creek (1702-0012) 18	Garbage & Refuse
Broome	Minor Tribs to Lower Susquehanna (0603-0044)	Phosphorus
Chautauqua	Chadakoin River and tribs (0202-0018)	Phosphorus
Chautauqua	Lake Erie (Main Lake, South) (0105-0033)	Fecal Coliform
Chautauqua	Lake Erie, Dunkirk Harbor (0105-0009)	Fecal Coliform
Dutchess	Fallkill Creek (1301-0087)	Phosphorus
Dutchess	Wappingers Lake (1305-0001)	Phosphorus
Dutchess	Wappingers Lake (1305-0001)	Silt/Sediment
Erie	Delaware Park Pond (0101-0026)	Phosphorus
Erie	Ellicott Creek, Lower, and tribs (0102-0018)	Phosphorus
Erie	Ellicott Creek, Lower, and tribs (0102-0018)	Silt/Sediment

Erie	Green Lake (0101-0038)	Phosphorus
Erie	Lake Erie (Main Lake, North) (0104-0037)	Fecal Coliform
Erie	Lake Erie (Northeast Shoreline) (0104-0036)	Fecal Coliform
Erie	Rush Creek and tribs (0104-0018)	Fecal Coliform
Erie	Rush Creek and tribs (0104-0018)	Phosphorus
Erie	Scajaquada Creek, Lower, and tribs (0101-0023)	Fecal Coliform
Erie	Scajaquada Creek, Lower, and tribs (0101-0023)	Oils & Floating Sub.
Erie	Scajaquada Creek, Lower, and tribs (0101-0023)	Phosphorus
Erie	Scajaquada Creek, Middle, and tribs (0101-0033)	Fecal Coliform
Erie	Scajaquada Creek, Middle, and tribs (0101-0033)	Oils & Floating Sub.
Erie	Scajaquada Creek, Middle, and tribs (0101-0033)	Phosphorus
Erie	Scajaquada Creek, Upper, and tribs (0101-0034)	Fecal Coliform
Erie	Scajaquada Creek, Upper, and tribs (0101-0034)	Phosphorus
Erie	South Branch Smoke Cr, Lower, and tribs (0101-0036)	Phosphorus
Erie	South Branch Smoke Cr, Lower, and tribs (0101-0036)	Silt/Sediment
Genesee	Tonawanda Cr, Middle, Main Stem (0102-0002)	Phosphorus
Genesee	Tonawanda Cr, Middle, Main Stem (0102-0006)	Fecal Coliform
Herkimer	Mohawk River, Main Stem (1201-0093)	Fecal Coliform
Herkimer	Mohawk River, Main Stem (1201-0093)	Oils & Floating Sub.
Kings	Coney Island Creek (1701-0008) 18	Fecal Coliform
Kings	Coney Island Creek (1701-0008) 18	Garbage & Refuse
Kings	Gowanus Canal (1701 0011) 18	Garbage & Refuse
Kings	Hendrix Creek (1701-0006) 18	Fecal Coliform
Kings	Hendrix Creek (1701-0006) 18	Garbage & Refuse
Kings	Hendrix Creek (1701-0006) 18	Nitrogen
Kings	Mill Basin and tidal tribs (1701 0178) 18	Garbage & Refuse
Kings	Paerdegat Basin (1701-0363) 18	Garbage & Refuse
Kings	Prospect Park Lake (1701-0196)	Phosphorus
Monroe	Buck Pond (0301-0017)	Phosphorus
Monroe	Cranberry Pond (0301-0016)	Phosphorus

Monroe	Long Pond (0301-0015)	Phosphorus
Monroe	Minor Tribs to Irondequoit Bay (0302-0038)	Fecal Coliform
Monroe	Minor Tribs to Irondequoit Bay (0302-0038)	Phosphorus
Monroe	Rochester E–bayment - East (0302-0002)	Fecal Coliform
Monroe	Rochester E–bayment - West (0301-0068)	Fecal Coliform
Monroe	Thomas Creek/White Brook and tribs (0302-0023)	Phosphorus
Nassau	Beaver Lake (1702-0152)	Phosphorus
Nassau	Camaans Pond (1701-0052)	Phosphorus
Nassau	Cold Spring Harbor, and tidal tribs (1702-0018)	Pathogens
Nassau	Dosoris Pond (1702-0024)	Fecal Coliform
Nassau	East Bay (1701-0202)	Fecal Coliform
Nassau	East Meadow Brook, Upper, and tribs (1701-0211)	Silt/Sediment
Nassau	East Rockaway Inlet (1701-0217)	Fecal Coliform
Nassau	Glen Cove Creek, Lower, and tribs (1702-0146)	Fecal Coliform
Nassau	Glen Cove Creek, Lower, and tribs (1702-0146)	Silt/Sediment
Nassau	Grant Park Pond (1701-0054)	Phosphorus
Nassau	Hempstead Bay (1701-0032)	Fecal Coliform
Nassau	Hempstead Harbor, north, and tidal tribs (1702-0022)	Pathogens
Nassau	Hempstead Harbor, south, & tidal tribs (1702-0263)	Fecal Coliform
Nassau	Hempstead Lake (1701-0015)	Phosphorus
Nassau	Long Island Sound, Nassau County Waters (1702-0028)	Fecal Coliform
Nassau	Long Island Sound, Nassau County Waters (1702-0028)	Nitrogen
Nassau	Manhasset Bay, and tidal tribs (1702-0021)	Fecal Coliform
Nassau	Manhasset Bay, and tidal tribs (1702-0141)	Fecal Coliform
Nassau	Massapequa Creek, Upper, and tribs (1701-0174)	Fecal Coliform
Nassau	Massapequa Creek, Upper, and tribs (1701-0174)	Phosphorus
Nassau	Middle Bay (1701-0208)	Fecal Coliform
Nassau	Milburn/Parsonage Creeks, Upp, and tribs (1701-0212)	Phosphorus
Nassau	Mill Neck Creek and tidal tribs (1702-0151)	Pathogens
Nassau	Oyster Bay Harbor (1702-0016)	Pathogens
Nassau	Reynolds Channel, east (1701-0215)	Fecal Coliform

Nassau	Seafords/Seamans Creeks, Upper, and tribs (1701-0201)	Fecal Coliform
Nassau	Shell Creek and Barnums Channel (1701-0213386)	Fecal Coliform
Nassau	South Oyster Bay (1701-0041)	Fecal Coliform
Nassau	Tidal Tribs to Hempstead Bay (1701-0218)	Fecal Coliform
Nassau	Tidal Tribs to Hempstead Bay (1701-0218)	Nitrogen
Nassau	Tidal Tribs to South Oyster Bay (1701-0200)	Fecal Coliform
Nassau	Tribs (fresh) to East Bay (1701-0204)	Fecal Coliform
Nassau	Tribs (fresh) to East Bay (1701-0204)	Phosphorus
Nassau	Tribs (fresh) to East Bay (1701-0204)	Silt/Sediment
Nassau	Tribs to Smith Pond/Halls Pond (1701-0221)	Phosphorus
Nassau	Woodmere Channel (1701-0219)	Fecal Coliform
Nassau	Woodmere Channel (1701-0219)	Nitrogen
New York	East River, Lower (1702-0011) 18	Garbage & Refuse
New York	Harlem River (1702-0004) 18	Garbage & Refuse
New York	Harlem Meer (1702-0103)	Phosphorus
New York	The Lake in Central Park (1702-0105)	Phosphorus
Niagara	Bergholtz Creek and tribs (0101-0004)	Fecal Coliform
Niagara	Bergholtz Creek and tribs (0101-0004)	Phosphorus
Niagara	Hyde Park Lake (0101-0030)	Phosphorus
Oneida	Ballou, Nail Creeks (1201-0203)	Phosphorus
Oneida	Mohawk River, Main Stem (1201-0010)	Fecal Coliform
Oneida	Mohawk River, Main Stem (1201-0094)	Fecal Coliform
Oneida	Utica Harbor (1201-0228)	Fecal Coliform
Onondaga	Bloody Brook and tribs (0702 0006) 10	Fecal Coliform
Onondaga	Ley Creek and tribs (0702 0001) 10	Fecal Coliform
Onondaga	Ley Creek and tribs (0702-0001) 10	Ammonia (NH3)
Onondaga	Ley Creek and tribs (0702-0001) 10	Phosphorus
Onondaga	Minor Tribs to Onondaga Lake (0702-0022) 10	Nitrogen (NH3, NO2)
Onondaga	Minor Tribs to Onondaga Lake (0702-0022) 10	Phosphorus
Onondaga	Minor Tribs to Onondaga Lake (0702-0022) 10	Fecal Coliform
Onondaga	Onondaga Creek, Lower (0702-0023) 10	Ammonia (NH3)
Onondaga	Onondaga Creek, Lower (0702-0023) 10	Fecal Coliform

Onondaga	Onondaga Creek, Lower (0702-0023) 10	Phosphorus
Onondaga	Onondaga Creek, Middle, and tribs (0702-0004) 10	Fecal Coliform
Onondaga	Onondaga Lake, Southern End (0702-0021) [10]	Fecal Coliform
Ontario	Great Brook and minor tribs (0704-0034)	Phosphorus 2
Ontario	Great Brook and minor tribs (0704-0034)	Silt/Sediment
Orange	Greenwood Lake (1501-0001)	Phosphorus
Orange	Monhagen Brook and tribs (1306-0074)	Phosphorus
Orange	Orange Lake (1301-0008) [16]	Phosphorus
Oswego	Lake Neatahwanta (0701-0018)	Phosphorus
Putnam	Bog Brook Reservoir (1302-0041)	Phosphorus
Putnam	Boyd Corners Reservoir (1302-0045)	Phosphorus
Putnam	Croton Falls Reservoir (1302-0026)	Phosphorus
Putnam	Diverting Reservoir (1302-0046)	Phosphorus
Putnam	East Branch Reservoir (1302-0040)	Phosphorus
Putnam	Middle Branch Reservoir (1302-0009)	Phosphorus
Putnam	Oscawana Lake (1301-0035)	Phosphorus
Putnam	Palmer Lake (1302-0103)	Phosphorus
Putnam	West Branch Reservoir (1302-0022)	Phosphorus
Queens	Alley Creek/Little Neck Bay Trib (1702-0009) 18	Fecal Coliform
Queens	Atlantic Ocean Coastline (1701-0014)	Fecal Coliform
Queens	Bergen Basin (1701-0009) 18	Fecal Coliform
Queens	Bergen Basin (1701-0009) 18	Garbage & Refuse
Queens	Bergen Basin (1701-0009) 18	Nitrogen
Queens	East River, Upper (1702-0010) 18	Garbage & Refuse
Queens	East River, Upper (1702-0032) 18	Garbage & Refuse
Queens	Flushing Creek/Bay (1702 0005) 18	Garbage & Refuse
Queens	Flushing Creek/Bay (1702-0005)	Nitrogen
Queens	Flushing Creek/Bay (1702-0005) 18	Fecal Coliform
Queens	Jamaica Bay, Eastern, and tribs, Queens (1701-0005) 18	Fecal Coliform
Queens	Jamaica Bay, Eastern, and tribs, Queens (1701-0005) 18	Garbage & Refuse
Queens	Jamaica Bay, Eastern, and tribs, Queens (1701-0005) 18	Nitrogen

Queens	Kissena Lake (1702-0258)	Phosphorus
Queens	Little Neck Bay (1702-0029)	Fecal Coliform
Queens	Meadow Lake (1702-0030)	Phosphorus
Queens	Newtown Creek and tidal tribs (1702 0002) 18	Garbage & Refuse
Queens	Newtown Creek and tidal tribs (1702-0002) 18	Fecal Coliform
Queens	Shellbank Basin (1701-0001) 18	Nitrogen
Queens	Spring Creek and tribs (1701-0361) 18	Garbage & Refuse
Queens	Thurston Basin (1701-0152) 18	Fecal Coliform
Queens	Thurston Basin (1701-0152) 18	Garbage & Refuse
Queens	Willow Lake (1702-0031)	Phosphorus
Rensselaer	Nassau Lake (1310-0001)	Phosphorus
Richmond	Arthur Kill, Class I, and minor tribs (1701 0010) 18	Garbage & Refuse
Richmond	Arthur Kill, Class SD, and minor tribs (1701-0182) 18	Garbage & Refuse
Richmond	Grassmere Lake/Bradys Pond (1701-0357)	Phosphorus
Richmond	Kill Van Kull (1701 0184) 18	Garbage & Refuse
Richmond	Newark Bay (1701 0183) 18	Garbage & Refuse
Richmond	Raritan Bay, Class SA (1701-0002)	Fecal Coliform
Rockland	Congers Lake, Swartout Lake (1501-0019)	Phosphorus
Rockland	Rockland Lake (1501-0021)	Phosphorus
Rockland	Sparkill Creek, Lower (1301-0088)	Fecal Coliform
Saratoga	Ballston Lake (1101-0036)	Phosphorus
Saratoga	Dwaas Kill and tribs (1101-0007)	Phosphorus
Saratoga	Dwaas Kill and tribs (1101-0007)	Silt/Sediment
Saratoga	Lake Lonely (1101-0034)	Phosphorus
Saratoga	Tribs to Lake Lonely (1101-0001)	Fecal Coliform
Saratoga	Tribs to Lake Lonely (1101-0001)	Phosphorus
Schenectady	Collins Lake (1201-0077)	Phosphorus
Schenectady	Duane Lake (1311-0006)	Phosphorus
Schenectady	Mariaville Lake (1201-0113)	Phosphorus
Suffolk	Acabonack Harbor (1701-0047)	Pathogens
Suffolk	Agawam Lake (1701-0117)	Phosphorus
Suffolk	Beaverdam Creek and tribs (1701-0104)	Ammonia
Suffolk	Bellport Bay (1701-0320)	Pathogens

Suffolk	Big/Little Fresh Ponds (1701-0125)	Phosphorus
Suffolk	Canaan Lake (1701-0018)	Phosphorus
Suffolk	Canaan Lake (1701-0018)	Silt/Sediment
Suffolk	Centerport Harbor (1702-0229)	Pathogens
Suffolk	Conscience Bay and tidal tribs (1702-0091)	Pathogens
Suffolk	Flanders Bay, East/Center, and tribs (1701-0030)	Pathogens
Suffolk	Flanders Bay, West/Lower Sawmill Creek (1701-0254)	Nitrogen
Suffolk	Flanders Bay, West/Lower Sawmill Creek (1701-0254)	Pathogens
Suffolk	Flax Pond (1702-0240)	Fecal Coliform
Suffolk	Forge River, Lower and Cove (1701-0316)	Fecal Coliform
Suffolk	Fresh Pond (1701-0241)	Phosphorus
Suffolk	Goldsmith Inlet (1702-0026)	Pathogens
Suffolk	Goose Creek (1701-0236)	Pathogens
Suffolk	Great Cove (1701-0376)	Fecal Coliform
Suffolk	Great South Bay, East (1701-0039)	Nitrogen
Suffolk	Great South Bay, Middle (1701-0040)	Nitrogen
Suffolk	Great South Bay, West (1701-0173)	Nitrogen
Suffolk	Hashamomuck Pond (1701-0162)	Pathogens
Suffolk	Heady and Taylor Creeks and tribs (1701-0294)	Pathogens
Suffolk	Huntington Harbor (1702-0228)	Pathogens
Suffolk	Lake Montauk (1701-0031)	Pathogens
Suffolk	Lake Ronkonkoma (1701-0020)	Fecal Coliform
Suffolk	Lake Ronkonkoma (1701-0020)	Phosphorus
Suffolk	Little Sebonac Creek (1701-0253)	Pathogens
Suffolk	Long Island Sound, Suffolk Co, Central (1702-0265)	Fecal Coliform
Suffolk	Mattituck Inlet/Cr, Low, and tidal tribs (1702-0020)	Pathogens
Suffolk	Meetinghouse/Terrys Creeks and tribs (1701-0256)	Pathogens
Suffolk	Mill and Seven Ponds (1701-0113)	Phosphorus
Suffolk	Millers Pond (1702-0013)	Phosphorus
Suffolk	Moriches Bay, East (1701-0305)	Nitrogen
Suffolk	Moriches Bay, West (1701-0038)	Nitrogen
Suffolk	Mt Sinai Harbor and tidal tribs (1702-0019)	Pathogens

Suffolk	Mud Creek, Upper, and tribs (1701-0101)	Fecal Coliform
Suffolk	Narrow Bay (1701-0318)	Pathogens
Suffolk	Nicoll Bay (1701-0375)	Fecal Coliform
Suffolk	North Sea Harbor and tribs (1701-0037)	Pathogens
Suffolk	Northport Harbor (1702-0230)	Pathogens
Suffolk	Northwest Creek and tidal tribs (1701-0046)	Pathogens
Suffolk	Noyack Creek and tidal tribs (1701-0237)	Pathogens
Suffolk	Ogden Pond (1701-0302)	Pathogens
Suffolk	Patchogue Bay (1701-0326)	Pathogens
Suffolk	Peconic River, Lower, and tidal tribs (1701-0259)	Nitrogen
Suffolk	Peconic River, Lower, and tidal tribs (1701-0259)	Pathogens
Suffolk	Penniman Creek and tidal tribs (1701-0300)	Pathogens
Suffolk	Penny Pond, Wells and Smith Creeks (1701-0298)	Pathogens
Suffolk	Phillips Creek, Lower, and tidal tribs (1701-0299)	Fecal Coliform
Suffolk	Port Jefferson Harbor, North, and tribs (1702-0015)	Pathogens
Suffolk	Quantuck Bay (1701-0042)	Pathogens
Suffolk	Quantuck Bay (1701-0042)	Nitrogen
Suffolk	Quantuck Canal/Moneybogue Bay (1701-0371)	Pathogens
Suffolk	Quogue Canal (1701-0301)	Fecal Coliform
Suffolk	Reeves Bay and tidal tribs (1701-0272)	Pathogens
Suffolk	Richmond Creek and tidal tribs (1701-0245)	Pathogens
Suffolk	Sag Harbor and Sag Harbor Cove (1701-0035)	Pathogens
Suffolk	Sebonac Cr/Bullhead Bay and tidal tribs (1701-0051)	Pathogens
Suffolk	Setauket Harbor (1702-0242)	Pathogens
Suffolk	Shinnecock Bay and Inlet (1701 0033)	Nitrogen
Suffolk	Stirling Creek and Basin (1701-0049)	Pathogens
Suffolk	Stony Brook Harbor and West Meadow Creek (1702-0047)	Pathogens
Suffolk	Tidal Tribs to Gr Peconic Bay, Northshr (1701-0247)	Pathogens
Suffolk	Tidal Tribs to West Moriches Bay (1701-0312)	Fecal Coliform
Suffolk	Tidal Tribs to West Moriches Bay (1701-0312)	Nitrogen
Suffolk	Town/Jockey Creeks and tidal tribs (1701-0235)	Pathogens
Suffolk	Tuthill, Harts, Seatuck Coves (1701-0309)	Pathogens
Suffolk	Weesuck Creek and tidal tribs (1701-0111)	Pathogens

Suffolk	West Creek and tidal tribs (1701-0246)	Fecal Coliform
Suffolk	Wooley Pond (1701-0048)	Pathogens
Tompkins	Cayuga Lake, Southern End (0705-0040)	Phosphorus
Tompkins	Cayuga Lake, Southern End (0705-0040)	Silt/Sediment
Warren	Hague Brook and tribs (1006-0006)	Silt/Sediment
Warren	Huddle/Finkle Brooks and tribs (1006-0003)	Silt/Sediment
Warren	Indian Brook and tribs (1006-0002)	Silt/Sediment
Warren	Lake George (1006-0016) and tribs	Silt/Sediment
Warren	Tribs to Lake George, East Shore (1006-0020)	Silt/Sediment
Warren	Tribs to Lake George, Lk.George Village (1006-0008)	Silt/Sediment
Wayne	Lake Ontario Shoreline, Central (0302-0044)	Fecal Coliform
Westchester	Amawalk Reservoir (1302-0044)	Phosphorus
Westchester	Bronx River, Upper, and tribs (1702-0107)	Fecal Coliform
Westchester	Cross River Reservoir (1302-0005)	Phosphorus
Westchester	Hutchinson River, Middle, and tribs (1702-0074)	Fecal Coliform
Westchester	Hutchinson River, Middle, and tribs (1702-0074)	Oil/Grease
Westchester	Lake Katonah (1302-0136)	Phosphorus
Westchester	Lake Lincolndale (1302-0089)	Phosphorus
Westchester	Lake Meahagh (1301-0053)	Phosphorus
Westchester	Lake Mohegan (1301-0149)	Phosphorus
Westchester	Lake Shenorock (1302-0083)	Phosphorus
Westchester	Larchmont Harbor (1702-0116)	Fecal Coliform
Westchester	Long Island Sound, Westchester Co Waters (1702-0001)	Fecal Coliform
Westchester	Long Island Sound, Westchester Co Waters (1702-0001)	Nitrogen
Westchester	Mamaroneck Harbor (1702-0125)	Fecal Coliform
Westchester	Mamaroneck River, Lower (1702-0071)	Silt/Sediment
Westchester	Mamaroneck River, Upp, & minor tribs (1702-0123)	Silt/Sediment
Westchester	Milton Harbor/Lower Blind Brook (1702-0063)	Fecal Coliform
Westchester	Muscoot/Upper New Croton Reservoir (1302-0042)	Phosphorus
Westchester	New Croton Reservoir (1302-0010)	Phosphorus
Westchester	New Rochelle Harbor (1702-0259)	Fecal Coliform
Westchester	Port Chester Harbor/Lower Byram River (1702-0260)	Fecal Coliform

Westchester	Reservoir No.1/Lake Isle (1702-0075)	Phosphorus
Westchester	Saw Mill River (1301-0007)	Fecal Coliform
Westchester	Saw Mill River (1301-0007)	Phosphorus
Westchester	Saw Mill River, Middle, and tribs (1301-0100)	Fecal Coliform
Westchester	Saw Mill River, Middle, and tribs (1301-0100)	Phosphorus
Westchester	Sheldrake River (1702-0069)	Phosphorus
Westchester	Sheldrake River (1702-0069)	Silt/Sediment
Westchester	Silver Lake (1702-0040)	Phosphorus
Westchester	Teatown Lake (1302-0150)	Phosphorus
Westchester	Titicus Reservoir (1302-0035)	Phosphorus
Westchester	Truesdale Lake (1302-0054)	Phosphorus
Westchester	Wallace Pond (1301-0140)	Phosphorus

Appendix D. Forms

Included in this section are the following documents, in order:

- Monitoring Locations Inspection and Sampling Field Sheet
- Construction Site Inspection Report Form
- No Exposure Certification
- Municipal Facility Assessment Form
- Storm Event Data Form
- Visual Monitoring Form

Monitoring Locations Inspection and Sampling Field Sheet

Section 1: Background Data

Subwatershed:		Monitoring Location ID:	
Today's date:		Time (Military):	
Investigators:		Form completed by:	
Temperature (°F):	Rainfall (in.): Last 24 hours: Last 48 hours:		
Latitude:	Longitude:	GPS Unit:	GPS LMK #:
Camera:		Photo #s:	

Land Use in Drainage Area (Check all that apply):

☐ Industrial	☐ Open Space
☐ Ultra-Urban Residential	☐ Institutional
☐ Suburban Residential	Other: _____
☐ Commercial	Known Industries: _____

Notes (e.g., origin, if known):

Section 2: Monitoring Location Description

LOCATION	MATERIAL	SHAPE	DIMENSIONS (IN.)	SUBMERGED
☐ **Closed Pipe**	☐ RCP ☐ CMP ☐ PVC ☐ HDPE ☐ Steel ☐ Other: _____	☐ Circular ☐ Single ☐ Elliptical ☐ Double ☐ Box ☐ Triple ☐ Other: _____ ☐ Other: _____	Diameter/Dimensions: _____	In Water: ☐ No ☐ Partially ☐ Fully With Sediment: ☐ No ☐ Partially ☐ Fully
☐ **Open drainage**	☐ Concrete ☐ Earthen ☐ Rip-Rap ☐ Other: ____	☐ Trapezoid ☐ Parabolic ☐ Other: ____	Depth: ____ Top Width: ___ Bottom Width: ____	
☐ **In-Stream**	**(applicable when collecting samples)**			
Flow Present?	☐ Yes ☐ No	***If No, Skip to Section 5***		
Flow Description (If present)	☐ Trickle ☐ Moderate ☐ Substantial			

Section 3: Quantitative Characterization

FIELD DATA FOR FLOWING MONITORING LOCATIONS				
PARAMETER		**RESULT**	**UNIT**	**EQUIPMENT**
☐ Flow #1	Volume		Liter	Bottle
	Time to fill		Sec	
☐ Flow #2	Flow depth		In	Tape measure
	Flow width	____' ____"	Ft, In	Tape measure
	Measured length	____' ____"	Ft, In	Tape measure
	Time of travel		S	Stopwatch
Temperature			°F	Thermometer
pH			pH Units	Test strip/Probe
Ammonia			mg/L	Test strip

Monitoring Locations Inspection and Sampling Field Sheet

Section 4: Physical Indicators for Flowing Monitoring Locations Only

Are Any Physical Indicators Present in the flow? ☐ Yes ☐ No (*If No, Skip to Section 5)*

INDICATOR	CHECK if Present	DESCRIPTION	RELATIVE SEVERITY INDEX (1-3)		
Odor	☐	☐ Sewage ☐ Rancid/sour ☐ Petroleum/gas ☐ Sulfide ☐ Other:	☐ 1 - Faint	☐ 2 – Easily detected	☐ 3 – Noticeable from a distance
Color	☐	☐ Clear ☐ Brown ☐ Gray ☐ Yellow ☐ Green ☐ Orange ☐ Red ☐ Other:	☐ 1 – Faint colors in sample bottle	☐ 2 – Clearly visible in sample bottle	☐ 3 – Clearly visible in flow
Turbidity	☐	See severity	☐ 1 – Slight cloudiness	☐ 2 - Cloudy	☐ 3 – Opaque
Floatables -Does Not Include Trash!!	☐	☐ Sewage (Toilet Paper, etc.) ☐ Suds ☐ Petroleum (oil sheen) ☐ Other:	☐ 1 – Few/slight; origin not obvious	☐ 2 - Some; indications of origin (e.g., possible suds or oil sheen)	☐ 3 - Some; origin clear (e.g., obvious oil sheen, suds, or floating sanitary materials)

Section 5: Physical Indicators for Both Flowing and Non-Flowing Monitoring Locations

Are physical indicators that are not related to flow present? ☐ Yes ☐ No (*If No, Skip to Section 6)*

INDICATOR	CHECK if Present	DESCRIPTION	COMMENTS
Monitoring Location Damage	☐	☐ Spalling, Cracking or Chipping ☐ Peeling Paint ☐ Corrosion	
Deposits/Stains	☐	☐ Oily ☐ Flow Line ☐ Paint ☐ Other:	
Abnormal Vegetation	☐	☐ Excessive ☐ Inhibited	
Poor pool quality	☐	☐ Odors ☐ Colors ☐ Floatables ☐ Oil Sheen ☐ Suds ☐ Excessive Algae ☐ Other:	
Pipe benthic growth	☐	☐ Brown ☐ Orange ☐ Green ☐ Other:	

Section 6: Overall Monitoring Location Characterization

☐ Unlikely ☐ Potential (presence of two or more indicators) ☐ Suspect (one or more indicators with a severity of 3) ☐ Obvious

Section 7: Data Collection

1.	Sample for the lab?	☐ Yes	☐ No		
2.	If yes, collected from:	☐ Flow	☐ Pool		
3.	Intermittent flow trap set?	☐ Yes	☐ No	If Yes, type: ☐ OBM	☐ Caulk dam

Section 8: Any Non-Illicit Discharge Concerns (e.g., trash or needed infrastructure repairs)?

NEW YORK STATE
DEPARTMENT OF ENVIRONMENTAL CONSERVATION
DIVISION OF WATER

New York State Department of Environmental Conservation

Construction Site Inspection Report for SPDES MS4 General Permit GP-0-24-001

Project Name:		Date:	
Project Location:		Weather:	
Permit # (if any): **NYR**	Contacted: ☐Yes ☐No	Entry Time:	Exit Time:
Name of SPDES Permittee:		Inspection Type:	☐NOT ☐ Complaint
Phone Number(s):			☐ Compliance ☐ Referral
On-site Representative(s) and Company(s):		MS4 Operator Name:	
		MS4 Permit ID: NYR20A	

SPDES Authority

	Yes	No	N/A		Citation
1.	☐	☐	☐	Does the project have permit coverage?	GP-0-20-001: I.A & II. B
2.	☐	☐	☐	Is a copy of the NOI and Acknowledgment Letter available on site and accessible for viewing?	GP-0-20-001: II.D.2
3.	☐	☐	☐	Is a copy of the MS4 SWPPP Acceptance Form available on site and accessible for viewing?	GP-0-20-001: II.D.2
4.	☐	☐	☐	Is an up-to-date copy of the signed SWPPP retained at the construction site?	GP-0-20-001: II.D.2. & III.A.4
5.	☐	☐	☐	Is a copy of the SPDES General Permit retained at the construction site?	GP-0-20-001: II.D.2
6.	☐	☐	☐	Does the NOI accurately report the number of acres to be disturbed?	GP-0-20-001: II.B.4

SWPPP Content

	Yes	No	N/A		Citation
7.	☐	☐	☐	Does the SWPPP describe and identify the erosion and sediment control measures to be employed?	GP-0-20-001: III.B.1.e
8.	☐	☐	☐	Does the SWPPP provide an inspection schedule and maintenance requirements for the E&SC measures?	GP-0-20-001: III.B.1.i
9.	☐	☐	☐	Does the SWPPP describe and identify the stormwater management practices to be employed?	GP-0-20-001: III.B.2
10.	☐	☐	☐	Does the SWPPP identify the contractor(s) and subcontractor(s) responsible for each measure?	GP-0-20-001: III.A.6
11.	☐	☐	☐	Does the SWPPP identify at least one trained individual from each contractor(s) and subcontractor(s) companies?	GP-0-20-001: III.A.6
12.	☐	☐	☐	Does the SWPPP include all the necessary Contractor Certification Statements and signatures?	GP-0-20-001: III.A.6
13.	☐	☐	☐	Is the SWPPP signed by the permittee?	GP-0-20-001: VII.H.2
14.	☐	☐	☐	Is the SWPPP prepared by a qualified professional (if post-construction stormwater management required)?	GP-0-20-001: III.A.3
15.	☐	☐	☐	Do the SMPs conform to the Enhanced Phosphorus Removal Standards (projects in TMDL watersheds)?	GP-0-20-001: III.B.3

Recordkeeping

	Yes	No	N/A		Citation
16.	☐	☐	☐	Are self-inspections performed as required by the permit (weekly, or twice weekly for >5 acres disturbed)?	GP-0-20-001:IV.C.2.a. & b
17.	☐	☐	☐	Are the self-inspections performed and signed by a qualified inspector and retained on site?	GP-0-20-001:II.C.2.,IV.C.6 & VII.H.3
18.	☐	☐	☐	Do the qualified inspector's reports include the minimum reporting requirements?	GP-0-20-001: IV.C.4
19.	☐	☐	☐	Do inspection reports identify corrective measures that have not been implemented or are recurring?	GP-0-20-001: IV.C.5

Visual Observations

	Yes	No	N/A		Citation
20.	☐	☐	☐	Are all erosion and sediment control measures installed properly?	GP-0-20-001: VII.L
21.	☐	☐	☐	Are all erosion and sediment control measures being maintained properly?	GP-0-20-001: IV.A.1
22.	☐	☐	☐	Was written authorization issued for any disturbance greater than 5 acres?	GP-0-20-001: II.D.3
23.	☐	☐	☐	Have stabilization measures been implemented in inactive areas per Permit (>5acres) or ESC Standard?	GP-0-20-001: II.D.3.b & III.B.1.f
24.	☐	☐	☐	Are post-construction stormwater management practices constructed/installed correctly?	GP-0-20-001: III.B.2
25.	☐	☐	☐	Has final site stabilization been achieved and temporary E&SC measures removed prior to NOT submittal?	GP-0-20-001: V.A.2
26.	☐	☐	☐	Was there a discharge from the site on the day of inspection?	
27.	☐	☐	☐	Is there evidence that a discharge caused or contributed to a violation of water quality standards?	ECL 17-0501, 6 NYCRR 703.2 & GP-0-20-001: I.D

Water Quality Observations

Describe the discharge(s): location, source(s), impact on receiving water(s), etc.

Describe the quality of the receiving water(s) both upstream and downstream of the discharge:

Describe any other water quality standards or permit violations:

Additional Comments:

☐ Photographs attached

Overall Inspection Rating: ☐ Satisfactory ☐ Marginal ☐ Unsatisfactory	
Name/Agency of Lead Inspector:	Signature of Lead Inspector:
Names/Agencies of Other Inspectors:	

NEW YORK STATE | Department of Environmental Conservation

NO EXPOSURE CERTIFICATION

For High Priority Municipal Facilities

in SPDES MS4 General Permit, GP-0-24-001

The completed No Exposure Certification must be documented in the SWMP Plan.
Please do not submit this form to the Department unless requested.

I. Owner/Facility Information

Owner/Operator Name:		
Mailing Address:	City/State/Zip:	
Contact Name:	Phone No.:	
Facility Name:		
Street Address:	City/State/Zip:	
County:	Latitude:	Longitude:

II. Exposure Checklist

	Are any of the following materials or activities exposed to precipitation, now or in the foreseeable future? (Please check either "Yes" or "No" in the appropriate box.) If you answer "Yes" to any of these questions (1) through (11), you are not eligible for no exposure.	YES	NO
1	Using, storing or cleaning machinery or equipment, and areas where residuals from using, storing or cleaning machinery or equipment remain and are exposed to stormwater		
2	Materials or residuals on the ground or in stormwater inlets from spills/leaks		
4	Material handling equipment (except adequately maintained vehicles)		
5	Materials or products during loading/unloading or transporting activities		
6	Materials or products stored outdoors (except final products intended for outside use [e.g., new cars] where exposure to stormwater does not result in the discharge of pollutants)		
7	Materials contained in open, deteriorated or leaking storage drums, barrels, tanks, and similar containers		
8	Materials or products handled/stored on roads or railways owned or maintained by the discharger		
9	Waste material (except waste in covered, non-leaking containers [e.g., dumpster])		

III. Certification

I certify under penalty of law that I have read and understand the eligibility requirements for claiming a condition of "no exposure" and obtaining an exclusion from SPDES stormwater permitting. I certify under penalty of law that there are no discharges of storm water contaminated by exposure to industrial activities or materialsfrom the industrial facility or site identified in this document (except as allowed under 40 CFR 122.26(g)(2)). I understand that I am obligated to submit a no exposure certification form upon request to the NPDES permitting authority or to the operator of the local municipal separate storm sewer system (MS4) into which the facility discharges (where applicable). I understand that I must allow the SPDES permitting authority, or MS4 Operator where the discharge is into the local MS4, to perform inspections to confirm the condition of no exposure and to make such inspection reports publicly available upon request.

Printed Name:	Title/Position:
Signature:	Date:

NEW YORK STATE Department of Environmental Conservation	**Municipal Facility Assessment Form For SPDES MS4 General Permit, GP-0-24-001**

Assessments must be conducted by a person with the knowledge and skills to assess conditions and activities that could impact stormwater quality at the facility and evaluate the effectiveness of best management practices required by the SPDES MS4 General Permit (GP-0-24-001).

MS4 Permit ID:	MS4 Operator Name:	
Facility Name:	Facility Type:	Date:
Weather Conditions:		
Is stormwater runoff present during this assessment? ☐ Yes ☐ No		
Comments:		

General		**Yes**	**No**
1	Is this a high priority municipal facility?	☐	☐
2	If this is a high priority municipal facility, does the facility qualify for a No Exposure Certification?	☐	☐
3	If this is a high priority municipal facility, is there a completed SWPPP available?	☐	☐
4	Does the facility have any MS4 outfalls?	☐	☐
5	Does the facility have any interconnections?	☐	☐
6	Does the facility have any municipal facility intraconnections?	☐	☐
Comments:			
Good Housekeeping		**Yes**	**No**
7	Are paved surfaces free of trash, sediment, and/or debris?	☐	☐
8	Date the paved area was last swept or vacuumed.	☐	☐
9	Do outdoor waste receptacles have covers?	☐	☐
10	Are the waste receptacles emptied on a regular basis?	☐	☐
11	Are there signs of leaks, contaminants or overfilling at the waste receptacle area?	☐	☐
12	Are the following facility areas free of accumulated trash, sediment, debris, contaminants, and spills:	☐	☐
	- Salt storage areas	☐	☐
	- Container storage areas	☐	☐
	- Maintenance areas	☐	☐

	- Staging areas	☐	☐
	- Material stockpile areas	☐	☐
Comments:			

Vehicle and Equipment Areas		☐ N/A	Yes	No
13	Are vehicle/equipment parked indoors or under a roof?		☐	☐
14	Are vehicles/equipment washed in only designated areas?		☐	☐
15	Are vehicles washed regularly to remove contamination and prevent them from polluting stormwater?		☐	☐
16	Is all wash water treated in an oil water separator prior to discharge?		☐	☐
17	Is all wash water managed so it does not enter the MS4?		☐	☐
Comments				

Vehicle/Equipment Maintenance		☐ N/A	Yes	No
18	Is equipment stored under shelter or elevated and covered?		☐	☐
19	Are fluids drained over a drip pan or pad?		☐	☐
20	Are funnels or pumps used when transferring fluids?		☐	☐
21	Are waste rags and used absorbent pads disposed of properly?		☐	☐
22	Are any vehicles and/or equipment leaking fluids?		☐	☐
23	Are drip pans immediately placed under leaks?		☐	☐
24	Are materials, equipment, and activities located so that leaks are contained in existing containment and diversion systems (confine the storage of leaky or leak-prone vehicles and equipment awaiting maintenance to protected areas)?		☐	☐
25	Are vehicles inspected daily for leaks?			
Comments:				

Fueling areas		☐ N/A	Yes	No
26	Is fueling performed under a canopy or roof?		☐	☐
27	Are spill cleanup materials available at the fueling area?		☐	☐
28	Are breakaway valves used on fueling hoses?		☐	☐
29	Is the fueling handle lock disconnected so the operator must attend the fueling?		☐	☐
30	Is stormwater runoff from fueling area treated in an oil/water separator?		☐	☐
31	Is the fueling automatic stop inspected regularly to ensure it is working properly?		☐	☐
32	Are all fuel deliveries monitored?		☐	☐
Comments:				

	Salt Storage Piles or Pile Containing Salt	☐ N/A	Yes	No
33	Is salt stored in a salt storage building or under a roof?		☐	☐
34	Are controls in place to minimize spills while adding or removing material from the pile?		☐	☐
35	Are salt spills cleaned up promptly?		☐	☐
36	Is overflow and tracked salt removed promptly from loading areas?		☐	☐
37	Is stormwater draining away from the salt pile directed to a vegetated filter area		☐	☐
Comments:				

	Fluids Management	☐ N/A	Yes	No
38	Are all drums and containers of fluids stored with proper cover and containment?		☐	☐
39	Are fluids stored in appropriate containers and/or storage cabinets?		☐	☐
40	Are all fluids kept in original containers or labeled in a manner that describes the contents adequately?		☐	☐
41	Are Material Safety Data Sheets (MSDS/SDS) readily available?		☐	☐
42	Are all containers that are stored free of leaks or deposits?		☐	☐
43	Are containers of product inspected regularly?		☐	☐
44	Is used oil and antifreeze stored indoors and/or on spill containment pallets?		☐	☐
45	Is used oil and antifreeze properly disposed of or recycled?		☐	☐
Comments:				

	Lead Acid Batteries	☐ N/A	Yes	No
46	Are lead-acid batteries stored indoors on spill containment pallets or in bins?		☐	☐
47	Are intact batteries stored on an acid-resistant rack or tub?		☐	☐
48	Are cracked or leaking batteries stored in labeled, closed, leak-proof containers?		☐	☐
49	Is the date each battery was placed in storage recorded?		☐	☐
50	Are batteries stacked more than 5 high?		☐	☐
51	Are batteries inspected regularly for leaks?		☐	☐
Comments:				

	Spill Prevention and Response Procedures	☐ N/A	Yes	No
52	Are vehicles inspected daily for leaks?		☐	☐

53	Is spill control equipment and absorbents readily available?	☐	☐
54	Are emergency phone numbers posted in conspicuous areas?	☐	☐
55	Are spills contained and cleaned up immediately?	☐	☐
Comments:			

General Material Storage Areas	☐ N/A	Yes	No
56	Are leaking or damaged materials stored inside a building or another type of storm resistance shelter?	☐	☐
57	Are all material stockpiles within containment structures (e.g., concrete barriers, earthen berms) or stored in a manner that does not allow discharge of impacted stormwater?	☐	☐
58	Are used fuel tanks and other scrap metal and parts drained of fluids and stored under cover?	☐	☐
59	Are outdoor containers covered?	☐	☐
60	Are piles of spoils, asphalt, debris, etc. stored under a roof or cover?	☐	☐
61	Are spills of material or debris cleaned up promptly?	☐	☐
62	Are used tire storage piles placed away from storm drains or conveyances?	☐	☐
63	Are tires recycled frequently to keep the number of stored tires manageable?	☐	☐
Comments:			

Stormwater Management		Yes	No
64	Are employees trained on the municipal facility procedures?	☐	☐
66	Are BMPs and treatment structures working as designed?	☐	☐
67	Are BMPs and treatment structures free from debris buildup or overgrown vegetation that may impair function?	☐	☐
68	Catch basins should be cleaned in accordance with the timeframes listed in Part VI.F.3.c.iii. / Part VII.F.3.c.iii, depending on the MS4 Operator type. Based on this, do any catch basins need to be cleaned?	☐	☐
69	Are berms, curbing or other methods used to divert and direct discharges adequate and in good condition?	☐	☐
70	Are rooftop drains directed to areas away from pavement?	☐	☐
Comments:			

Erosion and Sediment Controls		Yes	No
71	Are soil stabilization measures (e.g., seed and mulch, rolled erosion control products) considered in areas that have the potential for significant soil erosion?	☐	☐
72	Are natural buffers maintained around surface waters?	☐	☐
73	Are flow velocity dissipation devices in place at monitoring locations and channel outlets (rock riprap, stone check dams, concrete baffles)?	☐	☐
74	Do controls conform to the NYS Standards and Specifications for Erosion and Sediment Control (2016), or equivalent?	☐	☐

Comments:
Corrective Actions and Comment
Describe Inspection findings and if necessary, the corrective actions taken

Inspector Signature		Date:	

NEW YORK STATE | Department of Environmental Conservation

Storm Event Data Form for SPDES MS4 General Permit, GP-0-24-001

Do not submit this form to the Department; keep this form with the municipal facility's SWPPP and in the MS4 Operator's SWMP Plan.

Permit Number:

N	Y	R	2	0	A			

Facility Name:

Contact First Name:

Contact Last Name:

Contact Phone:

Contact Email:

Storm Event Date:

Storm Duration (in hours):

Rainfall Measurement from Storm Event (in inches):

Date of Last Measurable Storm Event:

Duration Between Storm Event Sampled and End of Previous Measurable Storm (in hours):

Certification

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Facility Operator First Name (please print or type)

Facility Operator Last Name (please print or type)

/ /

Date

Signature

NEW YORK STATE OF OPPORTUNITY | Department of Environmental Conservation

Visual Monitoring Form MS4 GP-0-24-001

All high priority municipal facilities covered under the MS4 GP-0-24-001 must perform Visual Monitoring twice a permit term, separated by a minimum of one (1) year. Please see the permit Part VI.F/VII.F for additional requirements. This form is part of the facilities records and should be retained onsite with the facility's Stormwater Pollution Prevention Plan. ***Please do not submit this form to the Department.***

MS4 Operator Permit ID

Facility Name

Outfall Number

Examiner's Name

Examiner's Title

Reporting Year

Rainfall Amount

Qualifying Storm? ◯Yes ◯No

Runoff Source? ◯Rainfall ◯Snowmelt

Date/Time Collected __ / __ / __ __ : __ __ AM / PM

Date/Time Examined __ / __ / __ __ : __ __ AM / PM

1. Does the stormwater appear to be colored? ..... ◯Yes ◯No

If yes, describe

2. Is the stormwater clear or transparent? ..... ◯Yes ◯No

If yes, which of the following best describes the clarity of the stormwater: ..... ◯Clear ◯Milky ◯Opaque

3. Can you see a rainbow sheen effect on the water surface?..... ◯Yes ◯No

If yes, which best describes the sheen?..... ◯Rainbow Sheen ◯Floating Oil Globules

4. Does the sample have an odor? ..... ◯Yes ◯No

If yes, describe

5. Is there something floating on the surface of the sample? ..... ◯Yes ◯No

If yes, describe

6. Is there something suspended in the water column of the sample? ..... ◯Yes ◯No

If yes, describe

7. Is there something settled on the bottom of the sample?..... ..... ◯Yes ◯No

If yes, describe

8. Is there foam or material forming on the top of the sample surface?..... ◯Yes ◯No

If yes, describe

Detail any concerns, corrective actions taken and any other indicators of pollution present in the sample:

Works Cited

Center for Watershed Protection, Illicit Discharge Detection and Elimination: A Guidance Manual for Program Development and Technical Assistance, October 2004 (CWP 2004)

New York State Department of Environmental Conservation, Maintenance Guidance: Stormwater Management Practices, March 31, 2017 (NYS DEC Maintenance Guidance 2017)

New York State Department of Environmental Conservation, Model Local Law to Prohibit Illicit Discharges, Activities and Connections to Separate Storm Sewer Systems, April 2006 (NYS DEC Model IDDE Local Law 2006)

New York State Department of Environmental Conservation, Sample Local Law for Stormwater Management and Erosion & Sediment Control, March 2006 (NYS DEC Sample SM and E&SC Local Law 2006)

New York State, Standards and Specifications for Erosion & Sediment Control, November 2016 (NYS E&SC 2016)

New York State, Stormwater Management Design Manual, January 2015 (NYS SWMDM 2015)

SPDES Multi-Sector General Permit for Stormwater Discharges Associated with Industrial Activity, GP-0-23-001 (MSGP)

SPDES General Permit for Stormwater from Construction Activities, GP-0-20-001 (CGP)

SPDES General Permit for Stormwater Discharges from the Municipal Separate Storm Sewer Systems, GP-0-24-001 (MS4 GP)

United States Department of Transportation Federal Highway Administration, Highway Functional Classification Concepts, Criteria and Procedures, 2013 (USDOT 2013)

ATTACHMENT 2

TOWN OF WAWAYANDA

STORMWATER BASEMAP

ATTACHMENT 2: Stormwater Basemap

Town of Warwick
Stormwater Management Plan 2026

N
W E
S

0 0.75 1.5 3 Miles

- Automatically-Designated MS4 Area
- Additionally-Designated MS4 Area
- 100ft Contours

Stream Classifications

- A
- B
- C
- Lakes and Reservoirs

Land Use

- Industrial
- Residential
- Commercial
- Open Space
- Institutional

Roads

- Interstates
- State Route
- County Road
- Local Roads
- Private Roads
- New Jersey

Sussex County

Passaic County

MHE ENGINEERING

ATTACHMENT 3

STORMWATER EDUCATION & OUTREACH PAMPHLET

WHAT IS STORMWATER RUNOFF AND HOW DOES IT BECOME A PROBLEM

Stormwater pollution occurs when rainfall or snowmelt runoff travels across loose soils or impervious surfaces and transports sediment, vehicle fluids, chemicals, fertilizers, salts, and other contaminants into natural water supplies and sensitive environments. It can also run directly into storm drainage systems and catchment areas. From there, it's carried without treatment into our streams, ponds, reservoirs and rivers.

Stormwater pollution can be problematic due to the pollutants it can pick up and transport to sensitive areas like potable water sources or polluted/threatened environments.



COMMON POLLUTANTS

- Salts
- Fertilizers (Phosphorus and Nitrogen)
- Car Fluids (Oils and Gas)
- Soaps
- Sediment
- Sewage
- Trash



CONTACT US

MHE ENGINEERING

33 Airport Center Drive
Suite 202
New Windsor, NY 12553

845-567-3100

David A. Fritts, CPESC, CESSWI, Associate
dfritts@mhepc.com

TOWN OF WARWICK
123 KINGS HIGHWAY
WARWICK, NY 10990
845-986-1124



POLLUTION SOURCES AND SOLUTIONS

EDUCATION

Polluted stormwater runoff can have many adverse effects on plants, fish, animals and people. Homeowners have the most impact at reducing Stormwater Pollution and Phosphorus Loading from:

Fertilizers, pesticides, yard clippings and leaves can wash into the drainage networks and pollute waterbodies via nutrient loading. Compost yard waste and use that as fertilizer in place of commercial fertilizers.

Don't over water your lawn. Have a rain barrel to catch roof runoff and utilize that for lawn care. Avoid or minimize the use of fertilizers and pesticides for lawn care.

ILLICIT DISCHARGE DETECTION AND ELIMINATION (IDDE)

Homeowners, businesses and contractors can accidently/intentionally dump pollutants into the drainage network or directly into water bodies.

The general public should report any suspicious discharges (dirty/cloudy/tinted water, unusual smells, floating debris and random dumping) to Municipal offices. Municipal offices will investigate and attempt to identify the source.

PHOSPHORUS POLLUTION

Phosphorus is the most common form of stormwater pollution due multiple sources of pollution (sediment erosion, sewer overflow and fertilizer application).

This can cause algae blooms in aquatic habits that depletes dissolved oxygen through overproduction and mass die off.

EDUCATIONAL AWARENESS

1. Sediment can cloud the water and make it difficult or impossible for aquatic plants to grow. Sediment also can destroy aquatic habits and fill in streams, ponds and lakes.
2. Polluted stormwter can often affect drinking water sources. This, in turn, can create human health issues and increase drinking water treatment costs.
3. Bacteria and other pathogens can wash into swimming areas and create health hazards, often making beach closures necessary.
4. Debris, plastic bags, drink containers, cigarette butts and litter washing into waterbodies can choke, suffocate or disable aquatic life like ducks, fish, turtles and birds.
5. Excess nutrients can cause algae blooms. When algae dies, it sinks to the bottom and decomposes in a process that removes oxygen from water called eutrophication. Fish and other aquatic organisms can't exist in water with low dissolved oxygen levels.
6. Household hazardous waste like insectides, paint solvents, used motor oil, and other auto fluids can poison aquatic life.

SEPTIC SYSTEMS

Leaking and poorly maintained septic systems release nutrients and pathogents (bacteria and viruses) that can be picked up by stormwater and discharged into nearby waterbodies. Pathogens can cause public health problems and environmental concerns.

Inspect your system every 3 years and pump your tank as necessary (every 3 to 5 years).

PET WASTE

Pet waste can be a major source of bacteria and excess nutrients in local waters.

When walking your pet, remember to pick up the waste and dispose of it properly. Flushing pet waste is the best disposal method.

AUTO CARE

Washing your car and degreasing your auto parts at home can send detergents and other contaminants through the storm sewer system. Dumping automotive fluids into storm drains has the same result as dumping the materials directly into a waterbody.

Use a commercial car wash that treats or recycles its wastewater, or wash your car in your yard so the water infiltrates into the ground.

Don't dispose of any hazardous materials (cleaning chemicals, auto fluids, greases) into storm drains. Property dispose of them in sealed containers and take to a certified disposal facility. All facilities that change oil must accept used waste oil.

ATTACHMENT 4

STORMWATER MANAGEMENT REGULATIONS

§ 164-47.10. Stormwater management. [Added 2-18-2010 by L.L. No. 1-2010; amended 10-25-2012 by L.L. No. 3-2012]

A. Purposes and findings. The purpose of this stormwater management regulation is to establish minimum requirements for the control of stormwater runoff, to prevent soil erosion and sedimentation of surface waters, and to protect and safeguard the general health, safety and welfare of Town residents in accordance with the following findings:

(1) Land development activities and associated increases in site impervious cover often alter the hydrologic response of local watersheds and increase stormwater runoff rates and volumes, flooding, stream channel erosion, and/or sediment transport and deposition.

(2) This stormwater runoff contributes to increased quantities of waterborne pollutants, including siltation of aquatic habitat for fish and other species.

(3) Clearing and grading during construction increases soil erosion and increases loss of native vegetation necessary for terrestrial and aquatic habitat

(4) Improper design and construction of stormwater management facilities and practices can increase the velocity of stormwater runoff, thereby increasing stream bank erosion and sedimentation.

(5) Impervious surfaces allow less water to percolate into the soil, thereby decreasing groundwater recharge and stream base flow.

(6) Substantial economic losses can result from these adverse impacts on the waters of the Town.

(7) Stormwater runoff, soil erosion and nonpoint source pollution can be controlled and minimized through the regulation of stormwater runoff from land development activities.

(8) The regulation of stormwater runoff discharges from land development activities, which control and minimize increases in stormwater runoff rates and volumes; soil erosion; stream channel erosion; and nonpoint source pollution associated with stormwater runoff, is in the public interest and will minimize threats to public health and safety.

(9) Regulation of land development activities which include performance standards governing stormwater management and site design will produce development compatible with the existing functions of a particular site or an entire watershed and thereby mitigate the adverse effects of erosion and sedimentation from development.

(10) Conventional engineering design dictates using whatever solution is simplest to design, most efficient to build, and cheapest to maintain. While this may be a satisfactory means of addressing the need for stormwater management, it does little to reflect the important natural resource that water represents in the community and fails to reflect the scenic and rural context of the Town.

B. Objectives of stormwater management. Establishing minimum stormwater management requirements and controls will address the findings of fact cited above by achieving the

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following objectives:

(1) Require land development activities to conform to the substantive requirements of the New York State Department of Environmental Conservation (NYSDEC) State Pollutant Discharge Elimination System (SPDES) General Permit for Construction Activities, as amended or revised.

(2) Minimize increases in stormwater runoff from land development activities in order to reduce flooding, siltation, increases in stream temperature, and stream bank erosion and maintain the integrity of stream channels and associated wildlife habitats.

(3) Minimize increases in pollution caused by stormwater runoff from land development activities which would otherwise degrade local water quality.

(4) Control the total annual volume of stormwater runoff which flows from any specific site during and following development to the maximum extent practicable.

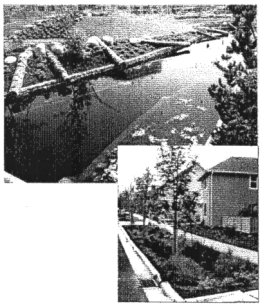
(5) Manage stormwater runoff rates and volumes and reduce soil erosion and nonpoint source pollution, wherever possible, through stormwater management practices and ensure that these management practices are properly maintained and eliminate threats to public safety.

(6) All stormwater should be treated as a valuable resource.

(7) Ensure that stormwater management basins are always regarded as an aesthetic and environmental asset to the community, as opposed to just a necessity.

(8) Stormwater design is an integral element of neighborhood design. Engineering elements must not detract from their surroundings nor from the character of the neighborhood.

(9) Stormwater management should integrate appropriate art and landscape architecture designs so that Warwick can continue to be a thriving and livable rural community.



C. Applicability.

(1) This section shall be applicable to all land development activities as defined herein. All land development activities, subject to review and approval by the Planning Board under subdivision, site plan, and/or special permit regulations, shall be reviewed subject to the standards contained in this section. The Town Board designates the Code

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Enforcement Officer for receipt of all stormwater pollution prevention plans (SWPPP) and directs the Code Enforcement Officer to forward such plans to the Planning Board and/or Town Engineer for review and approval unless the application is before the Planning Board, in which case the Planning Board will review the SWPPP directly.

(2) There are three levels of stormwater management required, depending upon the area of disturbance and other criteria as listed in § 164-47.10C(2)(a) to (c) below. Land development activities will require one of the three following SWPPPs:

(a) A simple SWPPP for land development activities with less than one acre of disturbance.

(b) An intermediate SWPPP for:

[1] Land development activities from one acre to less than five acres of disturbance.

[2] Land development activities, regardless of size, that the Code Enforcement Officer or Planning Board determines could cause adverse impacts on water quality due to the presence of steep slopes of 15% or greater, soil characteristics such as those classified by the U.S. Department of Agriculture as presenting a moderate erosion hazard, the layout of impervious surfaces, proximity to sensitive areas within 100 feet of the disturbance, or proximity to an existing stormwater structure or facility.

(c) A complete SWPPP for:

[1] Land development activities of five acres or more.

[2] Land development activities, regardless of size, that the Code Enforcement Officer or the Planning Board determines could cause adverse impacts on water quality due to the post-construction water quality or quantity, presence of steep slopes, soil characteristics, the layout of impervious surfaces, potential for pollutant generation on site, proximity to sensitive areas, or proximity to a stormwater structure or facility.

[3] Land development activities that will create 1/2 acre or more of contiguous impervious surfaces.

[4] Land development activities initially disturbing less than five acres of land that is part of a larger common plan of development or sale of the entire contiguous quantity of land in possession of, recorded as property of, or owned (in any form of ownership, including land owned as a partner, corporation, joint tenant, etc.) by the same individual (and/or that individual's spouse), and comprises not only the area of land development activities initially sought but also all contiguous lands owned by the individual (and/or that individual's spouse) in any form of ownership that may have a cumulative impact of five acres or more;

[5] Land development activities that have been determined to have a significant

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adverse environmental impact, as defined by the New York State Environmental Quality Review Act (SEQR) and as determined by the Town Planning Board or other designated lead agency as requiring appropriate mitigation measures to reduce or avoid such impacts, may be subject to a complete SWPPP.

D. Exemptions. The following activities shall be exempt from review under this section:

(1) Agriculture conducted in a manner consistent with the New York State Department of Agriculture and Markets' "Sound Agricultural Practices Guidelines," as amended from time to time by the Advisory Council on Agriculture.

(2) Forestry conducted in a manner consistent with the "Timber Harvesting Guidelines" as defined and amended from time to time by the New York State Department of Environmental Conservation, except that landing areas and log haul roads are subject to this subsection.

(3) Routine maintenance activities that result in a disturbance of less than 10,890 square feet (0.25 acre) and are performed to maintain the original line and grade, hydraulic capacity or original purpose of a facility.

(4) Repairs to any stormwater management practice or facility deemed necessary by the Code Enforcement Officer and/or Town Engineer.

(5) Land development activities for which a building permit has been approved on or before February 18, 2010.

(6) Cemetery graves, excluding aboveground structures such as mausoleums.

(7) Installation of fence, sign, telephone, and electric poles and other kinds of posts or poles, but not including installation of transmission equipment, provided that the area of disturbance is less than 1/4 acre.

(8) Emergency activity immediately necessary to protect life, property or natural resources.

(9) Activities of an individual engaging in home gardening by growing flowers, vegetables and other plants, primarily for use by that person and his or her family.

(10) Existing small residential lots in accordance with § 164-45.1 of the Zoning Law.

(11) Renewable energy technologies involving solar or wind generation unless subject to § 164-46B of the Zoning Law.

(12) Interior alterations and minor exterior alterations of structures shall not require an SWPPP. Such minor interior or exterior alterations shall require only the approval of the Building Inspector and issuance of a building permit (see § 164-22 "designated protection area," Subsection A, if applicable).

E. Stormwater pollution prevention plans. No application for approval of a land development activity shall be deemed complete until the Code Enforcement Officer or Planning Board has received an SWPPP prepared in accordance with the standards and specifications herein. The

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Code Enforcement Officer or Planning Board may require an SWPPP regardless of the area of proposed disturbance where there exists a good reason in the nature of the land, including but not limited to topography, location, drainage, surface water and groundwater resources, and other physical features of the site as well as the character of the surrounding community. To determine which type of SWPPP is required, a notice of ground disturbance form must be completed by the applicant.

(1) Notice of ground disturbance. No land development activity which exceeds the thresholds in § 164-47.10C shall be commenced until the Code Enforcement Officer or Planning Board has approved a SWPPP. The applicant shall submit to the Code Enforcement Officer or Planning Board, on a form to be supplied, a notice of ground disturbance. The notice of ground disturbance shall include the following: **[Amended 5-8-2014 by L.L. No. 2-2014]**

(a) Contact information including owner and applicant's name, address, project address, phone numbers, e-mail address, tax parcel numbers.

(b) A brief description of the project, including a sketch, which may be combined with other drawings required for a building permit, specifically showing existing drainage features and vegetation on the site.

(c) A description of the proposed project phases.

(d) The ground area in square feet and acres that will be disturbed for each phase or phases of the project. The areas to be measured include, but are not limited to, driveways, parking areas, buildings, grading and clearing, lawns, ditches, drainage structures, utilities, stockpiles, including the total project area of disturbance, total parcel acreage, area of existing impervious surface, total area of impervious surface expected at completion, and total contiguous impervious area.

(e) A description of the distance(s) from the areas of ground disturbance on any part of the site to the edge of any stream, pond, lake, or wetland on or in the vicinity of the site.

(f) Any mapped or other indicators of wetlands on the site or adjacent to the site.

(g) A description of the slope(s) of the site (in numerical or descriptive format).

(h) A description of any linear excavations greater than or equal to 500 feet long and three feet wide.

(i) A description of any activities that may involve the fill or excavation of greater than 250 cubic yards of soil, equivalent to 25 dump truck loads.

(j) A list of and brief description of any other permits required for the project.

(k) Any additional details requested by the Code Enforcement Officer or Planning Board.

(2) Contents of a simple SWPPP;

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(a) Notice of ground disturbance.

(b) The applicant will provide to the Code Enforcement Officer or Planning Board for review a generalized plan describing the erosion and sediment control measures to be used to minimize the impacts of the land development activity appropriate for the site, based upon the guidelines in the NYSDEC Erosion Control Manual or as developed by the Town for this purpose. Measures may include:

[1] Stabilized construction entrance;

[2] Stabilization of exposed soil;

[3] Protection of adjacent properties, waterways, and natural areas;

[4] Management of concentrated flow areas; and

[5] Maintenance during construction.

(3) Contents of an intermediate SWPPP:

(a) All items included in the simple SWPPP.

(b) Existing pre-construction conditions:

[1] Site map, at a scale no smaller than one inch equals 50 feet, must include the following:

[a] Project parcel and surrounding areas within 200 feet of the parcel;

[b] Existing conditions for drainage, including topography, culverts, ditches, surface waters and wetlands (including names and classifications for both, if applicable), subwatershed boundaries, and existing vegetation;

[c] Existing buildings, structures, utilities, and pave areas;

[d] Contour lines in sufficient detail to represent site topography.

[2] Description of the existing soil(s), vegetative surface cover, and site impervious cover present.

[3] Assessment of the site limitations and development constraints with regard to factors including, but not limited to, slope, soil erodibility, depth to bedrock (if shallow), depth to seasonal high water, soil infiltration capacity, and proximity to surface waters and wetlands.

[4] Any existing data that describes the stormwater runoff at the site.

(c) Better site design practices:

[1] Description of the better site design practices to be used for this project as described by the NYSDEC and identified below in no particular order:

[a] Preservation of undisturbed areas.

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[b] Preservation of buffers.

[c] Reduction of clearing and grading.

[d] Locating sites in less sensitive areas.

[e] Open space design.

[f] Roadway reduction.

[g] Sidewalk reduction.

[h] Driveway reduction.

[i] Cul-de-sac reduction.

[j] Building footprint reduction.

[k] Parking reduction.

[l] Vegetated buffer/filter strips.

[m] Open vegetated channels.

[n] Bioretention.

[o] Infiltration.

[p] Rooftop runoff reduction mitigation.

[q] Stream daylighting for redevelopment projects.

[r] Tree planting.

[2] The Town requires that projects disturbing between one acre and two acres must apply at least two of these practices; projects disturbing between two acres and three acres must complete at least three of these practices; projects between three acres and four acres must complete at least four of these practices; and projects disturbing between four acres and five acres must complete at least five of these practices, the determination of which is to be made by the Planning Board during review of the project.

[3] Where the Planning Board finds that compliance with the standards herein would cause unusual hardship or extraordinary difficulties due to exceptional conditions of topography, access, location, shape, or other physical features of the site, the minimum requirements of these regulations may be waived or modified in accordance with § 164-74.1 of the Zoning Law.

(d) Proposed construction and post-construction conditions:

[1] Construction map(s) for the project may be combined with the existing conditions site map, but only if all required features can be shown clearly. At a minimum, the map(s) must show the following for the total site area: all

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improvements; areas of disturbance; areas that will not be disturbed; post-development topography; proposed changes to drainage patterns; locations of on-site and off-site material, waste, borrow, equipment storage area; and location(s) where stormwater from the site will discharge to water bodies or existing man-made drainage structures. The names of downstream receiving waters must be identified.

[2] If the project will create a new or increased concentrated discharge to a man-made drainage structure maintained by a private adjacent landowner, drainage district or drainage district association, written consent of that landowner, drainage district or drainage district association shall be provided in the form of a drainage easement, which shall be recorded on the plan and shall remain in effect with transfer of title to the property. No other discharge of concentrated flow to a neighboring private property is permitted.

[3] Identify on-site storage location for the SWPPP and all relevant records and certifications, including inspection records, post-construction maintenance requirements and the entity responsible for such maintenance.

[4] Construction phasing plan describing the intended sequence of construction activities, including clearing and grubbing, excavation and grading, utility and infrastructure installation, and any other activity at the site that results in soil disturbance. No more than three acres may be exposed by site preparation at any one time. If the applicant determines that this three-acre limit is insufficient, the applicant must provide a basis for the contention.

(e) Erosion and sediment control plan, including:

[1] Description of temporary and permanent structural and vegetative measures to be used for soil stabilization, runoff control and sediment control for each stage of the project from initial land clearing and grubbing to project close-out.

[2] Description of structural practices designed to divert flows from exposed soils, store flows, or otherwise limit runoff and the discharge of pollutants from exposed areas of the site to the degree attainable.

[3] Dimensions, material specifications and installation details for all erosion and sediment control practices, including the siting and sizing of any temporary sediment basins.

[4] A site map/construction drawing(s) specifying the location(s), size(s), and length(s) of each erosion and sediment control practice. This site map can be incorporated into the construction map described above.

[5] Identification of erosion control facilities, if any, that will be converted from temporary to permanent control measures.

[6] Implementation schedule for staging temporary erosion and sediment control practices, including the timing of initial placement and duration that each

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practice will remain in place. Erosion and sediment control measures must be constructed prior to beginning any other land disturbances. The devices must be maintained and must not be removed until the disturbed land areas are stabilized.

[7] Delineation of SWPPP implementation responsibilities for each part of the site.

[8] Maintenance schedule to ensure continuous and effective operation of all erosion and sediment control practices.

(f) Construction site waste management plan, including:

[1] Description of the pollution prevention measures that will be used to prevent litter, construction chemicals, and construction debris from becoming a pollutant source in stormwater runoff.

[2] Description of the type, quantities/sizes, and disposal methods for construction and waste materials expected to be stored on site and off site with updates as appropriate, and a description of controls to reduce pollutants from these materials, including storage practices to minimize exposure of the materials, to stormwater, and spill prevention and response.

(4) Contents of complete SWPPP:

(a) All items included in the Intermediate SWPPP.

(b) Site map/construction drawing(s) for the project, at the scale required by Article V of the Subdivision Regulations,[1] including a general location map. At a minimum, the site map should show the total site area; all improvements; areas of disturbance; areas that will not be disturbed; existing vegetation; mapped habitats; on-site and adjacent off-site surface water(s); wetlands and drainage patterns that could be affected by the construction activity; existing and final slopes; locations of off-site material, waste, borrow or equipment storage areas; and location(s) of the stormwater discharges(s). **[Amended 12-30-2014 by L.L. No. 7-2014]**

(c) Description of the soil(s) present at the site.

(d) Construction phasing plan describing the intended sequence of construction activities, including clearing and grubbing, excavation and grading, utility and infrastructure installation, and any other activity at the site that results in soil disturbance. Consistent with the general State Pollutant Discharge Elimination System (SPDES) permit, any project disturbing one acre or more shall be subject to an SWPPP, as defined in § 164-47.10E.

(e) Description of the pollution prevention measures that will be used to control litter, construction chemicals and construction debris from becoming a pollutant source in stormwater runoff.

1. **Editor's Note: See Ch. 137, Subdivision of Land.**

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(f) Description of construction and waste materials expected to be stored on site with updates as appropriate, and a description of controls to reduce pollutants from these materials, including storage practices to minimize exposure of the materials to stormwater and spill prevention and response.

(g) Temporary and permanent structural and vegetative measures to be used for soil stabilization, runoff control and sediment control for each stage of the project from initial land clearing and grubbing to project close-out, including the use of pervious pavers or pervious pavement, which is encouraged and in some cases required by this Zoning Law.

(h) A site map/construction drawing(s) specifying the location(s), size(s) and length(s) of each erosion and sediment control practice.

(i) Dimensions, material specifications and installation details for all erosion and sediment control practices, including the siting and sizing of any temporary sediment basins.

(j) Temporary practices that will be converted to permanent control measures.

(k) Implementation schedule for staging temporary erosion and sediment control practices, including the timing of initial placement and duration that each practice should remain in place.

(l) Maintenance schedule to ensure continuous and effective operation of the erosion and sediment control practice.

(m) Name(s) of the receiving water(s).

(n) Delineation of SWPPP implementation responsibilities for each part of the site.

(o) Description of structural practices designed to divert flows from exposed soils, store flows, or otherwise limit runoff and the discharge of pollutants from exposed areas of the site to the degree attainable.

(p) Any existing data that describes the stormwater runoff at the site.

(5) Land development activities, as defined herein and meeting Condition A or B below, shall also include water quantity and water quality controls (post-construction stormwater runoff controls) as set forth in Schedule A[2] herein, as applicable:

(a) Condition A: Stormwater runoff from land development activities involving disturbance of 1/4 acre up to five acres or discharging a pollutant of concern to Greenwood Lake, an impaired water identified on the Department of Environmental Conservation's 303(d) list of impaired waters, or a total maximum daily load (TMDL) designated watershed for which pollutants in stormwater have been identified as a source of the impairment.

(b) Condition B: Stormwater runoff from land development activities involving

2. Editor's Note: Schedule A is included at the end of this chapter.

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disturbance of five or more acres during the course of the project, inclusive of the construction of single-family residences and construction activities at agricultural properties.

(6) SWPPP requirements for Conditions A and B:

(a) All information required herein;

(b) Description of each post-construction stormwater management practice;

(c) Site map/construction drawing(s) showing the specific location(s) and size(s) of each post-construction stormwater management practice;

(d) Hydrologic and hydraulic analysis for all structural components of the stormwater management system for the applicable design storms;

(e) Comparison of post-development stormwater runoff conditions with pre-development conditions;

(f) Dimensions, material specifications and installation details for each post-construction stormwater management practice;

(g) Maintenance schedule to ensure continuous and effective operation of each post-construction stormwater management practice;

(h) Maintenance easements to ensure access to all stormwater management practices at the site, for the purpose of inspection and repair. Easements shall be recorded on the plan and shall remain in effect with transfer of title to the property;

(i) Inspection and maintenance agreement binding on all subsequent landowners served by the on-site stormwater management measures, in accordance with Schedule B[3] herein;

(j) For Condition A, the SWPPP shall be prepared by a licensed landscape architect or a certified professional engineer and shall be signed by the professional preparing the plan, who shall certify that the design of all stormwater management practices meet the requirements herein.

(k) The New York SPDES General Permit for Stormwater Runoff from Construction activities, as amended or revised, requires that SWPPPs be prepared by a licensed professional for land development activities discharging a pollutant of concern to an impaired water identified on the New York State Department of Environmental Conservation's 303(d) list of impaired waters or to a total maximum daily load (TMDL) designated watershed for which pollutants in stormwater have been identified as a source of the impairment.

F. Other permits. The applicant shall assure that all other applicable permits have been or will be acquired for the land development activity prior to approval of the final stormwater design plan.

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3. Editor's Note: Schedule B is included at the end of this chapter.

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G. Contractor certification. Each contractor and subcontractor identified in the SWPPP who will be involved in soil disturbance and/or stormwater management practice installation shall sign and date a copy of the following certification statement before undertaking any land development activity: "I certify under penalty of law that I understand and agree to comply with the terms and conditions of the Stormwater Pollution Prevention Plan. I also understand that it is unlawful for any person to cause or contribute to a violation of water quality standards." The certification shall include the name and title of the person providing the signature, address and telephone number of the contracting firm; the address (or other identifying description) of the site; and the date the certification is made. The certification statement(s) shall become part of the SWPPP for the land development activity. A copy of the SWPPP shall be retained at the site of the land development activity during construction from the date of initiation of construction activities to the date of final stabilization.

(1) Performance and design criteria for stormwater management and erosion and sediment control. All land development activities shall be subject to the following performance and design criteria:

(a) Technical standards. For the purpose of this subsection, the following documents shall serve as the official guides and specifications for stormwater management. Stormwater management practices that are designed and constructed in accordance with these technical documents shall be presumed to meet the standards imposed by this section:

[1] The New York State Stormwater Management Design Manual (New York State Department of Environmental Conservation, most current version or its successor, hereafter referred to as the "Design Manual").

[2] New York State Standards and Specifications for Erosion and Sediment Control (NYSDEC, most current version or its successor, hereafter referred to as the "Erosion Control Manual").

(b) Equivalence to technical standards. Where stormwater management practices are not in accordance with technical standards, the applicant or developer must demonstrate equivalence to the technical standards set forth herein, and the SWPPP shall be prepared by a licensed professional.

(c) Water quality standards. Any land development activity shall not cause an increase in turbidity that will result in substantial visible contrast to natural conditions in surface waters of the State of New York.

H. Maintenance, inspection and repair of stormwater facilities.

(1) Maintenance and inspection during construction. The applicant or developer of the land development activity or their representative shall at all times properly operate and maintain all facilities and systems of treatment and control (and related appurtenances) which are installed or used by the applicant or developer to achieve compliance with the conditions of this Zoning Law. Sediment shall be removed from sediment traps or sediment ponds whenever their design capacity has been reduced by 50%.

(2) Inspection documentation. For land development activities as defined herein and as

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required by New York State regulations, meeting Condition A or B, the applicant shall have a qualified professional conduct site inspections and document the effectiveness of all erosion and sediment control practices every month and within 24 hours of any storm event producing 0.5 inch of precipitation or more. Inspection reports shall be maintained in a site logbook. The Planning Board may require inspection by the Town Engineer, and an improvement bond may be required to ensure completion of all stormwater management facilities.

(3) Inspections required. The Town Code Enforcement Officer may require such inspections as necessary to determine compliance with this section and may either approve that portion of the work completed or notify the applicant wherein the work fails to comply with the requirements of this section and the SWPPP as approved. To obtain inspections, the applicant shall notify the Code Enforcement Officer in person at least 48 hours before any of the following:

(a) Start of construction.

(b) Installation of sediment and erosion control measures.

(c) Completion of site clearing.

(d) Completion of rough grading.

(e) Completion of final grading.

(f) Close of the construction season.

(g) Completion of final landscaping.

(h) Successful establishment of landscaping in public areas. If any violations are found, the applicant and developer shall be notified in writing of the nature of the violation and the required corrective actions. No further work shall be conducted except for site stabilization until any violations are corrected and all work previously completed has received approval by the Code Enforcement Officer.

(4) Inspections by Code Enforcement Officer. The Code Enforcement Officer is responsible for conducting inspections of stormwater management practices (SMPs). All applicants are required to submit as-built plans for any stormwater management practices located on site after final construction is completed. The plan must show the final design specifications for all stormwater management facilities and must be certified by a professional engineer.

(5) Maintenance Easement(s). Prior to the issuance of any approval that has a stormwater management facility as one of the requirements, the applicant or developer must execute a maintenance easement agreement that shall be binding on all subsequent landowners served by the stormwater management facility. The easement shall provide for access to the facility at reasonable times for periodic inspection by the Code Enforcement Officer and/or Town Engineer to ensure that the facility is maintained in proper working condition to meet design standards and any other provisions established by this section. The easement shall be recorded by the grantor in the office of the Orange County Clerk

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after approval by the Town Attorney or Deputy Attorney. The Town may require the formation of a drainage district or a backup drainage district, if warranted.

(6) Maintenance after construction. The owner or operator of permanent stormwater management practices installed in accordance with this section shall ensure they are operated and maintained to achieve the goals of this section. Proper operation and maintenance also includes, as a minimum, the following:

(a) A preventive/corrective maintenance program for all critical facilities and systems of treatment and control (or related appurtenances) which are installed or used by the owner or operator to achieve the goals of this section.

(b) Written procedures for operation and maintenance and training new maintenance personnel.

(c) Discharges from the SMPs shall not exceed design criteria or cause or contribute to water quality standard violations.

(d) The Planning Board may require a maintenance bond to fund the inspection of stormwater management facilities.

(e) Inspection programs shall be established on any reasonable basis, including but not limited to routine inspections; random inspections; inspections based upon complaints or other notice of possible violations; inspection of drainage basins or areas identified as higher-than-typical sources of sediment or other contaminants or pollutants; inspections of businesses or industries of a type associated with higher-than-usual discharges of contaminants or pollutants or with discharges of a type which are more likely than the typical discharge to cause violations of state or federal water or sediment quality standards or the SPDES stormwater permit; and joint inspections with other agencies inspecting under environmental or safety laws. Inspections may include, but are not limited to, reviewing maintenance and repair records; sampling discharges, surface water, groundwater, and material or water in drainage-control facilities; and evaluating the condition of drainage-control facilities and other stormwater management practices.

(7) Maintenance agreements. The Town Board shall approve a formal maintenance agreement for stormwater management facilities binding on all subsequent landowners and recorded in the office of the Orange County Clerk as a deed restriction on the property prior to final plan approval. The maintenance agreement shall be consistent with the terms and conditions of Schedule B of this section entitled "Example of Stormwater Control Facility Maintenance Agreement." The Town Board, in lieu of a maintenance agreement, at its sole discretion, may accept dedication of any existing or future stormwater management facility, provided that such facility meets all the requirements of this section and includes adequate and perpetual access and sufficient area, by easement or otherwise, for inspection and regular maintenance.

(8) Submission of reports. The Planning Board may require monitoring and reporting from entities subject to this section as are necessary to determine compliance with this section.

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(9) Right of entry for inspection. When any new stormwater management facility is installed on private property or when any new connection is made between private property and the public stormwater system, the landowner shall grant to the Code Enforcement Officer and/or Town Engineer the right to enter the property at reasonable times, and in a reasonable manner, for the purpose of inspection as specified in Subsection H herein. **[Amended 12-30-2014 by L.L. No. 7-2014]**

I. Construction completion guarantee. In order to ensure the full and faithful completion of all land development activities related to compliance with all conditions set forth by the Planning Board in its approval of the stormwater pollution prevention plan, the Planning Board may require the applicant or developer to provide, prior to construction, a performance bond, cash escrow, or irrevocable letter of credit from an appropriate financial or surety institution, which guarantees satisfactory completion of the project and names the Town of Warwick as the beneficiary. The security shall be in an amount to be determined by Planning Board, based on submission of final design plans, with reference to actual construction and landscaping costs. The performance guarantee shall remain in force until the surety is released from liability by the Town of Warwick, provided that such period shall not be less than one year from the date of acceptance, or such other certification that the facility(ies) have been constructed, in accordance with the approved plans and specifications, and that a one-year inspection has been conducted and the facilities have been found to be acceptable to the Code Enforcement Officer and/or Town Engineer. Per annum interest on cash escrow deposits shall be reinvested in the account until the surety is released from liability.

J. Maintenance guarantee. Where stormwater management and erosion and sediment control facilities are to be operated and maintained by the developer or by a corporation that owns or manages a commercial facility, the developer, prior to construction, may be required to provide the Planning Board or Code Enforcement Officer with an irrevocable letter of credit from an approved financial institution or surety to ensure proper operation and maintenance of all stormwater management and erosion control facilities both during and after construction and until the facilities are removed from operation. If the developer or landowner fails to properly operate and maintain stormwater management and erosion and sediment control facilities, the Town of Warwick may draw upon the account to cover the costs of proper operation and maintenance, including engineering and inspection costs.

K. Recordkeeping. The Planning Board may require entities subject to this section to maintain records demonstrating compliance with this section.

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ATTACHMENT 5

ENFORCEMENT RESPONSE PLAN WITH ATTACHMENTS

Enforcement Response Plan

As per Part IV.F of the New York State Department of Environmental Conservation's SPDES General Permit No. GP-0-24-001(Permit), effective January 3, 2024 (EDC), MS4 Operators (Operator[s]) must develop and implement an Enforcement Response Plan in order to document how violations to State and local stormwater laws will be addressed in their area of jurisdiction. State stormwater regulations relate to illicit discharges, construction activities, and post-construction activities. Regulations are defined and explained in detail in the following documents:

1. NYS Standards and Specifications for Erosion and Sediment Control (Blue Book, November 2016)
2. NYS Stormwater Management Design Manual (January 2015)
3. NYSDEC SPDES General Permit for Construction
4. NYS Municipal Stormwater Management Code

It is the responsibility of the Operator to implement State stormwater regulations by enforcing the documents listed above as well as through six (6) Minimum Control Measures (MCMs) that are described in Part VI of the Permit.

Violations may come to the attention of the Operator through public complaints or other third-party notifications as well as observations by municipal staff, including the Operator or a designee, during regular inspections or other site visits to construction or post-construction sites. When a non-compliant stormwater activity has been observed by or reported to the Operator, the Operator will consider the type, magnitude, and duration of the violation when initiating the enforcement proceedings. Minor and/or first time violations will be addressed through verbal or written warning from the operator, with significant and/or repeat violations being subject to additional enforcement actions including Stop Work Orders and fines with the potential for revocation of permits/approvals and/or calling of a projects bond and/or direct billing to the responsible party for remedial work to correct the violation(s).

The Operator will use the attached Violation and Enforcement Documentation form (Attachment A) to record and track all communications, correspondence, and enforcement actions. This form should be signed by the Operator when each violation is ultimately resolved. Completed Violation and Enforcement Documentation forms will be kept on file in the Town Hall with all other MS4 permit-related information.

As referenced above, the Operator is also responsible for implementing the six (6) MCMs prescribed within the Permit. Attachment B describes the actions that need to be taken within the two years of the EDC and Attachment C assigns responsibility for each activity, with the Operator being the responsible party who ensures these measures are met and documented in the municipality's Stormwater Management Plan (SWMP Plan).

Illicit Discharges

Upon discovery of an illicit discharge, the MS4 Operator shall implement the procedures outlined in the **Monitoring Locations Inspection and Sampling Program,** the **Illicit Discharge Elimination and Track Down Program,** and the **Illicit Discharge Elimination Program.** These are outlined in the MCM 3 section of the SWMP Plan.

All personnel responsible for conducting illicit discharge sampling, track down, or elimination work must receive training prior to engaging in such activities. Refresher training is required at least once every five (5) years, or sooner if the municipality updates its elimination procedures. Documentation of training, including names, titles, and contact information of trained staff, is provided in Attachment D of this Enforcement Response Plan and must be reviewed annually and updated as needed. Attachment E includes the form to be filled out when performing an outfall inspection.

Attachments:

A. Violation and Enforcement Documentation form
B. Description of two-year activities
C. Staffing plan/organizational chart
D. Trained Personnel in three (3) MCM 3 Programs re: Illicit Discharges
E. Outfall Inspection form

Violation and Enforcement Documentation

As per the procedures outlined in the municipality's Enforcement Response Plan, this form should be completed by the MS4 Operator or the assigned Stormwater Program Coordinator when a stormwater violation has occurred.

Municipality Town of Warwick

Date Time

Enforcement Response Number (ER #) 24 -

Location of violation

Is violation within an MS4 area? ☐ YES ☐ NO ☐ Uncertain

Category of Violation and/or Illicit Discharge

☐ Construction ☐ Post-construction ☐ Municipally-owned Facility

☐ Public Observation ☐ Other

Land/facility ownership type ☐ Public ☐ Private ☐ Unknown

Name of owner/operator

Source of illicit discharge and/or description of violation

Description of discharge (color, clarity, odor, duration, approx. flow rate/volume, etc)

Who detected discharge? ☐ Public ☐ Municipal Staff ☐ Other

Name and, if applicable, title

Municipal staff receiving notification of discharge

Name

Title

Enforcement Actions Taken and Responses

Date	MS4 Action	Required timeframe for remedial action	Remedial Action/Response	Date
	Verbal warning			
	Written notice of violation			
	Citation			
	Fine amount	$	Date paid	
	Stop Work Order			
	Withholding of plan approvals or other authorization for discharging into MS4			
	Additional measures taken by MS4			

Additional Notes

Date of Final Compliance

Compliance verified by

Name

Title

Signature of MS4 Operator

ATTACHMENT B

Monitoring Locations Inspection and Sampling Program

Within two (2) years of the EDC, the MS4 Operator must develop and implement a monitoring locations inspection and sampling program. The monitoring locations inspection and sampling program must be documented in the SWMP Plan specifying:

i. The monitoring locations inspection and sampling procedures including:
   a) During dry weather,18 one (1) inspection of each monitoring location identified in the inventory (Part VI.C.1.c.) every five (5) years following the most recent inspection;
   b) Documentation of all monitoring location inspections, including any sampling results, using the Monitoring Locations Inspection and Sampling Field Sheet (Appendix D) or an equivalent form containing the same information and include the completed monitoring location inspections and sampling results in the SWMP Plan (e.g., the completed Monitoring Locations Inspection and Sampling Field Sheets);
   c) Provisions to sample all monitoring locations which had inspections which resulted in a suspect or obvious illicit discharge characterization. The sampling requirement is based on the number and severity of physical indicators present in the flow to better inform track down procedures (Part VI.C.2.). If the source of the illicit discharge is clear and discernable (e.g., sewage), sampling is not necessary;
   d) Sampling may be done with field test kits or field instrumentation that are sufficiently sensitive to detect the parameter below the sampling action level used19 and are not subject to 40 CFR Part 136 requirements for approved methods and certified laboratories;
   e) Provisions to initiate, or cause to initiate,20 track down procedures (Part VI.C.2.a.), in accordance with the timeframes specified in Part VI.C.2.a.iii, for monitoring locations with an overall characterization21 as suspect illicit discharge or obvious illicit discharge or that exceed any sampling action level used;
   f) Provisions to re-inspect the monitoring location within thirty (30) days of initial inspection if there is a physical indicator not related to flow, potentially indicative of intermittent or transitory discharges, utilizing

techniques described in Chapter 12.6 of the Center for Watershed Protection Illicit Discharge Detection and Elimination: A Guidance Manual for Program Development and Technical Assistance, October 2004 (CWP 2004) or equivalent.

i. If those same physical indicators persist, the MS4 Operator must initiate illicit discharge track down procedures (Part VI.C.2.a.).
ii. The training provisions for the MS4 Operator's monitoring locations inspection and sampling procedures (Part VI.C.1.e.i.).
    a) If new staff are added, training on the MS4 Operator's monitoring locations inspection and sampling procedures (Part VI.C.1.e.i.) must be given prior to conducting monitoring locations inspections and sampling procedures;
    b) For existing staff, training on the MS4 Operator's monitoring locations inspection and sampling procedures (Part VI.C.1.e.i.) must be given prior to conducting monitoring locations inspections and sampling and once every five (5) years, thereafter; and
    c) If the monitoring locations inspection and sampling procedures (Part VI.C.1.e.i.) are updated (Part VI.C.1.e.iv.), training on the updates must be given to all staff prior to conducting monitoring locations inspections and sampling.
iii. The names, titles, and contact information for the individuals who have received monitoring locations inspection and sampling procedures training and update annually; and
iv. Annually, by April 1, the MS4 Operator must:
    a) Review and update the monitoring location inspection and sampling procedures (Part VI.C.1.e.i.) based on monitoring location inspection results (e.g., trends, patterns, areas with illicit discharges, and common problems); and
    b) Document the completion of this requirement in the SWMP Plan.

Illicit Discharge Track Down Program

Within two (2) years of the EDC, the MS4 Operator must develop and implement an illicit discharge track down program to identify the source of illicit discharges and the responsible party. The illicit discharge track down program must be documented in the SWMP Plan specifying:

A. The illicit discharge track down procedures including:

i. Procedures as described in Chapter 13 of CWP 2004 or equivalent;

ii. Steps taken for illicit discharge track down procedures;

iii. The following timeframes to initiate illicit discharge track down:

a) Within twenty-four (24) hours of discovery, the MS4 Operator must initiate track down procedures for flowing MS4 monitoring locations with obvious illicit discharges;

b) Within two (2) hours of discovery, the MS4 Operator must initiate track down procedures for obvious illicit discharges of sanitary wastewater that would affect bathing areas during bathing season, shell fishing areas or public water intakes and report orally or electronically to the Regional Water Engineer and local health department; and

c) Within five (5) days of discovery, the MS4 Operator must initiate track down procedures for suspect illicit discharges.

B. The training provisions for the MS4 Operator's illicit discharge track down procedures (Part VI.C.2.a.).

i. If new staff are added, training on the MS4 Operator's illicit discharge track down procedures (Part VI.C.2.a.) must be given prior to conducting illicit discharge track downs;

ii. For existing staff, training on the MS4 Operator's illicit discharge track down procedures (Part VI.C.2.a.) must be given prior to conducting illicit discharge track downs and once every five (5) years, thereafter; and

iii. If the illicit discharge track down procedures (Part VI.C.2.a.) are updated (Part VI.C.2.d.), training on the updates must be given to all staff prior to conducting illicit discharge track downs.

C. The names, titles, and contact information for the individuals who have received illicit discharge track down procedures training and update annually; and

D. Annually, by April 1, the MS4 Operator must:

i. Review and update the illicit discharge track down procedures (Part VI.C.2.a.); and

ii. Document the completion of this requirement in the SWMP Plan.

Illicit Discharge Elimination Program

Within two (2) years of the EDC, the MS4 Operator must develop and implement an illicit discharge elimination program. The illicit discharge elimination program must be documented in the SWMP Plan specifying:

a. The illicit discharge elimination procedures including:
    i. Provisions for escalating enforcement and tracking, both consistent with the ERP required in Part IV.F. of this SPDES general permit;
    ii. Provisions to confirm the corrective actions have been taken;
    iii. Steps taken for illicit discharge elimination procedures; and
    iv. The following timeframes for illicit discharge elimination:
        a) Within twenty-four (24) hours of identification of an illicit discharge that has a reasonable likelihood of adversely affecting human health or the environment, the MS4 Operator must eliminate the illicit discharge;
        b) Within five (5) days of identification of an illicit discharge that does not have a reasonable likelihood of adversely affecting human health or the environment, the MS4 Operator must eliminate the illicit discharge; and
        c) Where elimination of an illicit discharge within the specified timeframes (Part VI.C.3.a.iv.) is not possible, the MS4 Operator must notify the Regional Water Engineer.

b. The training provisions for the MS4 Operator's illicit discharge elimination procedures (Part VI.C.3.a.).
    i. If new staff are added, training on the MS4 Operator's illicit discharge elimination procedures (Part VI.C.3.a.) must be given prior to conducting illicit discharge eliminations;
    ii. For existing staff, training on the MS4 Operator's illicit discharge elimination procedures (Part VI.C.3.a.) must be given prior to conducting illicit discharge eliminations and once every five (5) years, thereafter; and
    iii. If the illicit discharge elimination procedures (Part VI.C.3.a.) are updated (Part VI.C.3.d.), training on the updates must be given to all staff prior to conducting illicit discharge eliminations.

c. The names, titles, and contact information for the individuals who have received illicit discharge elimination procedures training and update annually; and

d. Annually, by April 1, the MS4 Operator must:
    i. Review and update the illicit discharge elimination procedures (Part VI.C.3.a.); and
    ii. Document the completion of this requirement in the SWMP Plan.

Municipal Facility Inventory

i. Within two (2) years of the EDC, the MS4 Operator must develop and maintain an inventory of all municipal facilities in the SWMP Plan. The following information must be included in the inventory:

a) Name of municipal facility;
b) Street address;
c) Type of municipal facility;
d) Prioritization (high or low) (Part VI.F.2.c.);
e) Receiving waterbody name and class (mapped in accordance with Part IV.D.1.e.ii.a)) ;
f) Receiving waterbody WI/PWL Segment ID (mapped in accordance with Part IV.D.1.e.ii.b));
g) Contact information;
h) Responsible department;
i) Location of SWPPP (if high priority; when completed);
j) Type of activities present on site;
k) Size of facility (acres);
l) Date of last assessment;
m) BMPs identified; and
n) Projected date of next comprehensive site assessment (Part VI.F.2.d.ii.c) or Part VI.F.2.e.ii.c), depending on the municipal facility prioritization (Part VI.F.2.c.)).

ii. Annually, the MS4 Operator must update the inventory if new municipal facilities are added.

ATTACHMENT C:
Staff Plan/Organizational Chart

MS4 Operator

Name: Jesse Dwyer

Title: Supervisor

Municipality

Town of Warwick

Stormwater Program Coordinator

Name: Jamie Zajac

Title: MHE Consulting Engineers

MCM 1:

Public Education and Outreach Program

Task: Make information related to the prevention of illicit discharges available to municipal employees, businesses, and the public. (SIX MONTH)

Responsible party:

Tony Pascullo
Name
Building Inspector
Title

Involved parties (optional):

_____
Name
_____
Title

_____
Name
_____
Title

MCM 2:

Public Involvement/Participation

Task: Identify local point of contact to receive and respond to public stormwater mgmt. and permit compliance concerns. (SIX MONTH)

Responsible party:

Tony Pascullo
Name
Building Inspector
Title
building@townofwarwick.gov
Email address
845-986-1124 ext. 260
Phone number

Task 2: Engage the public in SWMP Plan and Annual Report (ONE YEAR)

Responsible party:

Tony Pascullo
Name
Building Inspector
Title

MCM 3:

Illicit Discharge Detection and Elimination

Task: Establish email or phone number for public reporting of illicit discharges. (SIX MONTH)

Responsible party:

Tony Pascullo
Name
Building Inspector
Title
building@townofwarwick.gov
Email address
845-986-1124 ext. 260
Phone number

Involved party (optional):

_____
Name
_____
Title

_____
Email address
_____
Phone number

MCM 4:

Construction Site Stormwater Runoff Control

Task 1: Develop and implement a Construction Oversight Program. (ONE YEAR)

Responsible party:

Jamie Zajac
Name
MHE Consulting Engineers
Title
jzajac@mhepc.com
Email address
845-567-3100
Phone number

Task 2: Prioritize inventory of applicable construction sites. (ONE YEAR)

Responsible party:

Jamie Zajac
Name
MHE Consulting Engineers
Title

MCM 5:

Post-Construction Stormwater Management

Task 1: Develop and implement a Post-Construction SMP Inspection and Maintenance Program. (ONE YEAR)

Responsible Party:

Jamie Zajac
Name
MHE Consulting Engineers
Title

Task 2: Inventory post-construction SMPs (ONE YEAR)

Responsible Party:

Jamie Zajac
Name
MHE Consulting Engineers
Title

MCM 6:

Pollution Prevention and Good Housekeeping

Task 1: Develop and implement procedures for sweeping and/or cleaning municipal streets, bridges, parking lots, and rights-of-way owned by the MS4 Operator. (SIX MONTH)

Responsible party:

Ben Astorino
Name
DPW Commissioner
Title

Task 2: Sweep streets in business and commercial areas. (ONE YEAR)

Responsible party:

Ben Astorino
Name
DPW Commissioner
Title

ATTACHMENT D **Town of Warwick**

MONITORING LOCATIONS INSPECTION & SAMPLING PROGRAM TRAINED PERSONNEL

NAME: DAVID FRITTS
TITLE: CPESC, CESSWI
CONTACT INFORMATION: MHE ENGINEERING
111 WHEATFIELD DRIVE, SUITE 1
MILFORD, PA 18337
570-296-2765

NAME: JEREMY VALENTINE
TITLE: PROJECT MANAGER
CONTACT INFORMATION: MHE ENGINEERING
111 WHEATFIELD DRIVE, SUITE 1
MILFORD, PA 18337
570-296-2765

NAME:
TITLE:
CONTACT INFORMATION:

ILLICIT DISCHARGE TRAINED PERSONNEL

NAME: DAVID FRITTS
TITLE: CPESC, CESSWI
CONTACT INFORMATION: MHE ENGINEERING
111 WHEATFIELD DRIVE, SUITE 1
MILFORD, PA 18337
570-296-2765

NAME: JEREMY VALENTINE
TITLE: PROJECT MANAGER
CONTACT INFORMATION: MHE ENGINEERING
111 WHEATFIELD DRIVE, SUITE 1
MILFORD, PA 18337
570-296-2765

NAME:
TITLE:
CONTACT INFORMATION:

MS4 OUTFALL MAPPING FIELD WORKSHEET

ATTACHMENT E

Section 1: Background Data

Subwatershed:		Monitoring Location ID:	
Today's date:		Time (Military):	
Investigators:		Form completed by:	
Temperature (°F):	Rainfall (in.): Last 24 hours: Last 48 hours:		
Latitude:	Longitude:	GPS Unit:	GPS LMK #:
Camera:		Photo #s:	

Land Use in Drainage Area (Check all that apply):

- ☐ Industrial
- ☐ Ultra-Urban Residential
- ☐ Suburban Residential
- ☐ Commercial
- ☐ Open Space
- ☐ Institutional
- Other: _____
- Known Industries: _____

Notes (e.g., origin, if known):

Section 2: Monitoring Location Description

LOCATION	MATERIAL	SHAPE	DIMENSIONS (IN.)	SUBMERGED
☐ **Closed Pipe**	☐ RCP ☐ CMP ☐ PVC ☐ HDPE ☐ Steel ☐ Other: _____	☐ Circular ☐ Single ☐ Elliptical ☐ Double ☐ Box ☐ Triple ☐ Other: _____ ☐ Other: _____	Diameter/Dimensions: _____	In Water: ☐ No ☐ Partially ☐ Fully With Sediment: ☐ No ☐ Partially ☐ Fully
☐ **Open drainage**	☐ Concrete ☐ Earthen ☐ Rip-Rap ☐ Other: ☐	☐ Trapezoid ☐ Parabolic ☐ Other: ☐	Depth: ☐ Top Width: ☐ Bottom Width: ☐	
☐ **In-Stream**	**(applicable when collecting samples)**			
Flow Present?	☐ Yes ☐ No	***If No, Skip to Section 5***		
Flow Description (If present)	☐ Trickle ☐ Moderate ☐ Substantial			

Section 3: Quantitative Characterization

FIELD DATA FOR FLOWING MONITORING LOCATIONS				
PARAMETER		**RESULT**	**UNIT**	**EQUIPMENT**
☐ Flow #1	Volume		Liter	Bottle
	Time to fill		Sec	
☐ Flow #2	Flow depth		In	Tape measure
	Flow width	____' ____"	Ft, In	Tape measure
	Measured length	____' ____"	Ft, In	Tape measure
	Time of travel		S	Stopwatch
Temperature			°F	Thermometer
pH			pH Units	Test strip/Probe
Ammonia			mg/L	Test strip

Contents of form taken from NYSDEC MS4 Permit GP-0-24-001 Appendix D

Section 4: Physical Indicators for Flowing Monitoring Locations Only

Are Any Physical Indicators Present in the flow? ☐ Yes ☐ No *(If No, Skip to Section 5)*

INDICATOR	CHECK if Present	DESCRIPTION	RELATIVE SEVERITY INDEX (1-3)		
Odor	☐	☐ Sewage ☐ Rancid/sour ☐ Petroleum/gas ☐ Sulfide ☐ Other:	☐ 1 - Faint	☐ 2 – Easily detected	☐ 3 – Noticeable from a distance
Color	☐	☐ Clear ☐ Brown ☐ Gray ☐ Yellow ☐ Green ☐ Orange ☐ Red ☐ Other:	☐ 1 – Faint colors in sample bottle	☐ 2 – Clearly visible in sample bottle	☐ 3 – Clearly visible in flow
Turbidity	☐	See severity	☐ 1 – Slight cloudiness	☐ 2 - Cloudy	☐ 3 – Opaque
Floatables -Does Not Include Trash!!	☐	☐ Sewage (Toilet Paper, etc.) ☐ Suds ☐ Petroleum (oil sheen) ☐ Other:	☐ 1 – Few/slight; origin not obvious	☐ 2 - Some; indications of origin (e.g., possible suds or oil sheen)	☐ 3 - Some; origin clear (e.g., obvious oil sheen, suds, or floating sanitary materials)

Section 5: Physical Indicators for Both Flowing and Non-Flowing Monitoring Locations

Are physical indicators that are not related to flow present? ☐ Yes ☐ No *(If No, Skip to Section 6)*

INDICATOR	CHECK if Present	DESCRIPTION	COMMENTS
Monitoring Location Damage	☐	☐ Spalling, Cracking or Chipping ☐ Peeling Paint ☐ Corrosion	
Deposits/Stains	☐	☐ Oily ☐ Flow Line ☐ Paint ☐ Other:	
Abnormal Vegetation	☐	☐ Excessive ☐ Inhibited	
Poor pool quality	☐	☐ Odors ☐ Colors ☐ Floatables ☐ Oil Sheen ☐ Suds ☐ Excessive Algae ☐ Other:	
Pipe benthic growth	☐	☐ Brown ☐ Orange ☐ Green ☐ Other:	

Additional Notes:	

Section 6: Overall Monitoring Location Characterization

☐ Unlikely ☐ Potential (presence of two or more indicators) ☐ Suspect (one or more indicators with a severity of 3) ☐ Obvious

Section 7: Data Collection

1.	Sample for the lab?	☐ Yes	☐ No		
2.	If yes, collected from:	☐ Flow	☐ Pool		
3.	Intermittent flow trap set?	☐ Yes	☐ No	If Yes, type: ☐ OBM	☐ Caulk dam

Section 8: Any Non-Illicit Discharge Concerns (e.g., trash or needed infrastructure repairs)?

Comments:	

Contents of form taken from NYSDEC MS4 Permit GP-0-24-001 Appendix D

ATTACHMENT 6

STORMWATER SYSTEM MAP

ATTACHMENT 6

Stormwater System Map

Town of Warwick
Stormwater Management Plan 2026

Stormdrians
Retrofits
Outfalls

Automatically-Designated MS4 Areas
Additionally-Designated MS4 Areas
HUC 12 Watersheds

WI/PWL Status
Impaired
Threatened
Threat(Poss)
Minor Impacts
No Known Impact
Need Verification
UnAssessed

WI/PWL Status
Impaired
Threatened
Minor Impacts
No Known Impact
Needs Verification
UnAssessed

N
W
E
S

0 0.25 0.5 1 Miles

TOWN OF WARWICK

Village of Greenwood Lake

Greenwood Lake

NEW JERSEY

17A
5
210

MHE ENGINEERING

HUC 12 WATERSHEDS

Goshen
Wawayanda
Minisink
Florida
MEADOW CREEK
QUAKER CREEK
Chester
LOWER POCHUCK CREEK-WALLKILL RIVER
Monroe
Warwick
Warwick
UPPER WAWAYANDA CREEK
Tuxedo
UPPER POCHUCK CREEK
Greenwood Lake
LOWER WAWAYANDA CREEK
UPPER WANAQUE RIVER
RINGWOOD RIVER

N

Area shown in larger map

0 2.5 5 10 Miles

ATTACHMENT 7

ILLICIT DISCHARGE REGULATIONS

Chapter 100

MUNICIPAL SEPARATE STORM SEWER SYSTEM

ARTICLE I

Illicit Discharges, Activities and Connections

§ 100-1. Purpose; intent.
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§ 100-3. Applicability.
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§ 100-9. Use of best management practices to prevent, control and reduce stormwater pollutants.
§ 100-10. Suspension of access to MS4.
§ 100-11. Industrial or construction activity discharges.
§ 100-12. Access and monitoring of discharges.
§ 100-13. Notification of spills.
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§ 100-15. Appeal of notice of violation.
§ 100-16. Corrective measures after appeal.
§ 100-17. Injunctive relief.
§ 100-18. Alternative remedies.
§ 100-19. Violations deemed a public nuisance.
§ 100-20. Remedies not exclusive.

[HISTORY: Adopted by the Town Board of the Town of Warwick as indicated in article histories. Amendments noted where applicable.]

GENERAL REFERENCES

Sanitary sewers — See Ch. 124.

Sanitary sewer user charge system — See Ch. 127.

Solid waste management facilities — See Ch. 134.

Water — Ch. 157.

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ARTICLE I
Illicit Discharges, Activities and Connections
[Adopted 11-20-2008 by L.L. No. 4-2008]

§ 100-1. Purpose; intent.

The purpose of this article is to provide for the health, safety, and general welfare of the citizens of the Town of Warwick through the regulation of nonstormwater discharges to the municipal separate storm sewer system (MS4) to the maximum extent practicable as required by federal and state law. This article establishes methods for controlling the introduction of pollutants into the MS4 in order to comply with requirements of the SPDES General Permit for Municipal Separate Storm Sewer Systems. The objectives of this article are:

A. To meet the requirements of the SPDES General Permit for Stormwater Discharges from MS4s, Permit No. GP-02-02, or as amended or revised;

B. To regulate the contribution of pollutants to the MS4 since such systems are not designed to accept, process or discharge nonstormwater wastes;

C. To prohibit illicit connections, activities and discharges to the MS4;

D. To establish legal authority to carry out all inspection, surveillance and monitoring procedures necessary to ensure compliance with this article; and

E. To promote public awareness of the hazards involved in the improper discharge of trash, yard waste, lawn chemicals, pet waste, wastewater, grease, oil, petroleum products, cleaning products, paint products, hazardous waste, sediment and other pollutants into the MS4.

§ 100-2. Definitions.

Whenever used in this article, unless a different meaning is stated in a definition applicable to only a portion of this article, the following terms will have meanings set forth below:

BEST MANAGEMENT PRACTICES (BMPs) — Schedules of activities, prohibitions of practices, general good housekeeping practices, pollution prevention and educational practices, maintenance procedures, and other management practices to prevent or reduce the discharge of pollutants directly or indirectly to stormwater, receiving waters, or stormwater conveyance systems. BMPs also include treatment practices, operating procedures, and practices to control site runoff, spillage or leaks, sludge or water disposal, or drainage from raw materials storage.

CLEAN WATER ACT — The Federal Water Pollution Control Act (33 U.S.C. § 1251 et seq.), and any subsequent amendments thereto.

CONSTRUCTION ACTIVITY — Activities requiring authorization under the SPDES Permit for Stormwater Discharges From Construction Activity, GP-02-01, as amended or revised. These activities include construction projects resulting in land disturbance of one or more acres. Such activities include but are not limited to clearing and grubbing, grading, excavating, and demolition.

DEPARTMENT — The New York State Department of Environmental Conservation.

DESIGN PROFESSIONAL — New York State licensed professional engineer or licensed architect.

HAZARDOUS MATERIALS — Any material, including any substance, waste, or combination thereof, which because of its quantity, concentration, or physical, chemical, or infectious characteristics may cause,

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or significantly contribute to, a substantial present or potential hazard to human health, safety, property, or the environment when improperly treated, stored, transported, disposed of, or otherwise managed.

ILLICIT CONNECTIONS — Any drain or conveyance, whether on the surface or subsurface, which allows an illegal discharge to enter the MS4, including but not limited to:

A. Any conveyances which allow any nonstormwater discharge, including treated or untreated sewage, process wastewater, and wash water to enter the MS4 and any connections to the storm drain system from indoor drains and sinks, regardless of whether said drain or connection had been previously allowed, permitted, or approved by an authorized enforcement agency; or

B. Any drain or conveyance connected from a commercial or industrial land use to the MS4 which has not been documented in plans, maps, or equivalent records and approved by an authorized enforcement agency.

ILLICIT DISCHARGE — Any direct or indirect nonstormwater discharge to the MS4, except as exempted in § 100-6 of this article.

INDIVIDUAL SEWAGE TREATMENT SYSTEM — A facility serving one or more parcels of land or residential households, or a private, commercial or institutional facility, that treats sewage or other liquid wastes for discharge into the groundwaters of New York State, except where a permit for such a facility is required under the applicable provisions of Article 17 of the Environmental Conservation Law.

INDUSTRIAL ACTIVITY — Activities requiring the SPDES Permit for Discharges From Industrial Activities Except Construction, GP-98-03, as amended or revised.

MS4 — Municipal separate storm sewer system.

MUNICIPALITY — The Town of Warwick.

MUNICIPAL SEPARATE STORM SEWER SYSTEM — A conveyance or system of conveyances (including roads with drainage systems, municipal streets, catch basins, curbs, gutters, ditches, man-made channels, or storm drains):

A. Owned or operated by the Town of Warwick;

B. Designed or used for collecting or conveying stormwater;

C. Which is not a combined sewer; and

D. Which is not part of a publicly owned treatment works (POTW) as defined at 40 CFR 122.2.

NONSTORMWATER DISCHARGE — Any discharge to the MS4 that is not composed entirely of stormwater.

PERSON — Any individual, association, organization, partnership, firm, corporation or other entity recognized by law and acting as either the owner or as the owner's agent.

POLLUTANT — Dredged spoil, filter backwash, solid waste, incinerator residue, treated or untreated sewage, garbage, sewage sludge, munitions, chemical wastes, biological materials, radioactive materials, heat, wrecked or discarded equipment, rock, sand and industrial, municipal, agricultural waste and ballast discharged into water which may cause or might reasonably be expected to cause pollution of the waters of the state in contravention of the standards.

PREMISES — Any building, lot, parcel of land, or portion of land, whether improved or unimproved, including adjacent sidewalks and parking strips.

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SPECIAL CONDITIONS —

A. Discharge compliance with water quality standards: the condition that applies where a municipality has been notified that the discharge of stormwater authorized under its MS4 permit may have caused or has the reasonable potential to cause or contribute to the violation of an applicable water quality standard. Under this condition the municipality must take all necessary actions to ensure future discharges do not cause or contribute to a violation of water quality standards.

B. 303(d) listed waters: the condition in the municipality's MS4 permit that applies where the MS4 discharges to a 303(d) listed water. Under this condition the stormwater management program must ensure no increase of the listed pollutant of concern to the 303(d) listed water.

C. Total maximum daily load (TMDL) strategy: the condition in the municipality's MS4 permit where a TMDL including requirements for control of stormwater discharges has been approved by EPA for a water body or watershed into which the MS4 discharges. If the discharge from the MS4 did not meet the TMDL stormwater allocations prior to September 10, 2003, the municipality was required to modify its stormwater management program to ensure that reduction of the pollutant of concern specified in the TMDL is achieved.

D. The condition in the municipality's MS4 permit that applies if a TMDL is approved in the future by EPA for any waterbody or watershed into which an MS4 discharges. Under this condition the municipality must review the applicable TMDL to see if it includes requirements for control of stormwater discharges. If an MS4 is not meeting the TMDL stormwater allocations, the municipality must, within six months of the TMDL's approval, modify its stormwater management program to ensure that reduction of the pollutant of concern specified in the TMDL is achieved.

STATE POLLUTANT DISCHARGE ELIMINATION SYSTEM (SPDES) STORMWATER DISCHARGE PERMIT — A permit issued by the Department that authorizes the discharge of pollutants to waters of the state.

STORMWATER — Rainwater, surface runoff, snowmelt and drainage.

STORMWATER MANAGEMENT OFFICER (SMO) — An employee, the municipal engineer or other public official(s) designated by the Town of Warwick to enforce this article. The SMO may also be designated by the municipality to accept and review stormwater pollution prevention plans, forward the plans to the applicable municipal board and inspect stormwater management practices.

303(d) LIST — A list of all surface waters in the state for which beneficial uses of the water (drinking, recreation, aquatic habitat, and industrial use) are impaired by pollutants, prepared periodically by the Department as required by Section 303(d) of the Clean Water Act. 303(d) listed waters are estuaries, lakes and streams that fall short of state surface water quality standards and are not expected to improve within the next two years.

TMDL — Total maximum daily load.

TOTAL MAXIMUM DAILY LOAD — The maximum amount of a pollutant to be allowed to be released into a water body so as not to impair uses of the water, allocated among the sources of that pollutant.

WASTEWATER — Water that is not stormwater, is contaminated with pollutants and is or will be discarded.

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§ 100-3. Applicability.

This article shall apply to all water entering the MS4 generated on any developed and undeveloped lands unless explicitly exempted by an authorized enforcement agency.

§ 100-4. Responsibility for administration.

The Stormwater Management Officer(s) [SMO(s)] shall administer, implement, and enforce the provisions of this article. Such powers granted or duties imposed upon the authorized enforcement official may be delegated, in writing, by the SMO as may be authorized by the municipality.

§ 100-5. Severability.

The provisions of this article are hereby declared to be severable. If any provision, clause, sentence, or paragraph of this article or the application thereof to any person, establishment, or circumstances shall be held invalid, such invalidity shall not affect the other provisions or application of this article.

§ 100-6. Discharge prohibitions; exceptions.

A. Prohibition of illegal discharges. No person shall discharge or cause to be discharged into the MS4 any materials other than stormwater except as provided in Subsection A(1). The commencement, conduct or continuance of any illegal discharge to the MS4 is prohibited except as described as follows:

   (1) The following discharges are exempt from discharge prohibitions established by this article, unless the Department or the municipality has determined them to be substantial contributors of pollutants: water line flushing or other potable water sources, landscape irrigation or lawn watering, existing diverted stream flows, rising groundwater, uncontaminated groundwater infiltration to storm drains, uncontaminated pumped groundwater, foundation or footing drains, crawl space or basement sump pumps, air-conditioning condensate, irrigation water, springs, water from individual residential car washing, natural riparian habitat or wetland flows, dechlorinated swimming pool discharges, residential street wash water, water from fire-fighting activities, and any other water source not containing pollutants. Such exempt discharges shall be made in accordance with an appropriate plan for reducing pollutants.

   (2) Discharges approved, in writing, by the SMO to protect life or property from imminent harm or damage, provided that such approval shall not be construed to constitute compliance with other applicable laws and requirements, and further provided that such discharges may be permitted for a specified time period and under such conditions as the SMO may deem appropriate to protect such life and property while reasonably maintaining the purpose and intent of this article.

   (3) Dye testing in compliance with applicable state and local laws is an allowable discharge, but requires a verbal notification to the SMO prior to the time of the test.

   (4) The prohibition shall not apply to any discharge permitted under an SPDES permit, waiver, or waste discharge order issued to the discharger and administered under the authority of the Department, provided that the discharger is in full compliance with all requirements of the permit, waiver, or order and other applicable laws and regulations, and provided that written approval has been granted for any discharge to the MS4.

B. Prohibition of illicit connections.

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(1) The construction, use, maintenance or continued existence of illicit connections to the MS4 is prohibited.

(2) This prohibition expressly includes, without limitation, illicit connections made in the past, regardless of whether the connection was permissible under law or practices applicable or prevailing at the time of connection.

(3) A person is considered to be in violation of this article if the person connects a line conveying sewage to the municipality's MS4, or allows such a connection to continue.

§ 100-7. Prohibition against failing individual sewage treatment systems.

No persons shall operate a failing individual sewage treatment system in areas tributary to the municipality's MS4. A failing individual sewage treatment system is one which has one or more of the following conditions:

A. The backup of sewage into a structure.

B. Discharges of treated or untreated sewage onto the ground surface.

C. A connection or connections to a separate stormwater sewer system.

D. Liquid level in the septic tank above the outlet invert.

E. Structural failure of any component of the individual sewage treatment system that could lead to any of the other failure conditions as noted in this section.

F. Contamination of off-site groundwater.

§ 100-8. Prohibition against activities contaminating stormwater.

A. Activities that are subject to the requirements of this section are those types of activities that:

(1) Cause or contribute to a violation of the municipality's MS4 SPDES permit.

(2) Cause or contribute to the municipality being subject to the special conditions as defined in § 100-2 (Definitions) of this article.

B. Such activities include failing individual sewage treatment systems as defined in § 100-7, improper management of pet waste or any other activity that causes or contributes to violations of the municipality's MS4 SPDES permit authorization.

C. Upon notification to a person that he or she is engaged in activities that cause or contribute to violations of the municipality's MS4 SPDES permit authorization, that person shall take all reasonable actions to correct such activities such that he or she no longer causes or contributes to violations of the municipality's MS4 SPDES permit authorization.

§ 100-9. Use of best management practices to prevent, control and reduce stormwater pollutants.

A. Best management practices. Where the SMO has identified illicit discharges as defined in § 100-2 or activities contaminating stormwater as defined in § 100-8 the municipality may require implementation of best management practices (BMPs) to control those illicit discharges and activities.

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(1) The owner or operator of a commercial or industrial establishment shall provide, at his or her own expense, reasonable protection from accidental discharge of prohibited materials or other wastes into the MS4 through the use of structural and nonstructural BMPs.

(2) Any person responsible for a property or premises, which is, or may be, the source of an illicit discharge as defined in § 100-2 or an activity contaminating stormwater as defined in § 100-8, may be required to implement, at said person's expense, additional structural and nonstructural BMPs to reduce or eliminate the source of pollutant(s) to the MS4.

(3) Compliance with all terms and conditions of a valid SPDES permit authorizing the discharge of stormwater associated with industrial activity, to the extent practicable, shall be deemed compliance with the provisions of this section.

B. Individual sewage treatment systems; response to special conditions requiring no increase of pollutants or requiring a reduction of pollutants. Where individual sewage treatment systems are contributing to the municipality's being subject to the special conditions as defined in § 100-2 of this article, the owner or operator of such individual sewage treatment systems shall be required to:

(1) Maintain and operate individual sewage treatment systems as follows:

(a) Inspect the septic tank every three years to determine scum and sludge accumulation. Septic tanks must be pumped out whenever the bottom of the scum layer is within three inches of the bottom of the outlet baffle or sanitary tee or the top of the sludge is within 10 inches of the bottom of the outlet baffle or sanitary tee.

(b) Avoid the use of septic tank additives.

(c) Avoid the disposal of excessive quantities of detergents, kitchen wastes, laundry wastes, and household chemicals; and

(d) Avoid the disposal of cigarette butts, disposable diapers, sanitary napkins, trash and other such items.

(2) Septic tank maintenance.

(a) The contents of the septic tank shall be pumped out every three years after the tank has been installed. The tank may be pumped at more frequent intervals. A septic tank inspection report, prepared by a solid waste hauler registered with the New York State DEC, may be submitted in lieu of pumping if the scum/sludge levels are not within the parameters listed in Subsection B(2)(a)[1] and [2] below:

[1] The bottom of the scum layer is within three inches of the bottom of the outlet baffle.

[2] The top of the sludge layer is within eight inches of the bottom of the outlet baffle when noted during an inspection.

(b) Pumping/inspection of septic tanks shall be performed by a solid waste hauler registered with the New York State DEC in accordance with the requirements.

(c) Equipment used in the pumping of septic tanks shall meet the following requirements:

[1] Mobile tanks shall be securely mounted on trucks or trailers, shall be watertight and provided with a leakproof cover and shall be vented to permit the escape of gases but not the liquid or solid contents of the tank.

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[2] Pumps and hoses shall be maintained and operated in a condition that will prevent the leakage of sewage.

[3] Equipment shall be available to permit accurate measurement of the sludge and scum levels in relation to the bottom of the outlet baffle.

(d) Pumping of septic tanks shall be conducted in such a manner that the entire contents of the septic tank, including both liquids and solids, are removed.

(e) Pumping shall be carried out in a manner that will prevent spillage of sewage onto the ground. If any spillage occurs, the solid portion shall be immediately removed and disposed of in a sanitary manner and the area of the spill shall be disinfected using a suitable chlorine-bearing compound.

(f) Septage shall be disposed of at a sewage treatment plant designated in accordance with district and/or state solid waste management plans pursuant to New York State DEC & DOH regulations.

(3) Repair or replace individual sewage treatment systems as follows:

(a) In accordance with 10 NYCRR Appendix 75A to the maximum extent practicable.

(b) A design professional licensed to practice in New York State shall prepare design plans for any type of absorption field that involves:

[1] Relocating or extending an absorption area to a location not previously approved for such.

[2] Installation of a new subsurface treatment system at the same location.

[3] Use of alternative system or innovative system design or technology.

(c) Work may commence upon issuance of a septic permit by the Town of Warwick Building Department.

(d) A written certificate of compliance shall be submitted by the design professional to the municipality at the completion of construction of the repair or replacement system.

§ 100-10. Suspension of access to MS4.

A. Illicit discharges in emergency situations. The SMO may, without prior notice, suspend MS4 discharge access to a person when such suspension is necessary to stop an actual or threatened discharge which presents or may present imminent and substantial danger to the environment, to the health or welfare of persons, or to the MS4. The SMO shall notify the person of such suspension within a reasonable time thereafter, in writing, of the reasons for the suspension. If the violator fails to comply with a suspension order issued in an emergency, the SMO may take such steps as deemed necessary to prevent or minimize damage to the MS4 or to minimize danger to persons.

B. Suspension due to the detection of illicit discharge. Any person discharging to the municipality's MS4 in violation of this article may have his or her MS4 access terminated if such termination would abate or reduce an illicit discharge. The SMO will notify a violator, in writing, of the proposed termination of its MS4 access and the reasons therefor. The violator may petition the SMO for a reconsideration and hearing. Access may be granted by the SMO if he or she finds that the illicit discharge has ceased and the discharger has taken steps to prevent its recurrence. Access may be denied if the SMO

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determines, in writing, that the illicit discharge has not ceased or is likely to recur. A person commits an offense if the person reinstates MS4 access to premises terminated pursuant to this section without the prior approval of the SMO.

§ 100-11. Industrial or construction activity discharges.

Any person subject to an industrial or construction activity SPDES stormwater discharge permit shall comply with all provisions of such permit. Proof of compliance with said permit may be required in a form acceptable to the municipality prior to the allowing of discharges to the MS4.

§ 100-12. Access and monitoring of discharges.

A. Applicability. This section applies to all facilities that the SMO must inspect to enforce any provision of this article, or whenever the authorized enforcement agency has cause to believe that there exists, or potentially exists, in or upon any premises any condition which constitutes a violation of this article.

B. Access to facilities.

(1) The SMO shall be permitted to enter and inspect facilities subject to regulation under this article as often as may be necessary to determine compliance with this article. If a discharger has security measures in force which require proper identification and clearance before entry into its premises, the discharger shall make the necessary arrangements to allow access to the SMO.

(2) Facility operators shall allow the SMO ready access to all parts of the premises for the purposes of inspection, sampling, examination and copying of records as may be required to implement this article.

(3) The municipality shall have the right to set up on any facility subject to this article such devices as are necessary in the opinion of the SMO to conduct monitoring and/or sampling of the facility's stormwater discharge.

(4) The municipality has the right to require the facilities subject to this article to install monitoring equipment as is reasonably necessary to determine compliance with this article. The facility's sampling and monitoring equipment shall be maintained at all times in a safe and proper operating condition by the discharger at its own expense. All devices used to measure stormwater flow and quality shall be calibrated to ensure their accuracy.

(5) Unreasonable delays in allowing the municipality access to a facility subject to this article is a violation of this article. A person who is the operator of a facility subject to this article commits an offense if the person denies the municipality reasonable access to the facility for the purpose of conducting any activity authorized or required by this article.

(6) If the SMO has been refused access to any part of the premises from which stormwater is discharged, and he or she is able to demonstrate probable cause to believe that there may be a violation of this article, or that there is a need to inspect and/or sample as part of a routine inspection and sampling program designed to verify compliance with this article or any order issued hereunder, then the SMO may seek issuance of a search warrant from any court of competent jurisdiction.

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§ 100-13. Notification of spills.

Notwithstanding other requirements of law, as soon as any person responsible for a facility or operation, or responsible for emergency response for a facility or operation, has information of any known or suspected release of materials which are resulting or may result in illegal discharges or pollutants discharging into the MS4, said person shall take all necessary steps to ensure the discovery, containment, and cleanup of such release. In the event of such a release of hazardous materials said person shall immediately notify emergency response agencies of the occurrence via emergency dispatch services. In the event of a release of nonhazardous materials, said person shall notify the municipality, in person, or by telephone or facsimile, no later than the next business day. Notifications in person or by telephone shall be confirmed by written notice addressed and mailed to the municipality within three business days of the telephone notice. If the discharge of prohibited materials emanates from a commercial or industrial establishment, the owner or operator of such establishment shall also retain an on-site written record of the discharge and the actions taken to prevent its recurrence. Such records shall be retained for at least three years.

§ 100-14. Enforcement; penalties for offenses.

A. Notice of violation. When the municipality's SMO finds that a person has violated a prohibition or failed to meet a requirement of this article, he or she may order compliance by written notice of violation to the responsible person. Such notice may require, without limitation:

   (1) The elimination of illicit connections or discharges;

   (2) That violating discharges, practices, or operations shall cease and desist;

   (3) The abatement or remediation of stormwater pollution or contamination hazards and the restoration of any affected property;

   (4) The performance of monitoring, analyses and reporting;

   (5) Payment of a fine; and

   (6) The implementation of source control or treatment BMPs. If abatement of a violation and/or restoration of affected property is required, the notice shall set forth a deadline within which such remediation or restoration must be completed. Said notice shall further advise that, should the violator fail to remediate or restore within the established deadline, the work will be done by a designated governmental agency or a contractor, and the expense thereof shall be charged to the violator.

B. Penalties. In addition to or as an alternative to any penalty provided herein or by law, any person who violates the provisions of this article shall be guilty of a violation punishable by a fine not exceeding $350 or imprisonment for a period not to exceed six months, or both, for conviction of a first offense; for conviction of a second offense, both of which were committed within a period of five years, punishable by a fine not less than $350 nor more than $700 or imprisonment for a period not to exceed six months, or both; and upon conviction for a third or subsequent offense, all of which were committed within a period of five years, punishable by a fine not less than $700 nor more than $1,000 or imprisonment for a period not to exceed six months, or both. However, for the purposes of conferring jurisdiction upon courts and judicial officers generally, violations of this article shall be deemed misdemeanors and for such purpose only all provisions of law relating to misdemeanors shall apply to such violations. Each week's continued violation shall constitute a separate additional violation.

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§ 100-15. Appeal of notice of violation.

Any person receiving a notice of violation may appeal the determination of the SMO to the Town Board of the Town of Warwick within 15 days of its issuance, which shall hear the appeal within 30 days after the filing of the appeal and, within five days of making its decision, file its decision in the office of the Municipal Clerk and mail a copy of its decision by certified mail to the discharger.

§ 100-16. Corrective measures after appeal.

A. If the violation has not been corrected pursuant to the requirements set forth in the notice of violation or, in the event of an appeal, within five business days of the decision of the municipal authority upholding the decision of the SMO, then the SMO shall request the owner's permission for access to the subject private property to take any and all measures reasonably necessary to abate the violation and/or restore the property.

B. If refused access to the subject private property, the SMO may seek a warrant in a court of competent jurisdiction to be authorized to enter upon the property to determine whether a violation has occurred. Upon determination that a violation has occurred, the SMO may seek a court order to take any and all measures reasonably necessary to abate the violation and/or restore the property. The cost of implementing and maintaining such measures shall be the sole responsibility of the discharger.

§ 100-17. Injunctive relief.

It shall be unlawful for any person to violate any provision or fail to comply with any of the requirements of this article. If a person has violated or continues to violate the provisions of this article, the SMO may petition for a preliminary or permanent injunction restraining the person from activities which would create further violations or compelling the person to perform abatement or remediation of the violation.

§ 100-18. Alternative remedies.

A. Where a person has violated a provision of this article, he or she may be eligible for alternative remedies in lieu of a civil penalty, upon recommendation of the Municipal Attorney and concurrence of the Municipal Code Enforcement Officer, where:

   (1) The violation was unintentional.

   (2) The violator has no history of pervious violations of this article.

   (3) Environmental damage was minimal.

   (4) The violator acted quickly to remedy the violation.

   (5) The violator cooperated in the investigation and resolution.

B. Alternative remedies may consist of one or more of the following:

   (1) Attendance at compliance workshops.

   (2) Storm drain stenciling or storm drain marking.

   (3) River, stream or creek cleanup activities.

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§ 100-19. Violations deemed a public nuisance.

In addition to the enforcement processes and penalties provided, any condition caused or permitted to exist in violation of any of the provisions of this article is a threat to public health, safety and welfare, and is declared and deemed a nuisance, and may be summarily abated or restored, at the violator's expense, and/or a civil action to abate, enjoin or otherwise compel the cessation of such nuisance may be taken.

§ 100-20. Remedies not exclusive.

The remedies listed in this article, are not exclusive of any other remedies available under any applicable federal, state or local law, and it is within the discretion of the authorized enforcement agency to seek cumulative remedies.

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ATTACHMENT 8

EPA PUBLICATION ON ILLICIT DISCHARGE DETECTION AND ELIMINATION



Illicit Discharge Detection and Elimination

A Guidance Manual for Program Development and Technical Assessments

by the
Center for
Watershed Protection

and
Robert Pitt
University of Alabama

October 2004

Notice

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Illicit Discharge Detection and Elimination

A Guidance Manual for Program Development and Technical Assessments

by

Edward Brown and Deb Caraco
Center for Watershed Protection
Ellicott City, Maryland 21043

and

Robert Pitt
University of Alabama
Tuscaloosa, Alabama 35487

EPA Cooperative Agreement
X-82907801-0

Project Officer

Bryan Rittenhouse
Water Permits Division
Office of Water and Wastewater
U.S. Environmental Protection Agency
Washington, D.C.

October 2004

Photo Acknowledgments

Figure Number	Source
2	Snohomish County, WA
4	Fort Worth Department of Environmental Management (DEM)
5	Fort Worth DEM
8	Dr. Robert Pitt, University of Alabama
16	Fort Worth DEM
18	Horsley Whitten
28 (fire hydrant)	Fort Worth DEM
34 (highly turbid discharge)	Rachel Calabro, Massachusetts Department of Environmental Protection
34 (industrial discharge)	Dr. Robert Pitt
34 (paint)	Dr. Robert Pitt
34 (Toronto industrial spill)	Dr. Robert Pitt
34 (blood)	Fort Worth DEM
34 (failing septic)	Snohomish County, WA
34 (construction site)	Don Green, Franklin, TN
34 (discharge of rinse water)	Rachel Calabro
35 (natural foam)	Snohomish County, WA
35 (high severity suds)	Fort Worth DEM
35 (moderate severity oil)	R. Frymire
35 (high severity oil)	Kelly Dinsmore, City of Newark, DE
38 (bright red bacteria)	R. Frymire
38 (Sporalitis filamentous)	Robert Ressl, City of Arlington, TX
38 (extreme algal growth)	Mark Sommerfield, Montgomery Co., Maryland
38 (brownish algae)	R. Frymire
39 (*all* but 'brownish stain')	R. Frymire
41 (*all*)	R. Frymire
42	Galveston, TX
48	Fort Worth DEM
49	Dr. Robert Pitt
52-53	Jewell, 2001
58-59	Jewell, 2001
60	Sargent and Castonguay, 1998
63	NEIWPCC, 2003, www.neiwpcc.org/iddemanual.htm
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70	www.darrscleaning.com
71 (a)	Snohomish County, WA
71 (b)	King County, WA
72	Mecklenburg, NC Water Quality Program
73	U.S. EPA, 1999

Foreword

A number of past projects have found that dry-weather flows discharging from storm drainage systems can contribute significant pollutant loadings to receiving waters. If these loadings are ignored (by only considering wet-weather stormwater runoff, for example), little improvement in receiving water conditions may occur. Illicit dry-weather flows originate from many sources. The most important sources typically include sanitary wastewater or industrial and commercial pollutant entries, failing septic tank systems, and vehicle maintenance activities.

Provisions of the Clean Water Act (1987) require National Pollutant Discharge Elimination System (NPDES) permits for storm water discharges. Section 402 (p)(3)(B)(ii) requires that permits for municipal separate storm sewers shall include a requirement to effectively prohibit problematic non-storm water discharges into storm sewers. Emphasis is placed on the elimination of inappropriate connections to urban storm drains. This requires affected agencies to identify and locate sources of non-storm water discharges into storm drains so they may institute appropriate actions for their elimination.

This Manual is intended to provide support and guidance, primarily to Phase II NPDES MS4 communities, for the establishment of Illicit Discharge Detection and Elimination (IDDE) programs and the design and procedures of local investigations of non-storm water entries into storm drainage systems. It also has application for Phase I communities looking to modify existing programs and community groups such as watershed organizations that are interested in providing reconnaissance and public awareness services to communities as part of watershed restoration activities.

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Some references in the document pertain to work conducted during this project. This internal support information was developed as work tasks were completed and research findings were developed. In some cases, memoranda or technical support documents were prepared. Most of these documents are in “draft” form and have not been published. As a result, they should be considered supplemental and preliminary information that is not intended for widespread citation or distribution. In the References section, these documents are identified as “IDDE project support material” at the end of each citation. Interested readers can access these documents through the website link to the project archive and support information.

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Introduction

An up-to-date and comprehensive manual on techniques to detect and correct discharges in municipal storm drains has been unavailable until now. This has been a major obstacle for both Phase I and Phase II National Pollutant Discharge Elimination System (NPDES) municipal separate storm sewer system (MS4) communities that must have programs in place that detect, eliminate, and prevent illicit discharges to the storm drain system. Smaller Phase II communities, in particular, need simple but effective program guidance to comply with permits issued by the Environmental Protection Agency (EPA) and states. This manual provides communities with guidance on establishing and implementing an effective Illicit Discharge Detection and Elimination (IDDE) program.

Studies have shown that dry weather flows from the storm drain system may contribute a larger annual discharge mass for some pollutants than wet weather storm water flows (EPA, 1983 and Duke, 1997). Detecting and eliminating these illicit discharges involves complex detective work, which makes it hard to establish a rigid prescription to "hunt down" and correct all illicit connections. Frequently, there is no single approach to take, but rather a variety of ways to get from detection to elimination. Local knowledge and available resources can play significant roles in determining which path to take. At the very least, communities need to systematically understand and characterize their stream, conveyance, and storm sewer infrastructure systems. When illicit discharges are identified, they need to be removed. The process is ongoing and the effectiveness of a program should improve with time. In fact, well-coordinated IDDE programs can benefit from and contribute to other community-wide water resources-based programs, such as public education, storm water management, stream restoration, and pollution prevention.

This manual incorporates the experience of more than 20 Phase I communities that were surveyed about their practices, levels of program effort, and lessons learned (CWP, 2002). These communities took many different approaches to solve the IDDE problem, and provided great insights on common obstacles, setting realistic expectations and getting a hard job done right. Many of the IDDE methods presented in this manual were first developed and tested in many Phase I communities. Specific techniques applied in a community should be adapted to local conditions, such as dominant discharge types, land use, and generating sites.

Designed with a broad audience in mind, including agency heads, program managers, field technicians and water quality analysts, this manual is primarily focused on providing the thousands of Phase II communities that are now in the process of developing IDDE programs with guidance for the development and implementation of their own programs. The manual has been organized to address the broad range of administrative and technical considerations involved with setting up an effective IDDE program. The first 10 chapters of the Manual focus on "big picture" considerations needed to successfully get an IDDE program off

the ground. The final four chapters provide detailed technical information on the methods to screen, characterize and remove illicit discharges in MS4 communities. These chapters present the state-of-the-practice on specific monitoring techniques and protocols.

In general, the content of this manual gets progressively more complex and technical toward the end. The basic organization of the manual is outlined below. The information is provided to help:

- Define important terminology and understand key illicit discharge concepts
- Conduct an audit to understand community needs and capabilities
- Establish adequate legal authority
- Develop a tracking system to map outfalls and document reported illicit discharges
- Conduct desktop analyses to prioritize targets for illicit discharge control
- Conduct rapid reconnaissance of the stream corridor to find problem outfalls
- Apply new analytical and field methods to find and fix illicit discharges
- Educate municipal employees and the public to prevent discharges
- Estimate costs to run a program and conduct specific investigations

Chapter 1. The Basics of Illicit Discharges– The many different sources and generating sites that can produce illicit discharges are described in Chapter 1. The chapter also outlines key concepts and terminology needed to understand illicit discharges, why they cause water quality problems and the regulatory context for managing them.

Chapter 2. Components of an Effective Illicit Discharge Program– This chapter presents an overall framework to build an IDDE program, by outlining eight key components of good programs. Each of the following eight chapters is dedicated to a key program component. The first page of the program component chapters is notated with a puzzle icon labeled with the applicable program component number.

Chapter 3. Audit Existing Resources and Programs– This chapter provides guidance on evaluating existing resources, regulations, and ongoing activities in your community to better address illicit discharges.

Chapter 4. Establish Responsibility, Authority and Tracking– This chapter presents guidance on how to identify the local agency who will be responsible for administering the IDDE program, and how to establish the legal authority to control illicit discharges by adapting an existing ordinance or adopting a new one. The chapter also describes how to set up a program tracking system needed to document discharges and local actions to respond to them.

Chapter 5. Desktop Assessment of Illicit Discharge Potential– The fifth chapter describes desktop analyses to process available mapping data to quickly characterize and screen illicit discharge problems at the community and subwatershed scale. Key factors include water quality, land use, development age, sewer infrastructure and outfall density. Rapid screening techniques are presented to define where to begin searching for illicit discharge problems in your community.

Chapter 6. Developing Program Goals and Implementation Strategies–

Communities are required to establish and track measurable goals for their IDDE program under the NPDES MS4 permit program. This chapter recommends a series of potential program goals that can guide local efforts, as well as guidance on how to measure and track progress toward their achievement.

Chapter 7. Searching for Illicit Discharge Problems in the Field – This chapter briefly summarizes the major monitoring techniques to find illicit discharges, and discusses how to select the right combination of monitoring methods to incorporate into your local program.

Chapter 8. Isolating and Fixing Individual Illicit Discharges – The methods used to find and remove illicit discharges are briefly described in this chapter and include citizen hotlines and techniques to trace, locate and remove illicit discharge sources.

Chapter 9. Preventing Illicit Discharges – Prevention is a cost effective way to reduce pollution from illicit discharge. This chapter highlights a series of carrot and stick strategies to prevent illicit discharges.

Chapter 10. IDDE Program Evaluation – IDDE programs must continually evolve to changing local conditions. This chapter describes how to review and revisit program goals to determine if they are being met and to make any needed adjustments.

Chapter 11. The Outfall Reconnaissance Inventory (ORI) – The chapter presents detailed protocols to conduct rapid field screening of problem outfalls. The chapter also outlines the staff and equipment costs needed to conduct an ORI, and presents methods to organize, manage and interpret the data you collect.

Chapter 12. Chemical Monitoring – This chapter presents detailed guidance on the wide range of chemical monitoring options that can be used to identify the composition of illicit discharge flows. The chapter begins by describing different chemical indicators that have been used to identify illicit discharges, and presents guidance on how to collect samples for analysis. The chapter recommends a flow chart approach that utilizes four chemical indicators to distinguish the flow type. The chapter provides specific information on other analytical methods that can be used, as well as proper safety, handling, and disposal procedures. Simple and more sophisticated methods for interpreting monitoring data are discussed, along with comparative cost information.

Chapter 13. Tracking Discharges to Their Source – This chapter describes how to investigate storm drain systems to narrow and remove individual illicit discharges. These techniques include "trunk" investigations (e.g., video surveillance, damming, and infiltration and inflow studies) and on-site investigations (e.g., dye tests, smoke tests, and pollution prevention surveys). The pros and cons of each investigation technique are discussed, and comparative cost estimates are given.

Chapter 14. Techniques to Fix Discharges – This chapter provides tips on the best methods to repair or eliminate discharges. Specific advice is presented on how to identify responsible parties, develop pre-approved subcontractor lists, and estimate unit costs for typical repairs.

Appendices – Eleven technical appendices are provided at the end of the manual.

Chapter 1: The Basics of Illicit Discharges

An understanding of the nature of illicit discharges in urban watersheds is essential to find, fix and prevent them. This chapter begins by defining the terms used to describe illicit discharges, and then reviews the water quality problems they cause. Next, the chapter presents the regulatory context for controlling illicit discharges, and reviews the experience local communities have gained in detecting and eliminating them.

1.1 Important Terminology and Key Concepts

This Manual uses several important terms throughout the text that merit upfront explanation. This section defines the terminology to help program managers perform important illicit discharge detective work in their communities. Key concepts are presented to classify illicit discharges, generating sites and control techniques.

Illicit Discharge

The term "illicit discharge" has many meanings in regulation[1] and practice, but we use a four-part definition in this manual.

1. Illicit discharges are defined as a storm drain that has measurable flow during dry weather containing pollutants and/or pathogens. A storm drain with measurable flow but containing no pollutants is simply considered a discharge.
2. Each illicit discharge has a unique frequency, composition and mode of entry in the storm drain system.
3. Illicit discharges are frequently caused when the sewage disposal system interacts with the storm drain system. A variety of monitoring techniques is used to locate and eliminate illegal sewage connections. These techniques trace sewage flows from the stream or outfall, and go back up the pipes or conveyances to reach the problem connection.
4. Illicit discharges of other pollutants are produced from specific source areas and operations known as "generating sites." Knowledge about these generating sites can be helpful to locate and prevent non-sewage illicit discharges. Depending on the regulatory status of specific "generating sites," education, enforcement and other pollution prevention techniques can be used to manage this class of illicit discharges.

Communities need to define illicit discharges as part of an illicit discharge ordinance. Some non-storm water discharges to the MS4 may be allowable, such as discharges resulting from fire fighting activities and air conditioning condensate. Chapter 4 provides more detail on ordinance development.

[1] 40 CFR 122.26(b)(2) defines an illicit discharge as any discharge to an MS4 that is not composed entirely of storm water, except allowable discharges pursuant to an NPDES permit, including those resulting from fire fighting activities.

Storm Drain

A **storm drain** can be either an *enclosed pipe or an open channel.* From a regulatory standpoint, **major** storm drains are defined as enclosed storm drain pipes with a diameter of 36 inches, or greater or open channels that drain more than 50 acres. For industrial land uses, major drains are defined as enclosed storm drain pipes 12 inches or greater in diameter and open channels that drain more than two acres. **Minor** storm drains are smaller than these thresholds. Both major and minor storm drains can be a source of illicit discharges, and both merit investigation.

Some "pipes" found in urban areas may look like storm drains but actually serve other purposes. Examples include foundation drains, weep holes, culverts, etc. These pipes are generally not considered storm drains from a regulatory or practical standpoint. Small diameter "straight pipes," however, are a common source of illicit discharges in many communities and should be investigated to determine if they are a pollutant source.

Not all dry weather storm drain flow contains pollutants or pathogens. Indeed, many communities find that storm drains with dry weather flow are, in fact, relatively clean. Flow in these drains may be derived from springs, groundwater seepage, or leaks from water distribution pipes. Consequently, field testing and/or water quality sampling are needed to confirm whether pollutants are actually present in dry weather flow, in order to classify them as an illicit discharge.

Discharge Frequency

The **frequency** of dry weather discharges in storm drains is important, and can be classified as *continuous, intermittent or transitory.*

Continuous discharges occur most or all of the time, are usually easier to detect, and typically produce the greatest pollutant load. **Intermittent** discharges occur over a shorter period of time (e.g., a few hours per day or a few days per year). Because they are infrequent, intermittent discharges are hard to detect, but can still represent a serious water quality problem, depending on their flow type. **Transitory** discharges occur rarely, usually in response to a singular event such as an industrial spill, ruptured tank, sewer break, transport accident or illegal dumping episode. These discharges are extremely hard to detect with routine monitoring, but under the right conditions, can exert severe water quality problems on downstream receiving waters.

Discharge Flow Types

Dry weather discharges are composed of one or more possible **flow types**:

- *Sewage and septage* flows are produced from sewer pipes and septic systems.
- *Washwater* flows are generated from a wide variety of activities and operations. Examples include discharges of gray water (laundry) from homes, commercial carwash wastewater, fleet washing, commercial laundry wastewater, and floor washing to shop drains.
- *Liquid wastes* refers to a wide variety of flows, such as oil, paint, and process water (radiator flushing water, plating bath wastewater, etc.) that enter the storm drain system.
- *Tap water* flows are derived from leaks and losses that occur during the distribution of drinking water in the water supply system. Tap water discharges in the storm drain system may be more prevalent in communities

with high loss rates (i.e., greater than 15%) in their potable water distribution system. (source of 15% is from National Drinking Water Clearinghouse http://www.nesc.wvu.edu/ndwc/articles/OT/FA02/Economics_Water.html)

- *Landscape irrigation* flows occur when excess potable water used for residential or commercial irrigation ends up in the storm drain system.
- *Groundwater and spring water* flows occur when the local water table rises above the bottom elevation of the storm drain (known as the invert) and enters the storm drain either through cracks and joints, or where open channels or pipes associated with the MS4 may intercept seeps and springs.

Water quality testing is used to conclusively identify flow types found in storm drains. Testing can distinguish illicit flow types (sewage/septage, washwater and liquid wastes) from cleaner discharges (tap water, landscape irrigation and ground water).

Each flow type has a distinct chemical fingerprint. Table 1 compares the pollutant fingerprint for different flow types in Alabama. The chemical fingerprint for each flow type can differ regionally, so it is a good idea to develop your own "fingerprint" library by sampling each local flow type.

In practice, many storm drain discharges represent a blend of several flow types, particularly at larger outfalls that drain larger catchments. For example, groundwater flows often dilute sewage thereby masking its presence. Chapter 12 presents several techniques to help isolate illicit discharges that are blended with cleaner discharges. Illicit discharges are also masked by high volumes of storm water runoff making it difficult and frequently impossible to detect them during wet weather periods.

Mode of Entry

Illicit discharges can be further classified based on how they enter the storm drain system. The **mode of entry** can either be **direct** or **indirect. Direct entry** means that the discharge is directly connected to the storm drain pipe through a sewage pipe, shop drain, or other kind of pipe. Direct entry usually produces discharges that are continuous or intermittent. Direct entry usually occurs when two different kinds of "plumbing" are improperly connected. The three main situations where this occurs are:

Sewage cross-connections: A sewer pipe that is improperly connected to the storm drain system produces a continuous discharge of raw sewage to the pipe (Figure 1). Sewage cross-connections can occur in catchments where combined sewers or septic systems are converted to a separate sewer system, and a few pipes get "crossed."

Straight pipe: This term refers to relatively small diameter pipes that intentionally bypass the sanitary connection or septic drain fields, producing a direct discharge into open channels or streams as shown in Figure 2.

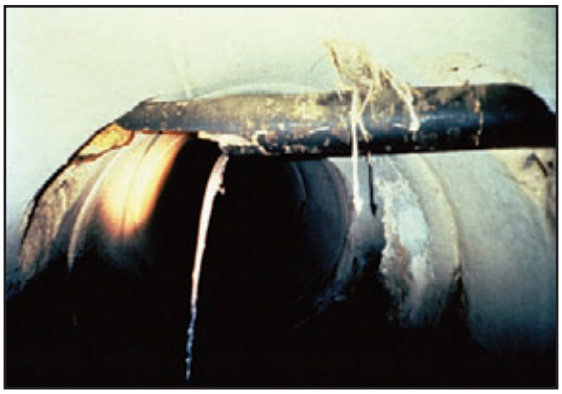


Figure 1: Sewer Pipe Discharging to the Storm Drain System

Table 1: Comparative "Fingerprint" (Mean Values) of Flow Types						
Flow Type	**Hardness (mg/L as CaCO3)**	**NH_3 (mg/L)**	**Potassium (mg/L)**	**Conductivity (µS/cm)**	**Fluoride (mg/L)**	**Detergents (mg/L)**
Sewage	50 (0.26)*	25 (0.53)*	12 (0.21)*	1215 (0.45)*	0.7 (0.1)*	9.7 (0.17)*
Septage**	57(0.36)	87 (0.4)	19 (0.42)	502 (0.42)	0.93 (0.39)	3.3 (1.33)
Laundry Washwater	45 (0.33)	3.2 (0.89)	6.5 (0.78)	463.5 (0.88)	0.85 (0.4)	758 (0.27)
Car Washwater	71 (0.27)	0.9 (1.4)	3.6 (0.67)	274 (0.45)	1.2 (1.56)	140 (0.2)
Plating Bath (Liquid Industrial Waste**)	1430 (0.32)	66 (0.66)	1009 (1.24)	10352 (0.45)	5.1 (0.47)	6.8 (0.68)
Radiator Flushing (Liquid Industrial Waste**)	5.6 (1.88)	26 (0.89)	2801 (0.13)	3280 (0.21)	149 (0.16)	15 (0.11)
Tap Water	52 (0.27)	<0.06 (0.55)	1.3 (0.37)	140 (0.07)	0.94 (0.07)	0 (NA)
Groundwater	38 (0.19)	0.06 (1.35)	3.1 (0.55)	149 (0.24)	0.13 (0.93)	0 (NA)
Landscape Irrigation	53 (0.13)	1.3 (1.12)	5.6 (0.5)	180 (0.1)	0.61 (0.35)	0 (NA)

** The number in parentheses after each concentration is the Coefficient of Variation; NA = Not Applicable*
*** All values are from Tuscaloosa, AL monitoring except liquid wastes and septage, which are from Birmingham, AL.*
Sources: Pitt (project support material) and Pitt et al. (1993)



Figure 2: Direct Discharge from a Straight Pipe

Industrial and commercial cross-connections: These occur when a drain pipe is improperly connected to the storm drain system producing a discharge of wash water, process water or other inappropriate flows into the storm drain pipe. A floor shop drain that is illicitly connected to the storm drain system is illustrated in Figure 3.

Sewage has the greatest potential to produce *direct* illicit discharges within any urban subwatershed, regardless of the diverse land uses that it comprises. The most commonly reported sewage-related direct discharges are broken sanitary sewer lines (81% of survey respondents), cross-connections (71% of survey respondents), and straight pipe discharges (38% of survey respondents). (CWP, 2002).

Older industrial areas tend to have a higher potential for illicit cross-connections.

Indirect entry means that flows generated outside the storm drain system enter through storm drain inlets or by infiltrating through the joints of the pipe. Generally, indirect modes of entry produce intermittent or transitory discharges, with the exception of groundwater seepage. The five main modes of indirect entry for discharges include:

Groundwater seepage into the storm drain pipe: Seepage frequently occurs in storm

drains after long periods of above average rainfall. Seepage discharges can be either continuous or intermittent, depending on the depth of the water table and the season. Groundwater seepage usually consists of relatively clean water that is not an illicit discharge by itself, but can mask other illicit discharges. If storm drains are located close to sanitary sewers, groundwater seepage may intermingle with diluted sewage.

Spills that enter the storm drain system at an inlet: These transitory discharges occur when a spill travels across an impervious surface and enters a storm drain inlet. Spills can occur at many industrial, commercial and transport-related sites. A very common example is an oil or gas spill from an accident that then travels across the road and into the storm drain system (Figure 4).

Dumping a liquid into a storm drain inlet: This type of transitory discharge is created when liquid wastes such as oil, grease, paint, solvents, and various automotive fluids are dumped into the storm drain (Figure 5). Liquid dumping occurs intermittently at sites that improperly dispose of rinse water and wash water during maintenance and cleanup operations. A common example is cleaning deep fryers in the parking lot of fast food operations.

Outdoor washing activities that create flow to a storm drain inlet: Outdoor washing may or may not be an illicit discharge, depending on the nature of the generating site that produces the wash water. For example, hosing off individual sidewalks and driveways may not generate significant flows or pollutant loads. On the other hand, routine washing of fueling areas, outdoor storage areas, and parking lots (power washing), and construction equipment cleanouts may result in unacceptable pollutant loads (Figure 6).

Non-target irrigation from landscaping or lawns that reaches the storm drain system: Irrigation can produce intermittent discharges from over-watering or misdirected sprinklers that send tap water over impervious areas (Figure 7). In some instances, non-target irrigation can produce unacceptable loads of nutrients, organic matter or pesticides. The most common example is a discharge from commercial landscaping areas adjacent to parking lots connected to the storm drain system.



Figure 3: A common industrial cross connection is a floor drain that is illicitly connected to a storm drain



Figure 4: Accident spills are significant sources of illicit discharges to the storm drain system



Figure 5: Dumping at a storm drain inlet



Figure 6: Routine outdoor washing and rinsing can cause illicit discharges



Figure 7: Non-target landscaping irrigation water

Land Use and Potential Generating Sites

Land use can predict the potential for indirect discharges, which are often intermittent or transitory. Many indirect discharges can be identified and prevented using the concept of "generating sites," which are sites where common operations can generate indirect discharges in a community. Both research and program experience indicate that a small subset of generating sites within a broader land use category can produce most of the indirect discharges. Consequently, the density of potential generating sites within a subwatershed may be a good indicator of the severity of local illicit discharge problems. Some common generating sites within major land use categories are listed in Table 2, and described below.

Residential Generating Sites: Failing septic systems were the most common residential discharge reported in 33% of IDDE programs surveyed (CWP, 2002). In addition, indirect residential discharges were

also frequently detected in 20% of the IDDE programs surveyed, which consisted of oil dumping, irrigation overflows, swimming pool discharges, and car washing. Many indirect discharges are caused by common residential behaviors and may not be classified as "illicit" even though they can contribute to water quality problems. With the exception of failing septic systems and oil dumping, most communities have chosen education rather than enforcement as the primary tool to prevent illicit discharges from residential areas.

Commercial Generating Sites: Illicit discharges from commercial sites were reported as frequent in almost 20% of local IDDE programs surveyed (CWP, 2002). Typical commercial discharge generators included operations such as outdoor washing; disposal of food wastes; car fueling, repair, and washing; parking lot power washing; and poor dumpster management. Recreational areas, such as marinas and campgrounds, were also reported to be a notable source of sewage discharges. It is important to note that not all businesses within a generating category actually produce illicit discharges; generally only a relatively small fraction do. Consequently, on-site inspections of individual businesses are needed to confirm whether a property is actually a generating site.

Sewage can also be linked to significant *indirect* illicit discharges in the form of sanitary sewer overflows (52% of survey respondents), sewage infiltration/inflow (48% of survey respondents), and sewage dumping from recreational vehicles (33% of survey respondents) (CWP, 2002).

Table 2: Land Uses, Generating Sites and Activities That Produce Indirect Discharges		
Land Use	**Generating Site**	**Activity that Produces Discharge**
Residential	• Apartments • Multi-family • Single Family Detached	• Car Washing • Driveway Cleaning • Dumping/Spills (e.g., leaf litter and RV/boat holding tank effluent) • Equipment Washdowns • Lawn/Landscape Watering • Septic System Maintenance • Swimming Pool Discharges
Commercial	• Campgrounds/RV parks • Car Dealers/Rental Car Companies • Car Washes • Commercial Laundry/Dry Cleaning • Gas Stations/Auto Repair Shops • Marinas • Nurseries and Garden Centers • Oil Change Shops • Restaurants • Swimming Pools	• Building Maintenance (power washing) • Dumping/Spills • Landscaping/Grounds Care (irrigation) • Outdoor Fluid Storage • Parking Lot Maintenance (power washing) • Vehicle Fueling • Vehicle Maintenance/Repair • Vehicle Washing • Washdown of greasy equipment and grease traps
Industrial	• Auto recyclers • Beverages and brewing • Construction vehicle washouts • Distribution centers • Food processing • Garbage truck washouts • Marinas, boat building and repair • Metal plating operations • Paper and wood products • Petroleum storage and refining • Printing	• All commercial activities • Industrial process water or rinse water • Loading and un-loading area washdowns • Outdoor material storage (fluids)
Institutional	• Cemeteries • Churches • Corporate Campuses • Hospitals • Schools and Universities	• Building Maintenance (e.g., power washing) • Dumping/Spills • Landscaping/Grounds Care (irrigation) • Parking Lot Maintenance (power washing) • Vehicle Washing
Municipal	• Airports • Landfills • Maintenance Depots • Municipal Fleet Storage Areas • Ports • Public Works Yards • Streets and Highways	• Building Maintenance (power washing) • Dumping/Spills • Landscaping/Grounds Care (irrigation) • Outdoor Fluid Storage • Parking Lot Maintenance (power washing) • Road Maintenance • Spill Prevention/Response • Vehicle Fueling • Vehicle Maintenance/Repair • Vehicle Washing

Industrial Generating Sites: Industrial sites produce a wide range of flows that can cause illicit discharges. The most common continuous discharges are operations involving the disposal of rinse water, process water, wash water and contaminated, non-contact cooling water. Spills and leaks, ruptured pipes, and leaking underground storage tanks are also a source of indirect discharges. Illicit discharges from industry were detected in nearly 25% of the local IDDE programs surveyed (CWP, 2002).

Industries are classified according to hundreds of different Standard Industrial Classification (SIC) codes. The SIC coding system also includes commercial, institutional and municipal operations[2]. Many industries are required to have storm water pollution prevention and spill response plans under EPA's Industrial Storm Water NPDES Permit Program. A complete list of the industries covered by the Storm Water NPDES Permit Program can be found in Appendix A. The appendix also rates each industrial category based on its potential to produce illicit discharges, based on analysis by Pitt (2001).

Institutional Generating Sites: Institutions such as hospitals, corporate campuses, colleges, churches, and cemeteries can be generating sites if routine maintenance practices/operations create discharges from parking lots and other areas. Many large institutional sites have their own areas for fleet maintenance, fueling, outdoor storage, and loading/unloading that can produce indirect discharges.

[2]More recently, federal agencies including EPA, have adopted the North American Industry Classification System (NAICS, pronounced "Nakes") as the industry classification system. For more information on the NAICS and how it correlates with SIC, visit http://www.census.gov/epcd/www/naics.html.

Municipal Generating Sites: Municipal generating sites include operations that handle solid waste, water, wastewater, street and storm drain maintenance, fleet washing, and yard waste disposal. Transport-related areas such as streets and highways, airports, rail yards, and ports can also generate indirect discharges from spills, accidents and dumping.

Finding, Fixing, and Preventing Illicit Discharges

The purpose of an IDDE program is to find, fix and prevent illicit discharges, and a series of techniques exist to meet these objectives. The remainder of the manual describes the major tools used to build a local IDDE program, but they are briefly introduced below:

Finding Illicit Discharges

The highest priority in most programs is to find any continuous and intermittent sewage discharges to the storm drain system. A range of monitoring techniques can be used to find sewage discharges. In general, monitoring techniques are used to find problem areas and then trace the problem back up the stream or pipe to identify the ultimate generating site or connection. Monitoring can sometimes pick up other types of illicit discharge that occur on a continuous or intermittent basis (e.g., wash water and liquid wastes). Monitoring techniques are classified into three major groups:

- Outfall Reconnaissance Inventory
- Indicator Monitoring at Storm Water Outfalls and In-stream
- Tracking Discharges to their Source

!!! Caution !!!

Using land use as an indicator for certain flow types such as sewage is often less reliable than other factors in predicting the potential severity of sewage discharges. More useful assessment factors for illicit sewage discharges include the age of the sewer system, which helps define the physical integrity and capacity of the pipe network, as well as age of development, which reveals the plumbing codes and practices that existed when individual connections were made over time. Two particular critical phases in the sewer history of a subwatershed are when sanitary sewers were extended to replace existing septic systems, or when a combined sewer was separated. The large number of new connections and/or disconnections during these phases increases the probability of bad plumbing.

Fixing Illicit Discharges

Once sewage discharges or other connections are discovered, they can be fixed, repaired or eliminated through several different mechanisms. Communities should establish targeted education programs along with legal authority to promote timely corrections. A combination of carrots and sticks should be available to deal with the diversity of potential dischargers.

Preventing Illicit Discharges

The old adage "an ounce of prevention is worth a pound of cure" certainly applies to illicit discharges. Transitory discharges from generating sites can be minimized through pollution prevention practices and well-executed spill management and response plans. These plans should be frequently practiced by local emergency response agencies and/or trained workers at generating sites. Other pollution prevention practices are described in Chapter 9 and explored in greater detail in Manual 8 of the Urban Subwatershed Restoration Manual Series (Schueler *et al.*, 2004).

National Urban Runoff Project

EPA's National Urban Runoff Project (NURP) studies highlighted the significance of pollutants from illicit entries into urban storm sewerage (EPA, 1983). Such entries may be evidenced by flow from storm sewer outfalls following substantial dry periods. Such flow, frequently referred to as "baseflow" or "dry weather flow", could be the result of direct "illicit connections" as mentioned in the NURP final report (EPA, 1983), or could result from indirect connections (such as leaky sanitary sewer contributions through infiltration). Many of these dry weather flows are continuous and would therefore occur during rain induced runoff periods. Pollutant contributions from dry weather flows in some storm drains have been shown to be high enough to significantly degrade water quality because of their substantial contributions to the annual mass pollutant loadings to receiving waters (project research).

1.2 The Importance of Illicit Discharges in Urban Water Quality

Dry and wet weather flows have been monitored during several urban runoff studies. These studies have found that discharges observed at outfalls during dry weather were significantly different from wet weather discharges. Data collected during the 1984 Toronto Area Watershed Management Strategy Study monitored and characterized both storm water flows and baseflows (Pitt and McLean, 1986). This project involved intensive monitoring in two test areas (a mixed residential/commercial area and an industrial area) during warm, cold, wet, and dry weather. The annual mass discharges of many pollutants were found to be greater in dry weather flows than in wet weather flows.

A California urban discharge study identified commercial and residential discharges of oil and other automobile-related fluids as a common problem based on visual observations (Montoya, 1987). In another study, visual inspection of storm water pipes discharging to the Rideau River in Ontario found leakage from sanitary sewer joints or broken pipes to be a major source of storm drain contamination (Pitt, 1983).

Several urban communities conducted studies to identify and correct illicit connections to their storm drain systems during the mid-1980s. These studies were usually taken in response to receiving water quality problems or as part of individual NURP research projects. The studies indicated the magnitude and extent of cross-connection problems in many urban watersheds. For example, Washtenaw County, Michigan tested businesses to locate direct illicit connections to the county storm drain system. Of the 160 businesses tested, 38% were found to have illicit storm drain connections (Schmidt and Spencer, 1986). An investigation of the separate storm sewer system in Toronto, Ontario revealed 59% of outfalls had dry weather flows, while 14% of the total outfalls were characterized as "grossly polluted," based on a battery of chemical tests (GLA, 1983). An inspection of the 90 urban storm water outfalls draining into Grays Harbor in Washington showed that 32% had dry weather flows (Pelletier and Determan, 1988). An additional 19 outfalls were considered suspect, based on visual observation and/or elevated pollutant levels compared to typical urban storm water runoff.

The Huron River Pollution Abatement Program ranks as one of the most thorough and systematic early investigations of illicit discharges (Washtenaw County, 1988). More than a thousand businesses, homes and other buildings located in the watershed were dye tested. Illicit connections were found at 60% of the automobile-related businesses tested, which included service stations, automobile dealerships, car washes, and auto body and repair shops. All plating shops inspected were found to have illicit storm drain connections. Additionally, 67% of the manufacturers, 20% of the private service agencies and 88% of the wholesale/retail establishments tested were found to have illicit storm sewer connections. Of the 319 homes dye tested, 19 were found to have direct sanitary connections to storm drains. The direct discharge of rug-cleaning wastes into storm drains by carpet cleaners was also noted as a common problem.

Eliminating illicit discharges is a critical component to restoring urban watersheds. When bodies of water cannot meet designated uses for drinking water, fishing, or recreation, tourism and waterfront home

values may fall; fishing and shellfish harvesting can be restricted or halted; and illicit discharges can close beaches, primarily as a result of bacteria contamination. In addition to the public health and economic impacts associated with illicit discharges, significant impacts to aquatic life and wildlife are realized. Numerous fish kills and other aquatic life losses have occurred in watersheds as a result of illicit or accidental dumping and spills that have resulted in lethal pollutant concentrations in receiving waters.

1.3 Regulatory Background For Illicit Discharges

The history of illicit discharge regulations is long and convoluted, reflecting an ongoing debate as to whether they should be classified as a point or nonpoint source of pollution. The Clean Water Act amendments of 1987 contained the first provisions to specifically regulate discharges from storm drainage systems. Section 402(p)(3)(B) provides that "permits for such discharges:

(i) May be issued on a system or jurisdiction-wide basis

(ii) Shall include a requirement to effectively prohibit non-storm water discharges into the storm sewers; and

(iii) Shall require controls to reduce the discharge of pollutants to the maximum extent practical including management practices, control techniques and system design and engineering methods, and such provisions as the Administrator or the State determines appropriate for the control of such pollutants."

In the last 15 years, NPDES permits have gradually been applied to a greater range of communities. In 1990, EPA issued a final rule, known as Phase I to implement section 402(p) of the Clean Water Act through the NPDES permit system. The EPA effort expanded in December 1999, when the Phase II final rule was issued. A summary of how both rules pertain to MS4s and illicit discharge control is provided below.

Summary of NPDES Phase I Requirements

The NPDES Phase I permit program regulates municipal separate storm sewer systems (MS4s) meeting the following criteria:

- Storm sewer systems located in an incorporated area with a population of 100,000 or more
- Storm sewer systems located in 47 counties identified by EPA as having populations over 100,000 that were unincorporated but considered urbanized areas
- Other storm sewer systems that are specially designated based on the location of storm water discharges with respect to waters of the United States, the size of the discharge, the quantity and nature of the pollutants discharged, and the interrelationship to other regulated storm sewer systems, among other factors

An MS4 is defined as any conveyance or system of conveyances that is owned or operated by a state or local government entity designed for collecting and conveying storm water, which is not part of a Publicly Owned Treatment Works. The total number of permitted MS4s in the Phase I program is 1,059.

PHASE I HIGHLIGHTS

Who must meet the requirements?	MS4s with population ≥100,00
How many Phase I communities exist nationally?	1,059
What are the requirements related to illicit discharges?	Develop programs to prevent, detect and remove illicit discharges



Phase I MS4s were required to submit a two-part application. The first part required information regarding existing programs and the capacity of the municipality to control pollutants. Part 1 also required identification of known "major" outfalls[3] discharging to waters of the United States, and a field screening analysis of representative major outfalls to detect illicit connections. Part 2 of the application required identification of additional major outfalls, limited monitoring, and a proposed storm water management plan (EPA, 1996).

Phase I communities were required to develop programs to detect and remove illicit discharges, and to control and prevent improper disposal into the MS4 of materials such as used oil or seepage from municipal sanitary sewers. The illicit discharge programs were required to include the following elements:

- Implementation and enforcement of an ordinance, orders or similar means to prevent illicit discharges to the MS4
- Procedures to conduct ongoing field screening activities during the life of the permit
- Procedures to be followed to investigate portions of the separate storm sewer system that, based on the results of the field screening required in Part 2 of the application, indicate a reasonable potential for containing illicit discharges or other sources of non-storm water
- Procedures to prevent, contain, and respond to spills that may discharge into the MS4
- A program to promote, publicize, and facilitate public reporting of the presence of illicit discharges or water quality impacts associated with discharges from the MS4
- Educational activities, public information activities, and other appropriate activities to facilitate the proper management and disposal of used oil and toxic materials
- Controls to limit infiltration of seepage from municipal sanitary sewers to the MS4

[3]A "major" outfall is defined as an MS4 outfall that discharges from a single pipe with an inside diameter of at least 36 inches, or discharges from a single conveyance other than a circular pipe serving a drainage area of more than 50 acres. An MS4 outfall with a contributing industrial land use that discharges from a single pipe with an inside diameter of 12 inches or more or discharges from a single conveyance other than a circular pipe serving a drainage area of more than two acres.

Summary of NPDES Phase II Requirements

The Phase II Final Rule, published in the Federal Register regulates MS4s that meet both of the following criteria:

- Storm sewer systems that are not a medium or large MS4 covered by Phase I of the NPDES Program
- Storm sewer systems that are located in an Urbanized Area (UA) as defined by the Bureau of the Census, or storm sewer systems located outside of a UA that are designated by NPDES permitting authorities because of one of the following reasons:
  - The MS4's discharges cause, or have the potential to cause, an adverse impact on water quality
  - The MS4 contributes substantially to the pollutant loadings of a physically interconnected MS4 regulated by the NPDES storm water program

MS4s that meet the above criteria are referred to as regulated small MS4s. Each regulated small MS4 must satisfy six minimum control measures:

1. Public education and outreach
2. Public participation/involvement
3. Illicit discharge detection and elimination
4. Construction site runoff control
5. Post-construction runoff control
6. Pollution prevention/Good housekeeping

Under the third minimum measure, an illicit discharge is defined as any discharge to an MS4 that is not composed entirely of storm water, except allowable discharges pursuant to an NPDES permit, including those resulting from fire fighting activities (40 CFR 122.26(b)(2)). To satisfy this minimum measure, the regulated small MS4 must include the following five components:

- Develop a storm sewer system map that shows the location of all outfalls and the names and locations of all waters of the United States that receive discharges from those outfalls
- Prohibit, through ordinance or other regulatory mechanism, non-storm water discharges into the storm sewer system and implement appropriate enforcement procedures and actions
- Develop and implement a plan to detect and address illicit discharges to the MS4
- Educate public employees, businesses, and the general public of hazards associated with illicit discharges and improper disposal of waste
- Identify the appropriate best management practices and measurable goals for this minimum measure

PHASE II HIGHLIGHTS

Who must meet the requirements?	Selected small MS4s 
How many Phase II communities exist nationally?	EPA estimates 5,000–6,000
What are the requirements related to illicit discharges?	Develop programs to prevent, detect and remove illicit discharges
What is the deadline for meeting these requirements?	Permits issued by March 10, 2003. Programs must be fully implemented by the end of first permit term (5 years)

In the regulation, EPA recommends that the plan to detect and address illicit discharges include procedures for:

- Locating priority areas likely to have illicit discharges (which may include visually screening outfalls during dry weather and conducting field tests of selected pollutants)
- Tracing the source of an illicit discharge
- Removing the source of the discharge
- Program evaluation and assessment

1.4 Experience Gained in Phase I

The Center for Watershed Protection conducted a series of surveys and interviews with Phase I communities to determine the current state of the practices utilized in local IDDE programs, and to identify the most practical, low-cost, and effective techniques to find, fix and prevent discharges. The detailed survey included 24 communities from various geographic and climatic regions in the United States. Some of the key findings of the survey are presented below (CWP, 2002)[4].

- Lack of staff significantly hindered implementation of a successful IDDE program. Phase I communities rely heavily on the expertise of their field staff—practical expertise that has been acquired over many years as programs gradually developed. Methods or approaches recommended for Phase II communities should be less dependent on professional judgment.

[4] Survey results are based on responses from 24 jurisdictions from 16 states. Surveys were supplemented by on-site interviews of staff of eight IDDE programs: Baltimore City, MD; Baltimore County, MD; Boston Water and Sewer Commission (BWSC), MA; Cambridge, MA; Dayton, OH; Raleigh, NC; Wayne County, MI; and Fort Worth, TX. Jurisdictions selected for the survey and interviews represent a variety of geographic and climatic regions. The EPA storm water coordinators for each region of the country were contacted for recommendations on jurisdictions to include in the survey. Also, a variety of jurisdiction sizes in terms of population, IDDE program service area, and land use was targeted.

- Clear and effective ordinance language should be adopted by Phase II communities to ensure that all potential sources of illicit discharges are prohibited, and that the community has sufficient legal authority to inspect private properties and enforce corrections.
- Many communities lacked up-to-date mapping resources, and found that mapping layers such as storm sewers, open drainage channels, waters of the U.S., outfalls, and land use were particularly useful to conduct and prioritize effective field investigations.
- Outfall screening required the greatest staff and equipment resources, and did not always find problem outfalls. Communities recommended a fast and efficient sampling approach that utilizes a limited number of indicator parameters at each outfall to find problem outfalls.
- When purchasing equipment, Phase II programs should communicate with other jurisdictions to consider sharing field equipment and laboratory costs.
- Use of some discharge tracers has proven challenging and sometimes fruitless, because of false or ambiguous results and complex or hazardous analytical methods. Accurate, cost-effective, and safe monitoring methods are needed to effectively use tracers.
- Municipal IDDE programs worked best when they integrated illicit discharge control in the wider context of urban watershed restoration. Table 3 provides some examples of how greater interagency cooperation can be achieved by linking restoration program areas.

In summary, survey communities expressed a strong need for relatively simple guidance to perform illicit discharge investigations. To address this need, the Manual has been designed to make simple program and technical recommendations for Phase II communities to develop cost-effective IDDE programs.

Table 3: Linking Other Municipal Programs to IDDE Program Needs	
Watershed-Related Program	**How Program Relates to IDDE Program Needs**
Subwatershed Mapping and Analysis	• Mapping and aerial photography are critical tools needed for illicit connection detection surveys. GIS tax map layers are often useful to identify property ownership.
Rapid Assessment of Stream Corridors	• Observations from physical stream assessments are often useful in identifying problem areas, including dry weather flow outfalls, illegal dumping, and failing infrastructure locations.
Watershed Monitoring and Reporting	• Compiled water quality and other indicator data can be useful in targeting problem areas.
Stream Restoration Opportunities	• Stream restoration opportunities can often be coordinated with sewer infrastructure upgrades and maintenance.
Watershed Education	• Educating the public about unwanted discharges can save programs money by generating volunteer networks to report and locate problem areas. Better awareness by the public can also reduce the likelihood of unintentional cross-connections.
Pollution Prevention for Generating Sites	• Providing incentives to businesses to inspect and correct connections can save programs money.

Chapter 2: Components of an Effective IDDE Program

The prospect of developing and administering an IDDE program can be daunting, complex and challenging in many communities. This Chapter organizes and simplifies the basic tasks needed to build a program. In general, a community should consider eight basic program components, as follows:

1. Audit Existing Resources and Programs – The first program component reviews existing local resources, regulations, and responsibilities that bear on illicit discharge control in the community. A systematic audit defines local needs and capabilities, and provides the foundation for developing the initial IDDE program plan over the first permit cycle.

2. Establish Responsibility, Authority and Tracking – This component finds the right "home" for the IDDE program within existing local departments and agencies. It also establishes the local legal authority to regulate illicit discharges, either by amending an existing ordinance, or crafting a new illicit discharge ordinance. This program component also involves creation of a tracking system to report illicit discharges, suspect outfalls, and citizen complaints, and to document local management response and enforcement efforts.

3. Complete a Desktop Assessment of Illicit Discharge Potential – Illicit discharges are not uniformly distributed across a community, but tend to be clustered within certain land uses, subwatersheds, and sewage infrastructure eras. This program component helps narrow your search for the most severe illicit discharge problems, through rapid analysis of existing mapping and water quality monitoring data.

4. Develop Program Goals and Implementation Strategies – This program component integrates information developed from the first three program components to establish measurable goals for the overall IDDE program during the first permit cycle. Based on these goals, managers develop specific implementation strategies to improve water quality and measure program success.

5. Search for Illicit Discharge Problems in the Field – This component involves rapid outfall screening to find problem outfalls within priority subwatersheds. Results of outfall surveys are then used to design a more sophisticated outfall monitoring system to identify flow types and trace discharge sources. Many different monitoring options exist, depending on local needs and discharge conditions.

6. Isolate and Fix Individual Discharges – Once illicit discharge problems are found, the next step is to trace them back up the pipe to isolate the specific source or improper connection that generates them. Thus, this program component improves local capacity to locate specific discharges, make needed corrections, and take any enforcement actions.

7. Prevent Illicit Discharges – Many transitory and intermittent discharges are produced by careless practices at the home or workplace. This important program component uses a combination of education and enforcement to promote better

pollution prevention practices. A series of carrots and sticks is used to reach out to targeted individuals to prevent illegal or unintentional illicit discharges.

8. Evaluate the Program – The last component addresses the ongoing management of the IDDE program. The measurable goals set for the IDDE program are periodically reviewed and revisited to determine if progress is being made, or implementation strategies need to be adjusted.

Within each program component, a community has many options to choose, based on its size, capability and the severity of its illicit discharge problems. Chapters 3 through 10 address each IDDE program component in more detail, and summarize its purpose, methods, desired product or outcome, and budget implications. The remainder of each chapter provides program managers with detailed guidance to choose the best options to implement the program component in their community.

Scheduling of the eight IDDE program components is not always sequential and may overlap in some cases. In general, the first four program components should be scheduled for completion within the first year of the permit cycle in order to develop an effective program for the remaining years of the permit. Table 4 summarizes the specific tasks and products associated with each IDDE program component. The scheduling, costs and expertise needed for each IDDE program component are compared in Table 5.

Table 4: Key Tasks and Products in IDDE Program Implementation

Program Component	Key Tasks	Products
1. Audit existing programs	• Infrastructure Profile • Existing Legal Authority • Available Mapping • Experienced Field Crews • Access to Lab Services • Education and Outreach Outlets • Discharge Removal Capability • Program Budget and Financing	• Agreement on Lead Agency • 5 year Program Development Plan • First Year Budget and Scope of Work
2. Establish responsibility and authority	• Review Existing Ordinances • Define “Illicit” • Provisions for Access/Inspections • Select Enforcement Tools • Design Tracking System	• Adopt or Amend Ordinance • Implement Tracking System
3. Desktop assessment of illicit discharge potential	• Delineate Subwatersheds • Compile Mapping Layers/Data • Define Discharge Screening Factors • Screen Subwatersheds for Illicit Discharge Potential • Generate Maps for Field Screening	• Prioritize Subwatersheds for Field Screening
4. Develop program goals and strategies	• Community Analysis of Illicit Discharge • Public Involvement	• Measurable Program Goals • Implementation Strategies

Table 4: Key Tasks and Products in IDDE Program Implementation		
Program Component	**Key Tasks**	**Products**
5. Search for illicit discharges problems in the field	• Outfall Reconnaissance Inventory (ORI) • Integrate ORI data in Tracking System • Follow-up Monitoring at Suspect Outfalls	• Initial Storm Drain Outfall Map • Develop Monitoring Strategy
6. Isolate and fix individual discharges	• Implement Pollution Hotline • Trunk and On-site Investigations • Corrections and Enforcement	• Maintain Tracking System
7. Prevent illicit discharges	• Select Key Discharge Behaviors • Prioritize Outreach Targets • Choose Effective Carrots and Sticks • Develop Budget and Delivery System	• Implement Residential, Commercial, Industrial or Municipal Pollution Prevention Programs
8. Program evaluation	• Analyze Tracking System • Characterize Illicit Discharges Detected • Update Goals and Strategies	• Annual Reports • Permit Renegotiation

Table 5: Comparison of IDDE Program Components					
IDDE Program Component	**When To Do It**	**Startup Costs**	**Annual Cost**	**Expertise Level**	**Type of Expertise**
1. Audit	Immediately	$	-0-	??	Planning/Permitting
2. Authority	Year 1	$$	$	??	Legal
3. Desktop Analysis	Year 1	$$	-0-	???	GIS
4. Goals/Strategies	Year 1	$	-0-	??	Stakeholder Management
5. Field Search/Monitoring	Year 2 to 5	$$	$$$$	???	Monitoring
6. Isolate and Fix	Year 2 to 5	$	$$	???	Pipe and Site Investigations
7. Prevention	Year 2 to 5	$$	$$$	??	Education
8. Evaluation/Tracking	Annually	-0-	$	?	Data Analysis

Key: *$ = <$10,000*
$$ = $10,000 - 25,000
$$$ = $25,000 - 50,000
$$$$ = > $50,000

? - Simple
?? - Moderately Difficult
??? - Complex

2.1 Management Tips To Develop an Effective IDDE Program

Every community will develop a unique IDDE program that reflects its size, development history, land use, and infrastructure. Still, some common threads run through effective and well-managed local IDDE programs. Below are some tips on building an effective local.

1. Go after continuous sewage discharges first. Effective programs place a premium on keeping sewage out of the storm drain system. Continuous sewage discharges pose the greatest threat to water quality and public health, produce large pollutant loads, and can generally be permanently corrected when the offending connection is finally found. Intermittent or indirect discharges are harder to detect, and more difficult to fix.

2. Put together an interdisciplinary and interagency IDDE development team. A broad range of local expertise needs to be coordinated to develop the initial IDDE plan, as indicated in Table 5. Effective programs assemble an interagency program development team that possesses the diverse skills and knowledge needed for the program, ranging from legal analysis, GIS, monitoring, stakeholder management and pipe repairs.

3. Educate everybody about illicit discharges. Illicit discharge control is a new and somewhat confusing program to the public, elected officials, and many local agencies. Effective programs devote considerable resources to educate all three groups about the water quality impacts of illicit discharges.

4. Understand your infrastructure. Finding illicit discharges is like finding a needle in a haystack on a shoestring budget. Many indirect or transitory discharges are extremely difficult to catch through outfall screening. Therefore, effective programs seek to understand the history and condition of their storm water and sewer infrastructure to find the combinations that create the greatest risk for illicit discharge. Effective programs also screen land uses to locate generating sites within targeted subwatersheds. For example, knowing the proximity of the infrastructure to the groundwater table or knowing that the sewer collection system has a long transit time can influence the indicator parameters and associated thresholds that a community chooses to target.

5. Walk all of your streams in the first permit cycle. Perform a rapid Outfall Reconnaissance Inventory (ORI) on every mile of stream or channel in the community, starting with the subwatersheds deemed to have the greatest risk. The ORI allows you to rapidly develop an accurate outfall map and quantify the severity of your discharge problems. ORI data and field photos are extremely effective in documenting local problems. Stream walks and the ORI should be conducted regularly as part of an IDDE program. In many areas, it may require as many as three stream walks to identify all outfall locations.

6. Use GPS to create your outfall map. In most communities, the storm water system and sewer pipe networks are poorly mapped, and consist of a confusing blend of pipes and structures that were constructed in many different eras. Effective programs perform a field reconnaissance to ground truth the precise locations of all outfalls using GPS technologies. Effective programs have learned to quickly evaluate outfalls of all sizes, and not just major ones (>36 inches in diameter).

7. Understand your discharges before developing a monitoring plan. Monitoring is usually the most expensive component of any local IDDE program, so it is extremely important to understand your discharges before committing to a particular monitoring method or tracer. Compiling a simple discharge "fingerprint" library that characterizes the chemistry of major flow types in the community (e.g., sewage, septage, washwater, groundwater, tap water, or non-target irrigation water) is recommended. This library can distinguish flow types and adjust monitoring benchmarks.

8. Consider establishing an ambient (in-stream) chemical and/or biological monitoring program. Prioritizing outfall screening and investigation can save time in the field. An ambient chemical or biological monitoring program can provide supplemental

information to help prioritize sites and can be used to document long-term success.

9. Utilize a simple outfall tracking system to organize all your IDDE program data. Illicit discharges are hard enough to find if an organized system to track individual outfalls is lacking. Effective programs develop a unified geospatial tracking system to locate each outfall, and store information on its address, characteristics, photos, complaints and monitoring data. The tracking system should be developed early in the permit cycle so that program managers can utilize it as an evaluation and reporting tool.

10. Outsource some IDDE functions to local watershed groups. Staffing is the greatest single line item expense associated with a local IDDE program, although staffing needs are often temporary or seasonal in nature. Some effective programs have addressed this staffing imbalance by contracting with watershed groups to screen outfalls, monitor stream quality, and handle storm water education. This strategy reduces overall program costs, and increases local watershed awareness and stewardship.

11. Utilize a hotline as an education and detection tool. Citizen hotlines are a low-cost strategy to engage the public in illicit discharge surveillance, and are probably the only effective way to pick up intermittent and transitory discharges that escape outfall screening. When advertised properly, hotlines are also an effective tool to increase awareness of illicit discharges and dumping. Effective programs typically respond to citizen reports within 24 hours, acknowledge their help, and send them storm water education materials. When citizens play a stronger role in reporting illicit discharge problems, local staff can focus their efforts on tracing the problem to its source and fixing it.

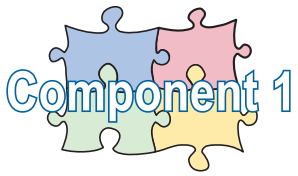
12. Cross-train all local inspectors to recognize discharges and report them for enforcement. Effective programs make sure that fire, building, plumbing, health, safety, erosion control and other local inspectors understand illicit discharges and know whom to contact locally for enforcement.

13. Target your precious storm water education dollars. Most programs never have enough resources to perform the amount of storm water education needed to reduce indirect and transitory discharges in their community. Consequently, effective programs target their discharges of concern, and spend their scarce dollars in the subwatersheds, neighborhoods or business sectors most likely to generate them.

14. Stress public health and safety benefits of sewage-free streams. Effective programs publicize the danger of sewage discharges, and notify the public and elected officials about the discharges that need to be prevented or corrected.

15. Calibrate your program resources to the magnitude of the illicit discharge problem. After a few years of analysis and surveys, communities get a good handle on the actual severity of their illicit discharge problems. In some communities, storm drains will be relatively clean, whereas others may have persistent problems. Effective programs are flexible and adaptive, and shift program resources to the management measure that will reduce the greatest amount of pollution.

16. Think of discharge prevention as a tool of watershed restoration. Discharge prevention is considered one of the seven primary practices used to restore urban watersheds (Schueler, 2004). Effective programs integrate illicit discharge control as a part of a comprehensive effort to restore local watersheds.



Chapter 3: Auditing Existing Resources and Programs

Purpose: This program component identifies the most capable local agency to staff and administer the IDDE program, analyzes staffing and resource gaps, and searches for all available local resources and expertise that can be applied to the IDDE program.

Method: The key method used for this program component is a local IDDE "audit," which consists of external research, agency interviews, and interagency meetings to determine existing resources and program gaps. The audit typically looks at eight major factors needed to build an IDDE program:

- Profile of existing storm water and sewer infrastructure, as well as historical plumbing codes
- Existing legal authority to regulate illicit discharges
- Available mapping data and GIS resources
- Field staff availability and expertise
- Lab/monitoring equipment and analytical capability
- Education and outreach resources and outlets
- Discharge removal capability and emergency response
- Program budgeting and financing

Desired Product or Outcome(s): The desired outcome is an initial five-year IDDE program development plan over the current permit cycle. This will usually consist of an internal agreement on the lead agency, an initial scope of work, the first year budget, and a budget forecast for the entire permit cycle.

Budget and/or Staff Resources Required: The cost to conduct an audit depends on the size of the community, the degree of interagency cooperation, and the local budget process. Plan for less than one staff month for smaller communities, and up to three staff months for larger ones.

Integration with Other Programs: The audit is the best time to integrate the other five minimum management measures required under NPDES Phase II permits, including public education and outreach, public involvement, construction site runoff control, post-construction runoff control, and pollution prevention/good housekeeping for municipal operations.

3.1 Audit Overview

A community should conduct a quick audit of existing and needed capacity when developing its IDDE program. The audit helps develop realistic program goals, implementation strategies, schedules, and budgets to comply with NPDES permit requirements and improve water quality. The audit consists of external research, agency interviews and interagency meetings to determine existing resources and program gaps. The audit examines the community's current capabilities in eight topic areas: infrastructure profile, legal authority, available mapping, field staff experience, access to monitoring labs, education and outreach resources, discharge removal capability, and program budgets and financing.

Existing expertise is likely divided among multiple agencies (see Table 6) that should be contacted during the audit. Some of these agencies can become important partners in the development and implementation of the IDDE program, and contribute resources, program efficiencies and overall cost savings. The first agencies to interview are local emergency responders that already deal with spills, accidents, hazardous materials and sewage leaks that occur. In addition, it is worth getting to know the local agency responsible for plumbing code inspection during construction.

Table 7 provides representative examples of questions that the audit should ask to determine the needs and capabilities of a community associated with each program element.

Table 6: Potential Local Agencies and Departments to Contact During an Audit

Audit Topic	Potential Agencies and Departments	
Infrastructure Profile	• Water and Sewer Authority	• Public Works
Existing Legal Authority	• Public Works • Planning Department • Parks and Recreation • Environmental Protection	• Local Health Department • Road Engineering • Fire, Police or Rescue (Hazardous material responders)
Available Mapping	• Public Works • Local Streets/Utilities	• Planning and Zoning • Emergency Responders
Field Staff	• Public Works • Environmental Compliance • Development Review	• Watershed Groups • Fire, Building, Health and Code Inspectors
Access to Lab Services	• Public Works • Local College or University	• Drinking Water or Wastewater Treatment Plant • Private Contract Monitoring Laboratories • Health Department
Education and Outreach Resources	• Parks and Schools • Water and Sewer Utility	• Community Liaison Office • Civic and Watershed Groups
Discharge Removal Capability	• Fire, Rescue and Police • Public Works	• Water and Sewer Utilities • Private Plumbing Contractors
Program Budget and Financing	• Grants • Fines • Application fees	• Utility Fees • Department Operating Budget

Table 7: Potential IDDE Audit Questions	
Audit Topics	**Questions**
Infrastructure Profile	• How many miles of streams and storm drains exist in the MS4? • What is the area served by storm drains, sewers, and septics? • What is the general age and condition of the infrastructure?
Existing Legal Authority	• Does an illicit discharge ordinance already exist? • Does effective inter-departmental coordination and cooperation currently occur? • Is there an existing reporting and tracking system (e.g., hotline)? • Is the municipality involved with industrial storm water NPDES permit activities or pre-treatment programs?
Available Mapping Data	• Does current GIS data exist and does it include coverage of sanitary and storm sewer networks? • Is there a centralized location for the data? • Are digital and hardcopy versions of mapping data readily available?
Field Staff	• Are municipal staff available to walk stream miles and record information? • Do municipal staff have the training and expertise to lead a field team? • Are basic field supplies already owned by the municipality and available for use?
Access to Lab Services	• Does the municipality have access to an analytical laboratory? • Is there a local university or institution that might be a willing partner? • If yes, is the existing equipment and instrumentation considered to be safe, accurate and reliable? • Are experienced municipal staff available to conduct analytical analyses? • Does the lab and staff have the capability to conduct more sophisticated special studies?
Education and Outreach Resources	• Does the community already have an Internet website to post outreach materials? • Are there regular community events that can be used to spread the message? • Are good inter-agency communication mechanisms in place? • Do outreach materials on illicit discharges already exist?
Discharge Removal Capability	• Who currently responds to spills, overflows and hazardous material emergencies? • Are municipal staff properly equipped and trained to repair most common types of illicit connections? • Does the municipality have clear authority identifying responsible parties? • Is there a response time commitment to known and reported problems? • Is there a list of pre-approved contractors to perform corrections?
Program Budget and Financing	• Is there a dedicated annual budget line item planned for the IDDE program? • Are there cost-share arrangements/opportunities available with other departments? • Have grant awards been awarded to the municipality for special studies associated with watershed restoration in the past?

3.2 Develop Infrastructure Profile

The first part of the audit profiles current and historic storm water and sewer infrastructure in the community. The basic idea is to get a general sense of the magnitude of the task ahead, by looking at the size, age and condition of the storm drain system (and the sewers within the MS4 as well). Some useful planning statistics include:

- Number of storm drain outfalls
- Miles of storm drain pipe
- Total stream and channel miles
- Total area serviced by storm drains
- Total area serviced by sewers
- Total area serviced by septic systems

These statistics are extremely helpful in getting a handle on the total effort required to assess the overall system. Any data on the nature and age of storm drains and sewers can be useful (e.g., open vs. enclosed, young vs. old). The basic infrastructure statistics can be generated from a quick analysis of infrastructure and topographic maps. At this stage, ballpark estimates are fine; more detailed estimates can be developed later in the desktop analysis component.

It is also worth examining historic plumbing codes to determine what kinds of connections were allowed in the past. Often, interviews with "old-timers" who remember past building codes and practices can provide insights about historical construction as to where illicit connections may be a problem.

3.3 Establish Legal Authority

This part of the audit examines whether a community currently has adequate legal authority to regulate illicit discharges through the following actions:

- Evaluate and modify plumbing codes[5]
- Prohibit illicit discharges
- Investigate suspected illicit discharges
- Require elimination of illicit discharges
- Carry out enforcement actions

The audit of existing legal authority entails a search and review of all existing ordinances that could conceivably bear on illicit discharge control, and interviews with the agencies that administer them. Some common local ordinances that may address illicit discharges are outlined in Table 8. Many communities already have regulations prohibiting specific illicit discharges, such as hazardous chemicals, litter or sewage. Often, public health ordinances may prohibit certain sewage discharges. Local utilities may have plumbing codes and staff capability to track down and remove illicit connections on the system they operate.

[5] In some states such as NC, plumbing codes are established through a state process. In these cases, local governments typically need specific authority to adopt any local modifications, which can be difficult to obtain. In such states, it may be prudent for the storm water program managers of several local governments to organize as a single cooperative group to modify codes at the state level.

Table 8: Codes and Ordinances with Potential Links to IDDE	
• Fire codes • Hazardous wastes/spill controls • Health codes • Industrial storm water compliance • Litter control regulations • Nuisance ordinances • Plumbing codes	• Pollution prevention permitting requirements • Restaurant grease regulations • Septic system regulations • Sewer/drain ordinances • Storm water ordinance • Street/highway codes

To establish legal authority, communities will need to either develop a new IDDE ordinance or modify an existing ordinance that addresses illicit discharges. Language from existing ordinances that addresses illicit discharges should be incorporated or cross-referenced into any new IDDE ordinance to minimize conflicts and confusion. Furthermore, existing code ordinances may need to be amended or superceded to be consistent with the new IDDE ordinance.

In some instances, communities may want to consider collaborating with neighboring or nearby MS4s to develop ordinance language and legal authority, particularly if they share a common receiving water. Non-municipal permittees such as Departments of Transportation and special districts may also look to collaborate with municipal MS4s when considering ordinance language and legal responsibility.

3.4 Review Available Mapping

The third part of the audit looks at the coverage and quality of mapping resources available to support the IDDE program. Specifically, efforts should be made to see if a Geographic Information System (GIS) exists, and what digital mapping layers it contains. If a community does not possess a GIS, a community may choose to establish one (which can be quite expensive), or rely on available hardcopy maps. GIS and hardcopy maps are frequently available from the following local agencies: planning, tax assessment, public works, parks and recreation, emergency response, environmental, transportation, utilities, or health. If a watershed extends beyond the boundaries of a community, it may be necessary to acquire mapping data from adjacent communities.

Non-local sources of mapping data include state and federal agencies and commercial vendors. EPA and state environmental regulatory agencies maintain lists of NPDES dischargers; Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) sites; Resource Conservation and Recovery Act (RCRA) sites; and other industrial or hazardous material discharge sites. These sites are readily available as GIS layers[6]. Commercial vendors are good sources for low-altitude aerial photos of your community. These can be expensive but are often the best way to get a high-resolution recent 'snapshot' of the jurisdiction. Chapter 5 presents more detail on mapping layers needed for an IDDE program.

3.5 Availability of Field Staff

Field staff play a critical role in any IDDE program as they walk streams, assess outfalls, collect samples, respond to discharge complaints, and handle

[6] Some readily available GIS layers provided by regulatory agencies can be incomplete and inaccurate (particularly with location information). Communities should use their IDDE program and the associated data collection efforts to update their local information associated with these databases.

enforcement. This part of the audit evaluates the availability of local staff to perform these functions, and their training needs. Phase I communities report that experienced field staff are a major factor in IDDE program success.

Experienced staff can be supplemented with support staff such as interns and local watershed groups, if they are properly trained (CWP, 2002). As part of the audit, program managers should investigate whether existing staff can be used or whether new hires are anticipated, and explore intern opportunities with local universities and community colleges. Any local staff with experience in water quality sampling or development inspection should be identified. Fire, building, health, safety and erosion control inspectors are all potential field crew draftees.

An initial estimate of the staff time needed for field crews should be made at this time. Phase I IDDE programs allocated a median of 1.0 person-year for field investigations, with a range of 0.1 to 10 person-years each year (CWP, 2002). Several communities utilized interns to assist with field monitoring and office work. Since many IDDE surveys are short term and seasonal, several communities hired or transferred employees to serve on field crews on a temporary basis. Many Phase I programs found it hard to precisely quantify actual staff time dedicated to IDDE field work because staff were assigned from many departments, or performed other unrelated tasks (building inspections, erosion and sediment control inspections, etc.).

3.6 Access to Laboratory Analysis

This part of the audit identifies the best options for laboratory analysis of water quality samples collected in the field. Four basic options exist to get access to laboratory services, including:

1. Contract services from a private lab
2. Use existing lab facilities at local drinking water or wastewater treatment plants
3. Partner with a local water and sewer district, university or community college
4. Develop your own “in-house” monitoring and lab capability

The last three options may require purchasing special monitoring analysis equipment, depending on the water quality indicators ultimately selected. If a community is considering developing “in-house” monitoring capabilities, it will need to address quality control, training needs, safety, and hazardous waste disposal. At this point, a community simply wants to acquire data on costs, indicator parameters, quality control, and experience for each of the options being evaluated. Chapter 12 provides more detail on factors to consider when selecting lab analysis options.

3.7 Education and Outreach

The next part of the audit looks at existing educational and outreach resources in the community. To begin, look for other groups that are already involved in storm water or watershed education, including parks, schools, watershed groups, utilities and any other agencies performing this role. Next, look for the current tools the public can use to report water quality problems, such as complaint hotlines, websites or community liaison offices. When these exist, it may be possible to “piggy back” illicit discharge reporting at little additional cost. If reporting tools do not exist, program managers should look for opportunities to share start-up costs

with other agencies that may stand to benefit from improved community interaction (e.g., erosion and sediment control, sanitary sewer overflows, abandoned cars, etc.).

The audit should also look at community-wide events and education outlets to spread the IDDE message, such as fairs, festivals, earth day events, school presentations, and homeowner association meetings. For a complete review of how to craft an effective outreach and education plan, consult Pollution Source Control Practices (Schueler *et al.*, 2004). Excellent education and outreach materials have already been developed by Phase I communities that are available at little or no cost (see Chapter 9). Program managers should consult these resources and modify them as needed to meet their local needs.

3.8 Discharge Removal Capability and Tracking

This part of the audit evaluates local capacity to locate specific discharges, make needed corrections or repairs, and take any enforcement actions. These responsibilities are frequently split among several local agencies. For example, spills are often handled by the fire department hazmat response team, whereas dumping may be enforced by public works. Communities should always coordinate their IDDE program with any experienced hazmat response teams that exist. Similarly, local water and sewer utilities or private contractors that are in the business of repairing pipes should always be consulted. Their experience in specialized techniques such as dye or video testing of pipe interiors is essential for many illicit discharge source investigations. Alternatively, communities can opt to contract out many of these services.

Illicit discharges often occur due to "bad plumbing" connections. Therefore, the audit should identify key building inspectors to determine what, if any, procedures are in place to prevent these deficiencies. Lastly, where corrections to plumbing are required, communities should maintain a list of "pre-approved" plumbing contractors that can promptly and professionally repair the problem.

To ensure coordination, an up-to-date tracking system should be shared among all agencies involved.

3.9 Program Funding

The last part of the audit explores how much the local IDDE program will cost, and how it will be funded. This section provides some general budgeting guidance on the costs to expect for the eight program components. Overall IDDE program costs vary depending on the severity of the illicit discharge problem, the size of the community (and storm drain systems), and the IDDE program choices you make.

Planning level budget estimates can be derived for the eight IDDE program components in three ways. The first way is to look at the cost of IDDE program compliance for Phase I NPDES communities. These costs were assessed in a CWP (2002) survey, and can be used to budget overall annual costs for an IDDE program. Table 9 summarizes median program costs for selected Phase I IDDE program activities. The second technique is to construct unit cost budgets for each program component, based on an assumed level of effort. The third technique relies on EPA's overall average estimate of compliance costs for Phase II IDDE program of $1.30 per capita (with a staggering range $0.04 to $2.61/capita).

Phase I IDDE Program Costs

The bulk of the cost for most IDDE programs is related to staffing – typically, about 75% of the total budget. Equipment costs were fairly reasonable, with programs spending a median of $1,000 on office computers and software, and about $4,000 on field equipment. Many equipment costs can typically be shared across other community programs. Lab costs, for either the purchase of lab equipment or the cost associated with sending samples to labs, were as high as $87,000 annually, with a median of $8,000. Finally, most programs had additional budgets for "other" which included items such as education, training, travel, consultants, and contractors.

It is worth noting that program costs presented in Table 9 do not reflect expenditures associated with special investigations, which may be pursued by communities to isolate specific sources or test new methods or the direct costs to fix problem connections. However, five communities provided data on typical correction costs, with an average cost of $2,500 per correction (Table 10).

Estimated Phase II IDDE Program Unit Cost

Cost estimates for the eight IDDE program components are outlined in Table 11; more detailed guidance on budgeting for individual program components is provided in subsequent chapters. Under this presentation of cost, data, staff, equipment, and supply costs are combined and incorporated into a primary program element, such as conducting an outfall reconnaissance inventory. This approach assumes a hypothetical scenario of stream/MS4 miles and outfalls to investigate (see Table 11 notes).

Table 9: Summary of Annual Phase I IDDE Program Costs

Program Element	Median Annual Cost
Staff	$85,100
Office Equipment (Computer/Software)	$1,000
Field Equipment	$4,000
Lab Equipment/Testing	$8,000
Other	$10,000
Total	**$121,825**

Table 10: Average Correction Costs

Jurisdiction	Average Cost Per Correction
Cambridge, MA	$5,000
Boston, MA	$3,570
Knoxville, TN	$2,000
Raleigh, NC	$1,000
Springfield, MO	$1,000
Average	**$2,500**

Table 11: IDDE Program Costs

IDDE Program Component		Start Up Cost		Annual Cost	
		Low	High	Low	High
Component 1:	a) Perform Audit	$3,000	$9,000	NA	NA
	b) Initial Program Plan	$1,000	$3,000	NA	NA
Component 2:	a) Adopt Ordinance	$1,000	$17,000	NA	NA
	b) Tracking System	$2,000	$15,000	$2,000	$2,000
Component 3:	a) Desktop Analysis	$1,000	$4,000	NA	NA
	b) Field Mapping	$500	$1,000	NA	NA
Component 4:	a) Develop Goals	$1,000	$3,000	NA	NA
	b) Field Monitoring Strategy	$1,000	$3,000	NA	NA
Component 5:	a) Outfall Reconnaissance Inventory (ORI)	NA	NA	$5,700	$12,800
	b) Establish Hotline	$1,300	$7,700	$1,500	$11,400
	c) Sample Analysis	$500	$15,500	$9,000	$21,200
	d) Outfall Map	NA	NA	$500	$1,000
Component 6:	a) Isolate	NA	NA	$2,000	$5,200
	b) Fix	NA	NA	$10,000	$30,000
Component 7:	a) Education	$1,000	$8,100	$1,300	$13,900
	b) Enforcement	NA	NA	$1,000	$14,000
Component 8:	a) Program Administration	$10,000	$15,000	$10,000	$15,000
TOTAL		**$23,300**	**$101,300**	**$43,000**	**$126,500**

Notes: NA = Not Applicable
Component 1 – Audit assumes $25/hr, 120 hours for low and 360 hrs for high. Program plan assumes 40 hrs for low and 120 hrs for high.
Component 2 – Ordinance low cost from Reese (2000), high cost from CWP (1998) adjusted and rounded for inflation (2002 $). Tracking system low cost assumes 40 hrs of development and $1K of equipment for start up. Annual cost for low assumes 40 hrs per year. High estimates are adapted from Reese (2000) and assume 200 hrs for development and $3k for equipment at start-up. High annual costs assume 100 hrs per year.
Component 3 – Desktop analysis assumes 1 week for low and 4 weeks for high. Mapping costs assume paper maps (CWP, 1998) under low and GIS under high (40 hrs)
Component 4 – Goals and strategies take 2 weeks for low and 6 weeks for high. Assume even split in time between two tasks.
Component 5 –
a) ORI costs are from Ch 11 and assume 10 miles with 2-person crew for low and 20 miles with 3-person crew for high. ORI costs assume work completed in one year, but not necessarily every year (permit cycle cost).
Low hotline costs are adapted from Reese (2000). High costs are from CWP research. Low annual costs assume an increased volume of calls due to advertisement and assume 50 hours per year dedicated to this plus annual training.
Sample analyses are from various sources and are presented in Chapter 12. Estimates based on 80 samples per year for both (shown as annual cost). Low start up costs are based on contract lab arrangements. High start up costs assume flow type library is developed for eight distinct flow types. Low annual costs assume in-house analysis for Flow Chart Method parameters. High annual costs assume contract lab analysis for 11 parameters.
Outfall map costs are same as the component 3 mapping task
Component 6 – Isolate and fix have no assumed start up costs and are both vary depending on the community conditions. Low annual isolation costs assume a one day investigation by a 2-person team per incident ($400) and four incidents per year plus $400 in equipment and supplies. High assumes one incident per month. Estimates include on-site inspections. Fix costs are from average costs from Phase I survey and assume same number of incidents as isolate. These costs can often be passed on to responsible parties.
Component 7 – Education estimate adapted from Reese (2000) and assumed to be 1/3 of total Phase I education budget. Some adjustments were made based on assumptions by CWP.
Component 8 – Low assumes 1/6 FTE, high assumes 1/4 FTE at an annual salary of $60K.

Financing an IDDE Program

Once the initial budget has been estimated, the next step is to investigate how to pay for it. A full discussion of how to finance local storm water management programs is beyond the scope of this manual, but it is worth consulting APWA (2001). The most common financing mechanisms include:

- Operating budgets
- Debt financing
- State grants and revolving loans
- Property assessments
- Local improvement districts
- Wastewater utility fees
- Storm water utility or district fees
- Connection fees
- Plan review/inspection fees
- Water utility revenues

Of these, storm water utilities or districts are generally considered one of the best dedicated financing mechanisms. Some useful resources to consult to finance your local storm water programs include the following:

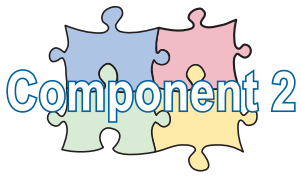
- An Internet Guide to Financing Storm Water Management. 2001 http://stormwaterfinance.urbancenter.iupui.edu
- Establishing a Storm Water Utility http://www.florida-stormwater.org/manual.html
- Florida Association of Storm Water Utilities. http://www.fasu.org
- How to Create a Storm Water Utility http://www.epa.gov/nps/urban.html
- The Storm Water Utility: Will It Work in Your Community? www.forester.net/sw_0011_utility.html

3.10 The Initial IDDE Program Plan

The local IDDE audit reveals resource gaps, and expertise and staffing needed to build an effective IDDE program. The next step is to organize how you plan to phase in the eight program components over the permit cycle. The process results in the development of an initial IDDE program plan that normally includes five elements:

- Overall schedule for plan implementation, with milestones
- Detailed work plan for the first year
- Budget for the first year
- Five-year budget forecast
- Process for gaining approval for first-year budget

Program managers should consult the next seven chapters for more guidance on planning and budgeting individual IDDE program components.



Chapter 4: Establishing Responsibility and Legal Authority

Purpose: This program component is where the legal and administrative authority is established to regulate, respond and enforce illicit discharges in the community. The component also reviews local plumbing codes to ensure that inappropriate connections are prohibited, and develops a tracking system to locate illicit discharges and track management response.

Method(s): Several methods are used to implement this program component, including development of a new or amended illicit discharge control ordinance and the creation of a relational computer database for internal and external tracking of illicit discharges.

Desired Product or Outcome(s):

a) Pass or amend a local ordinance that defines the lead regulatory agency, defines the range of illicit discharges to be covered, and specifies the range of enforcement mechanisms.

b) Establish an internal and external reporting and tracking system. The internal system is structured around the training/education of municipal staff to define and facilitate appropriated response and enforcement procedures. An external system or hotline links to the internal system and assists in response and enforcement by providing access to the public for reporting.

Budget and/or Staff Resources Required: Establishing responsibility, legal authority and an effective tracking system can take as little as a month of staff effort to complete if no major surprises or unforeseen costs are encountered in the process. However, the actual time-frame to adopt an ordinance or fund a response system, for example, is often much longer, given the crowded schedules of elected officials and timing of the local budget processes. Adoption of the ordinance and the actual budget authorization may require multiple votes over many months or years. Continuous engagement and education of key advisors, agency staff and elected officials are needed throughout the effort. Where hotlines exist (covering a range of municipal functions), significant staff and infrastructure savings should be realized. The primary hurdle in this instance will be employee training and education.

Integration with Other Programs: Public education to advertise the hotline and municipal training to educate employees across departments and agencies are the primary areas where this program component can be integrated with other community-wide initiatives. The hotline can be used to report other watershed and water quality problems (e.g., ESC, dumping, sanitary sewer overflows). Good coordination should occur between tracking repair costs and determining appropriate fine levels for enforcement purposes.

Three critical decisions are needed to implement this program component—what local agency will be responsible for administering the IDDE program, will it have adequate legal authority to do its job, and how will illicit discharges be tracked. Guidance is offered below to help program managers make these decisions.

4.1 Identify Responsible Department/Agency

For most communities, the IDDE program will be established under the same agency or department that oversees all other MS4 NPDES requirements (e.g., Department of Environmental Protection, Department of Public Works, Department of Health, etc.). For small communities, IDDE program administration and implementation may be wrapped into the broad duties of just a few staff. For larger communities, or where there are significant known problems associated with illicit discharges, a community may elect to have a dedicated department division with core staff. In either event, the agency and individuals responsible for the program should be well identified along with a clear understanding of program purpose, goals and actions.

Other local departments may already have authority over certain aspects of illicit discharges. Therefore, close coordination and communication with different departments is essential, and consideration should be given to consolidating responsibilities and authority. If consolidation is not pursued, regular inter-departmental briefings, training sessions, and data sharing will enhance program effectiveness and reduce the likelihood of significant lag times between discovery of a discharge and enforcement or correction due to split responsibilities between departments.

In some cases, communities may want to consider collaborating with adjacent or nearby permittees in order to form a regional approach to addressing illicit discharges. This might be appropriate in situations where municipalities share a common receiving water, and program implementation is conducted on a watershed management basis.

4.2 Develop Local Illicit Discharge Ordinance

A community must demonstrate that it has adequate legal authority to successfully implement and enforce its IDDE program. In fact, establishing legal authority is one of the required components identified in Phase II regulations, and can be identified as a measurable goal. Guidance is provided below on how to develop an IDDE ordinance to establish legal authority.

Reviewing What You Have

Communities with illicit discharge prohibitions in place have typically invoked legal authority using one or more of three mechanisms:

1. Storm water ordinance that prohibits illicit discharges to the drainage network
2. Plumbing code that prohibits illicit connections to the drainage network
3. Health code that regulates the discharge of harmful substances to the drainage network

A few concerns arise with the second and third mechanisms. One example is plumbing codes that only prohibit illicit connections fail to address other common discharges, such as indirect discharges, illegal dumping, or failing infrastructure. Similarly, exclusive reliance on health codes to regulate illicit discharges may not pick up discharges that are not harmful to human health, such as groundwater or potable water infiltration and residential irrigation return flows. With some revision and expansion, one or all of these existing mechanisms can meet the needs of the IDDE program. Alternatively, a new, stand-alone illicit discharge ordinance can be developed that supercedes all other related codes.

CASE STUDY

The City of Raleigh is an NPDES Phase I community. The Water Quality Group (WQG) within the Public Works Department oversees the City's illicit discharges program. The WQG was created in the early 1990s to be responsible for surface water quality across the City and to ensure compliance with the City's NPDES permits. Prior to that, various departments within city government handled water quality issues.

Raleigh's Illicit Discharge Ordinance was adopted in the second year of their original NPDES Phase I permit. The ordinance clearly defines and prohibits illicit discharges and illicit connections; requires containment and clean-up of spills/discharges to, or having the potential to be transported to, the storm drain system (it is also standard operating procedure that the City fire chief be notified of any spills immediately); allows for guaranteed right of entry for inspection of suspected discharges and connections; and outlines escalating enforcement measures, including civil penalties, injunctive relief, and criminal penalties.

Although the WQG runs the IDDE program, some functions are undertaken by the City's Public Utilities Department (e.g., fixing problems in the sanitary line, conducting dye and smoke testing, television inspection of the lines).

Raleigh began with a flat annual IDDE budget based on their past experience of what the program costs to run. More recently, the program began receiving additional funds from the City's storm water utility. A portion of the budget is allocated for testing. Cleaning and correction costs are funded through various budgets depending on the illicit discharge source. The WQG also budgets for two specialists: one is responsible for enforcement and dealing with citizen complaints and the other is responsible for monitoring and tracing the source of problems. The cost of television inspection and smoke testing is included in the Public Utilities Department budget.

Source: Senior (2002, 2004)

The length and complexity of an IDDE ordinance is largely a local community decision. Appendix B provides a model ordinance that may be adapted to meet the specific needs of local communities.

Some key components that should be addressed to ensure full authority to prevent and correct illicit discharges include the following:

- Prohibit illicit discharges
- Investigate suspected illicit discharges
- Require and enforce elimination of illicit discharges
- Address unique conditions or requirements

Defining What is Illicit

An IDDE ordinance should clearly define and/or identify illicit discharges and clearly state that these discharges are prohibited. Some communities may prefer to provide a short, concise definition of illicit discharges, while others may wish to list specific substances or practices that qualify as illicit discharges. However, if a detailed list is provided in the ordinance, a qualifying statement should follow in order to include polluting discharges not specifically listed.

Illicit connections should also be defined in the ordinance. These connections include pipes, drains, open channels, or other conveyances that have the potential to allow an illicit discharge to enter the storm drain system. The prohibition of illicit connections should be retroactive to include connections made in the past, whether or not the connection was permissible at the time. This is especially important if historic plumbing codes or standards of practice allowed for connection of laterals and drains (e.g., shop floor drains) to the MS4.

Lastly, the ordinance should identify categories of non-storm water discharges or other flows to the MS4 that are not considered illicit. For example, the Phase II rule exempts discharges resulting from fire fighting activities. Other activities that are commonly exempt include discharges from dye testing and non-storm water discharges permitted under an NPDES permit, provided that the discharger is in full compliance with the permit. The following categories of non-storm water discharges do not need to be addressed in the IDDE program unless the operator of the regulated small MS4 designates them as significant contributors of pollutants:

- Water line flushing
- Landscape irrigation
- Diverted stream flows
- Rising ground waters
- Uncontaminated ground water infiltration
- Uncontaminated pumped ground water
- Discharges from potable water sources
- Foundation and footing drain water
- Air conditioning condensation
- Irrigation water
- Springs
- Water from crawl space pumps
- Lawn watering
- Individual residential car washing
- Flows from riparian habitats and wetlands

In some cases, communities will need to assess unique local discharges of concern and ensure that they are properly addressed within the ordinance. Examples of unique conditions or requirements sometimes included in IDDE ordinances are septic system provisions, plumbing codes, point of sale dye testing, and pollution prevention plan requirements for certain generating sites.

Provisions for Access and Inspection

Although many communities report that most property owners cooperate when asked for access for illicit discharge investigations, this should never be taken for granted. Indeed, the right of access to private property for inspections is an essential provision of any IDDE ordinance. The ordinance should provide for guaranteed right of entry in case of an emergency or a suspected discharge or at any time for routine inspections, such as dye or smoke tests.

The ordinance should also clarify that right of entry applies to all land uses in the community, and that proof of discharge is not required to obtain entry. It should also state the responsibility of the property owner to disarm security systems and remove obstructions to safe and easy access. Enforcement actions should be established for property owners that refuse access, including the ability to obtain a search warrant through the court system.

Types of Enforcement Tools

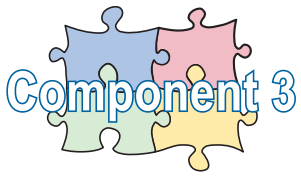
An IDDE ordinance should define a range of enforcement tools so the responsible agency can effectively handle the wide range of illicit discharge violations it is likely to encounter. Potential enforcement tools can range from warnings to criminal prosecution. The choice of enforcement tools should be based on volume and type of discharge, its impact on water quality and whether it was intentional or accidental. In addition, it is helpful to spell out the specific activities that trigger progressively greater enforcement. Table 12 summarizes the range of enforcement tools that have been used by communities to respond to illicit discharges.

The ordinance should provide for escalating enforcement measures to notify operators of violations and to require corrective action. Voluntary compliance should be used for first-time, minor offenders, while more serious violations or continued non-compliance may warrant a more aggressive enforcement approach. Finally, the ordinance should include methods for appeal to provide owners with avenues for compliance.

Establish a Tracking and Reporting System

Communities need to develop tracking and reporting systems to support the entire IDDE program, including enforcement. A relational database with geospatial features provides the greatest flexibility to cover multiple program objectives. From a legal standpoint, tracking systems are important for historical documentation of problems and corrective actions. More details on designing and operating a tracking system are described in subsequent chapters.

Table 12: Summary of IDDE-Related Enforcement Tools	
Type of Enforcement Action	**Description**
Written Warning with Voluntary Compliance	• Applies to first time, minor violations (Field staff should have authority to do this)
Written Notice of Violation Ordering Compliance	• Should clearly state description of remedial measures necessary, time schedule, penalties assessed if it doesn't happen, and timeframe for appeal
Administrative Penalties	• Daily financial penalty imposed by a responsible department for each day violation remains unfixed
Civil Penalties	• Daily financial penalty imposed by judicial authority for each day violation remains unfixed
Compensatory Action	• In lieu of enforcement proceedings or penalties, impose alternative compensatory action, e.g., storm drain stenciling, etc.
Criminal Prosecution	• Applies to intentional and flagrant violations of ordinance • Each day discharge continues is typically a separate offense • Can result in fines and imprisonment
Cost of Abatement of the Violation/Property Liens	• Applies when jurisdiction remedies the discharge or conducts cleanup, but may also be used to recoup administrative costs • May constitute a property lien if not paid within certain timeframe
Emergency Cease and Desist Order	• Applies when ordinance continues to be violated • Requires immediate compliance with ordinance by halting operations/ terminating discharges • May be a written or verbal order to remove illicit discharge
Suspension of Water or Sewer Service	• Applied in emergency situations to immediately discontinue discharge to MS4 • May be applied as enforcement measure when property owner does not comply/fix the problem within timely manner
Stop Work Order	• Typically applies to discharges associated with construction activity • No further work can be done until compliance is achieved



Chapter 5: Desktop Assessment of Illicit Discharge Potential

Purpose: This program component uses mapping and other available data to determine the potential severity of illicit discharges within a community, and identifies which subwatersheds or generating land uses merit priority investigation.

Method(s): A simple desktop assessment method can rapidly determine the severity of illicit discharge problems in a community. If an MS4 has fewer than 20 stream miles, this component can be skipped and a community can proceed directly to an ORI. The desktop assessment method has five basic elements:

1. Delineate subwatersheds or other drainage units within your community
2. Compile available mapping and data for each drainage unit (e.g., land use, age, outfalls, infrastructure history)
3. Derive subwatershed discharge screening factors using GIS analysis
4. Screen and rank illicit discharge potential at the subwatershed and community level
5. Generate maps to support field investigations

Desired Product or Outcome(s): The desktop assessment is used to guide initial field screening, and support initial IDDE program decisions. Key outcomes include:

a) Screening problem catchments or subwatersheds

b) Creation of GIS or other database system to track outfalls

c) Gaining an overall assessment as to the severity of illicit discharge problems in the community

d) Generation of basic mapping for subsequent field work

Budget and/or Staff Resources Required: The initial desktop assessment of illicit discharge potential should not be a long or arduous process, and should generally take less than four staff weeks. The quality and accuracy of the desktop assessment, however, will vary depending on the extent of available mapping information and GIS data. If mapping information is poor, the desktop assessment should be skipped, and program managers should go directly to the field to inventory outfalls.

Integration with Other Programs: If the desktop assessment suggests few potential illicit discharge problems, program managers may want to combine outfall surveys with broader stream corridor assessment tools such as the Unified Stream Assessment (Kitchell and Schueler, 2004). The desktop assessment provides insight on how to narrow your illicit discharge search, and is helpful when designing a discharge tracking system to best suit your needs. Finally, the desktop assessment can identify subwatersheds, generating sites, and neighborhoods where storm water education should be targeted to address illicit discharge problems.

5.1 Overview of Desktop Assessment of Illicit Discharge Potential

A community should understand the extent of water quality problems caused by illicit discharges. The desktop assessment should not be a time-consuming research effort, but should draw on existing background data and anecdotal information to initially characterize illicit discharge potential at the subwatershed level.

Subwatersheds are then screened based on their composite score, and are designated as having a low, medium or high risk:

- Low – no known illicit discharge problems in the subwatershed
- Medium – problems are confined to a few stream reaches, outfalls or specific generating sites in the subwatershed
- High – Problems are suspected to be severe throughout the subwatershed

The desktop assessment also shapes the overall direction of a local IDDE program. For example, if the desktop assessment indicates that the risk of illicit discharges is low in the community, program managers may want to shift resources to other minimum management measures and integrate them into a broader watershed assessment and restoration effort. For example, IDDE programs may emphasize storm water education, public involvement and hotline setup. By contrast, if the desktop assessment reveals significant potential for severe discharges, program managers will need to allocate significant program resources to find and fix the discharge problems.

The recommended scale for desktop assessments is the subwatershed or sewershed, which typically range from two to 10 square miles in area. These small planning units are easily delineated on maps or a GIS system. Next, mapping, monitoring and other data are analyzed to identify subwatersheds with the greatest potential to contribute illicit discharges. The sophistication of the analysis varies depending on the data available, but can encompass up to 10 different screening factors. The desktop assessment consists of five basic steps:

Limited mapping or data should not hinder a desktop assessment. Most communities will have some gaps, but should make the most out of what they have. The desktop assessment is an office exercise to locate the most promising subwatersheds to find illicit discharge; subsequent outfall screening is needed to discover the problem outfalls in the field.

Step 1: Delineate subwatersheds

Step 2: Compile mapping layers and subwatershed data

Step 3: Compute discharge screening factors

Step 4: Screen for illicit discharge potential at the subwatershed and community level

Step 5: Generate maps to support field investigations

Step 1: Delineate Subwatersheds

Since hundreds of outfalls and many stream miles exist in most communities, the MS4 should be divided into smaller, more manageable planning units known as subwatersheds. If the community already does watershed planning, these subwatersheds may already be delineated, and should be used for subsequent characterization and screening. Working at the subwatershed scale is usually the

most efficient way to conduct both desktop assessments and field surveys.

In small, heterogeneous or densely developed MS4s, conducting the assessment on a smaller scale may be more effective. In this case, sewersheds or catchments that are less than one square mile in area and have a common outfall or discharge point should be delineated. This finer level delineation allows for a refined characterization that can pinpoint probable sources of illicit discharges, but can obviously consume a lot of time. It should be noted that sewersheds do not always follow topographic delineations and therefore can provide a more accurate picture of the contributing areas to a particular outfall.

If subwatersheds are not yet defined, hydrologic, infrastructure and topographic map layers are needed to delineate the boundaries. Guidance on the techniques for accurately delineating subwatershed boundaries can be found at www.stormwatercenter.net (click "Slideshows," then scroll down to "Delineating Subwatershed Boundaries"). The use of digital elevation models (DEMs) and GIS can also make subwatershed delineation an easier and faster, automated process.

Some subwatersheds extend beyond the political boundaries of a community. Where possible, it is recommended that the entire subwatershed be delineated and assessed in conjunction with neighboring municipalities. This helps to ensure that all potential sources of illicit discharges are identified in the subwatershed, regardless of the community from which they originate.

Step 2: Compile Mapping Layers and Subwatershed Data

Once subwatersheds (or catchments) are delineated, a community can begin to acquire and compile existing data for each drainage area, preferably with a Geographic Information System (GIS). A GIS allows the user to analyze and manipulate spatial data, rapidly update data and create new data layers, associate data tables with each map layer, and create paper maps to display subwatershed information. A GIS can greatly speed up data compilation and provides greater accuracy in mapping specific locations. The mapping information facilitates the interpretation and understanding of the discharge screening factors (Step 3).

If a community does not currently have a GIS, developing a system from scratch may seem daunting, however, most GIS software can be installed on basic PCs, and free GIS data layers are often available online. The basic elements of a GIS program include a PC, Global Positioning System (GPS) units, a plotter, a digitizer, GIS software, data and staff training. As with many technologies, both low-end and high-end versions are available, as are many add-ons, extensions and tools. While a GIS is not necessary for the IDDE desktop assessment, it does make the process more efficient and accurate, which can save money in the long run. Moreover, other agencies within a community usually need or use GIS and may be willing to share hardware, software, support and development costs[7].

Acquiring data for each subwatershed is the next step in the desktop assessment process.

The extent and quality of the data available for mapping directly influence subsequent analyses and field investigations. A list of recommended data layers to acquire for the desktop assessment is provided in Table 13.

[7] If a community plans to defer using GIS, all databases it develops should have location information suitable for later use with GIS (i.e., using suitable georeferencing technology such as GPS).

Some mapping data may exist in GIS format, whereas others are only available in digital or hardcopy formats that need to be converted to GIS. Digital data with a geo-spatial reference such as latitude and longitude, parcel ID numbers or addresses can be directly entered into a GIS, if an existing road or parcel GIS layer can be associated to it. Hardcopy maps can also be digitized to create new GIS data layers. This can be a labor-intensive process, but will only need to be done once and can be easily updated. If GIS is not an option, hardcopy maps and data can be analyzed, with an emphasis on tax maps, topographic maps, historic aerial surveys, and storm drain and outfall maps.

Most data layers can be obtained from local sources, such as the city planning office, emergency response agency, or public works department. If a subwatershed extends beyond the boundaries of your community, you may need to acquire data from another local government. Some data layers may be available from state and federal agencies and commercial vendors. EPA and most state environmental agencies maintain databases of industrial NPDES, CERCLA, RCRA and other sites that handle or discharge pollutants or hazardous materials. These searchable permit databases are often available as GIS layers (see Appendix A). Commercial vendors are good sources for low-altitude aerial photos of your community. Aerial photos can be expensive but are often the best way to get a recent high-resolution 'snapshot' of subwatershed conditions.

Table 13: Useful Data for the Desktop Assessment

	Data	Likely Format
Recommended	Aerial photos or orthophotos	Digital map
	Subwatershed or catchment boundaries	Digital or hardcopy map
	Hydrology including piped streams	Digital or hardcopy map
	Land use or zoning	Digital or hardcopy map
	NPDES storm water permittees	Digital data or map
	Outfalls	Digital or hardcopy map
	Sewer system, 1" = 200' scale or better	Digital or hardcopy map
	Standard Industrial Classification codes for all industries	Digital or hardcopy data
	Storm drain system, 1" = 200' scale or better	Digital or hardcopy map
	Street map or equivalent GIS layers	Digital or hardcopy map
	Topography (5 foot contours or better)	Digital or hardcopy map
Optional	Age of development	Narrative data
	As-builts or construction drawings	Hardcopy map
	Condition of infrastructure	Narrative data
	Field inspection records	Hardcopy or digital data
	Depth to water table and groundwater quality	Digital data or maps
	Historical industrial uses or landfills	Narrative data or hardcopy map
	Known locations of illicit discharges (current and past)	Narrative data or digital map
	Outfall and stream monitoring data	Digital data
	Parcel boundaries	Digital or hardcopy map
	Pollution complaints	Narrative data
	Pre-development hydrology	Narrative data or hardcopy map
	Sanitary sewer Infiltration and Inflow (I/I) surveys	Hardcopy or digital data
	Septic tank locations or area served by septic systems	Hardcopy or digital map
	Sewer system evaluation surveys	Hardcopy or digital data

Alternatively, TerraServer (http://terraserver.microsoft.com/default.aspx) is a free mapping resource that most communities can use to get good quality aerial and other coverages (Figure 8 is an example). Higher quality photos may be desirable as more detailed investigations are pursued.

As GIS technology has become more affordable and easier to use, Phase II communities should harness their capabilities to develop the storm sewer system maps required by NPDES permits. GIS can become a powerful tool to track and manage the entire IDDE program, and demonstrate compliance in annual reports. In addition to being a powerful tool for analysis, GIS is also a great tool for communicating with the public. The images that can be created with GIS can summarize tables of data in a way that the public appreciates. If the recommended data layers are not available, a community may want to devote program resources to create or obtain them. Once data layers have been collected and digitized, they can be entered into the GIS to create a map of each subwatershed (Figure 8). Make sure all data layers are in the same coordinate system, and perform any conversions needed. Clip data layers to subwatersheds to enable calculation of factors such as land use, area, and outfall density. Summary data on subwatershed water quality and statistics on the age and condition of infrastructure should be entered into a database created for analysis in the next step.

Step 3: Compute Discharge Screening Factors

The third step of the desktop assessment defines and computes discharge factors to screen subwatersheds based on their illicit discharge potential (IDP). As many as 10 different discharge screening factors can be derived during the screening process, but not all may apply to every community. The potential screening factors are described in Table 14, along with how they are measured or defined. Keep in mind that

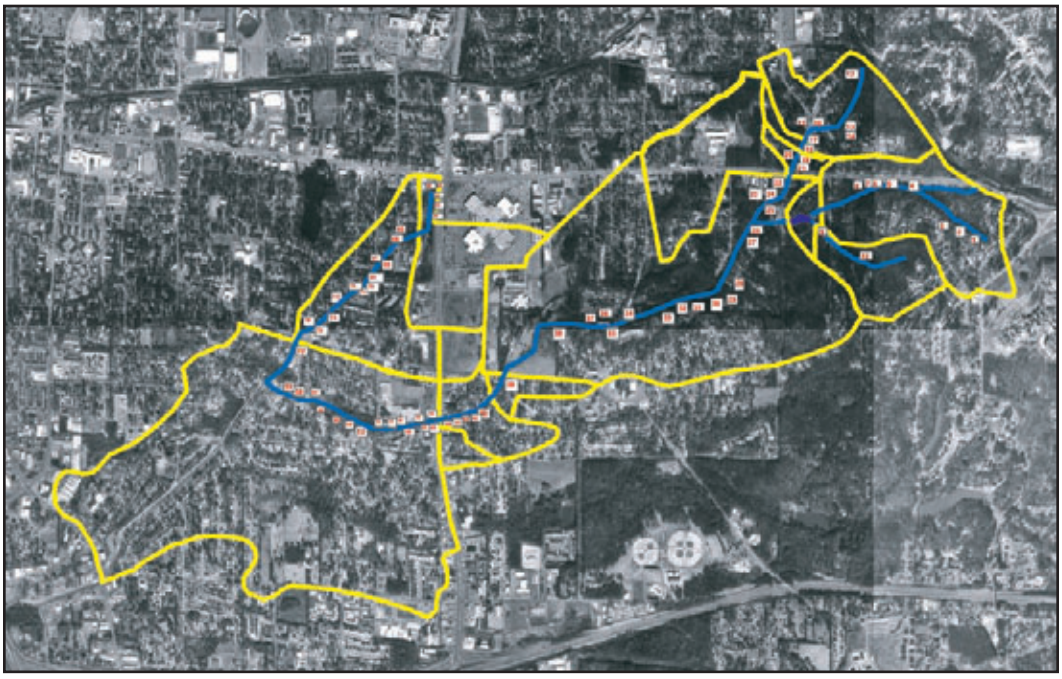


Figure 8: GIS Layers of Outfalls in a Subwatershed

Markings illustrate Tuscaloosa, AL outfalls and drainage areas surveyed as part of this project.

Table 14: Defining Discharge Screening Factors in a Community	
Discharge Screening Factors	**Defining and Deriving the Factor**
1. Past Discharge Complaints and Reports	Frequency of past discharge complaints, hotline reports, and spill responses per subwatershed. Any subwatershed with a history of discharge complaints should automatically be designated as having high IDP.
2. Poor Dry Weather Water Quality	Frequency that individual samples of dry weather water quality exceed benchmark values for bacteria, nutrients, conductivity or other predetermined indicators. High risk if two or more exceedances are found in any given year.
3. Density of Generating Sites or Industrial NPDES Storm Water Permits	Density of more than 10 generating sites or five industrial NPDES storm water sites per square mile indicates high IDP. Density determined by screening business or permit databases (Appendix A).
4. Storm Water Outfall Density	Density of mapped storm water outfalls in the subwatershed, expressed as the average number per stream or channel mile. A density of more than 20 outfalls per stream mile indicates high IDP.
5. Age of Subwatershed Development	Defined as the average age of the majority of development in a subwatershed. High IDP is often indicated for developments older than 50 years. Determined from tax maps and parcel data, or from other known information about neighborhoods.
6. Sewer Conversion	Subwatersheds that had septic systems but have been connected to the sanitary sewer system in the last 30 years have high IDP.
7. Historic Combined Sewer Systems	Subwatersheds that were once served by combined sewer system but were subsequently separated have a high IDP.
8. Presence of Older Industrial Operations	Subwatersheds with more than 5% of its area in industrial sites that are more than 40 years old are considered to have high IDP. Determined from historic zoning, tax maps, and “old-timers.”
9. Aging or Failing Sewer Infrastructure	Defined as the age and condition of the subwatershed sewer network. High IDP is indicated when the sewer age exceeds design life of its construction materials (e.g., 50 years) or when clusters of pipe breaks, spills, overflows or I/I are reported by sewer authorities.
10. Density of Aging Septic Systems	Subwatersheds with a density of more than 100 older drain fields per square mile are considered to have high IDP. Determined from analysis of lot size outside of sewer service boundaries.

these screening factors are a guide and not a guarantee. Each screening factor is described in detail in the following section.

1. Past Discharge Complaints and Reports

Many communities already have some handle on where illicit discharges have occurred in the past, based on past complaints, reports and interviews with spill responders and public works repair crews. Pollution complaints made to the local environmental or health department are also worth analyzing. Each of these historical sources should be analyzed to determine if any patterns or clusters where illicit discharges have historically occurred can be found. Ideally, the number of past discharge complaints should be expressed on a subwatershed basis. Even if there is not enough data to quantify past discharges, it may be helpful to get a qualitative opinion from public works crews.

2. Poor Dry Weather Water Quality

If dry weather water quality monitoring data have been collected for local streams, it can be an extremely useful resource to screen subwatersheds for IDP. In particular, look for extreme concentrations of enterococci or *E. coli*, or high ammonia-nitrogen or conductivity. Remember to edit out any samples that were collected during or shortly after storm events, as they reflect the washoff of pollutants during storm water runoff. In general, most communities have more subwatersheds than baseflow monitoring stations, so complete coverage is usually lacking. The following benchmarks are recommended to flag streams with high IDP, based on individual samples of dry weather water quality that exceed:

- Fecal coliform or *E. coli* standards (e.g., typically 1,000 to 5,000 MPN/100 ml)
- Ammonia-nitrogen levels of 0.30 mg/l
- Total phosphorus of 0.40 mg/l
- Conductivity levels that exceed the 90th percentile value for the pooled dataset

Subwatersheds can be classified as having a moderate risk if stream water quality values exceed half the benchmark value. An alternative approach is to statistically analyze long-term dry weather water quality monitoring dataset to define breakpoints (e.g., 50th, 75th, and 90th percentiles).

3. Density of Generating Sites or Industrial NPDES Storm Water Permits

The density of potential generating sites in a subwatershed can be a good screening factor, if land use and business databases are available. The basic database screening method used to locate commercial, industrial, institutional, municipal and transport-related generating sites is described in Chapter 1 and Appendix A. From the standpoint of discharge screening, the key variable to derive is the density of potential generating sites (e.g., sites/square mile). As a rule of thumb, more than 10 potential generating sites per square mile would indicate a high IDP, while subwatersheds with three to 10 generating sites per square mile might suggest a medium IDP.

Alternatively, communities may want to develop screening factors based on the density of industrial storm water permits in place within the subwatershed. State or federal regulatory agencies often have geospatial databases of industrial NPDES discharges that can be rapidly screened. Pretreatment programs are another valuable source of information on industrial and non-domestic discharges to the sanitary system.

4. Storm Water Outfall Density

The density of outfalls in a subwatershed is an effective discharge screening factor, and is expressed in terms of the number of outfalls per stream mile. Outfall density can be determined by analyzing storm drain maps, if they exist (although they often miss the smaller diameter outfalls that can also produce discharges). In general, subwatersheds that have more than 20 mapped outfalls per stream mile may indicate a higher risk for IDP. Alternatively, the breakpoints for outfall density can be statistically analyzed based on the frequency across all subwatersheds.

5. Age of Subwatershed Development

The average age of development in a subwatershed may predict the potential for illicit discharge problems. For example, a subwatershed where the average age of development is more than 100 years was

probably constructed before sewer service was widely available, and many of the pipes and connections may have changed over the years as a result of modernization and redevelopment. Presumably, the risk of potential discharges would be higher in these older subwatersheds. By contrast, a recently developed subwatershed may have a lower discharge risk due to improved construction materials, codes and inspections. Therefore, high IDP may be indicated when subwatershed development is more than 50 years old, with medium IDP for 20 to 50 year old development, and low IDP if fewer than 20 years old. You should always check with local building and plumbing inspectors to confirm the building eras used in the screening analysis. The actual age of development can be estimated by checking tax maps and plats, or based on architecture, or common knowledge of neighborhoods.

6. Sewer Conversion

Subwatersheds that were once served by septic systems but were subsequently connected often have a high IDP. These subwatersheds are identified by reviewing past sewer construction projects to determine when and why sewer service was extended.

7. Historic Combined Sewer Systems

Subwatersheds that were once served by combined sewer systems but were subsequently separated often have a high IDP. They can be identified by reviewing past municipal separation projects.

8. Presence of Older Industrial Operations

Older industrial areas tend to have a high potential for illicit cross-connections for several reasons. First, sanitary sewers may not have been installed to handle wash water, process water and other discharge flows when the operation was originally constructed. In the past, storm drains were often used to handle non-sewage discharges at older industrial facilities. In addition, sanitary and storm drain lines built in different eras are poorly mapped, which increases the chance that someone gets the plumbing wrong during an expansion or change in operations at the facility. As a result, older industries may inadvertently discharge to floor drains or other storm drain connections thinking they are discharging pretreated water to the sanitary sewer. Finally, older industries that produce large volumes of process water may not have enough sanitary sewer capacity to handle the entire discharge stream, causing them to improperly discharge excess water through the storm drain system.

For these reasons, subwatersheds where older industry is present should be regarded as having a high IDP. For operational purposes, older industry is defined as sites that predate the Clean Water Act (e.g., 40 years old or more). They can be identified from historic zoning and land use maps, old parcel records or talking with old-timers.

9. Aging or Failing Sewer Infrastructure

Aging or failing sewer infrastructure often signals potential illicit discharges, and can be defined by the age and condition of the subwatershed sewer network. High IDP is indicated when the sewer age exceeds the design life of its construction materials (e.g., 50 years) or when clusters of pipe breaks, spills, overflows or infiltration and inflow (I&I) are reported by sewer authorities. Older and aging sewer infrastructure experience more leaks, cross-connections and broken pipes that can contribute sewage to the storm drain system. The key factor

to determine is the approximate age of the sewer pipes and their construction materials, which can be gleaned from sewer maps I&I studies, or interviews with crews that regularly repair broken or leaking sewer pipes.

10. Density of Aging Septic Systems

Subwatersheds located outside of the sewer service area are presumably served by septic systems. Septic systems more than 30 years old are prone to failure, based on many site factors (Swann, 2001). In general, a high IDP is indicated if older septic tank density exceeds 100 per square mile. Sewer envelope boundaries or sewer network maps can be helpful to identify subwatersheds that are served by septic systems. Actual density is determined by counting or estimating the total number of septic households in the subwatershed. Tank density should be expressed as septic system units per square mile (average lot size can also be used as a surrogate estimator).

Step 4: Screen for Illicit Discharge Potential at the Subwatershed and Community Level

The process for screening IDP at the subwatershed level is fairly simple. The first step is to select the group of screening factors that apply most to your community, and assign them a relative weight. Next, points are assigned for each subwatershed based on defined scoring criteria for each screening factor. The total subwatershed score for all of the screening factors is then used to designate whether it has a low, medium or high risk to produce illicit discharges. Table 15 provides an example. Based on this comparison, high-risk subwatersheds are targeted for priority field screening. It is important for program managers to track and understand which screening factors contributed to identifying a watershed as "high-risk," as this may affect the type of investigatory strategy that is used for a particular watershed.

Table 15: Prioritizing Subwatersheds Using IDP Screening Factors

	Past Discharge Complaints/ Reports (total number logged)	**Poor dry weather water quality** (% of times bacteria standards are exceeded)	**Density of storm water outfalls** (# of outfalls per stream mile)	**Average age of development** (years)	**Raw IDP score**	**Normalized IDP score****
Subwatershed A	8 (2)*	30% (2)*	14 (2)*	40 (2)*	8	2
Subwatershed B	3 (1)	15% (1)	10 (2)	10 (1)	5	1.25
Subwatershed C	13 (3)	60% (3)	16 (2)	75 (3)	11	2.75
Subwatershed D	1 (1)	25% (1)	9 (1)	15 (2)	5	1.25
Subwatershed E	5 (1)	15% (1)	21 (3)	20 (1)	6	1.5

Notes:

* The number in parentheses is the IDP "score" (with 3 having a high IDP) earned for that subwatershed and screening factor. Basis for assigning scores (based on benchmarks) to assess IDP is as follows:
Past discharge complaints/reports: <5 = 1; 5-10 = 2; >10 = 3
Dry weather water quality: <25% = 1; 25-50% = 2; >50% = 3
Storm water outfall density: <10 = 1; 10-20 = 2; >20 = 3
Average age of development: <25 = 1; 25- 50 = 2; >50 = 3

** Normalizing the raw IDP scores (by dividing the raw score by the number of screening factors assessed) will produce scores that fall into the standard scale of 1 to 3 for low to high IDP, respectively.

The example provided in Table 15 uses four screening factors to assess five subwatersheds in a community. Data for each factor are compared against assigned benchmarks, as shown in the table. Each subwatershed receives a specific score for each individual screening factor. These scores are then totalled for each subwatershed, and the one with the highest score is given top priority screening. In this case, the screening priority would be given to Subwatershed C, then A, followed by E. Subwatersheds B and D, with the lowest potential for illicit discharges, have the lowest priority.

A similar screening process can be used to evaluate the IDP for the community as a whole. In this case, the entire population of subwatersheds in the community is analyzed to collectively determine the frequency of the three risk areas: high, medium, and low. Predefined criteria for classifying the community's IDP should be developed.

Table 16 and Figure 9 present an example system for classifying IDP as minimal, clustered or severe, based on the proportion of subwatersheds in each risk category. The community-wide assessment helps program managers define their initial IDDE program goals and implementation strategies, and target priority subwatersheds for field investigations.

Step 5: Generate Maps to Support Field Investigations

The last step in this program component involves generating the maps that field crews need to screen outfalls in priority subwatersheds. More detail on mapping requirements is provided in Chapter 11. The basic idea is to create relatively simple maps that show streams, channels, streets, landmarks, property boundaries and known outfall locations. The idea is to provide enough information so crews can find their way in the field without getting lost, but otherwise keep them uncluttered. Low altitude aerial photos are also a handy resource when available.

Table 16: Community-wide Rating of Illicit Discharge Potential

Rating	Indicators
Minimal (no known problems)	Majority of subwatersheds have a Low IDP risk, with the remainder having Medium IDP risk
Clustered (isolated problems)	More than 20% of subwatersheds with a Medium or High IDP risk that are in close proximity to each other
Severe (severe problems)	More than 50% of subwatersheds with a Medium or High IDP risk or more than 20% of subwatersheds with a High IDP risk

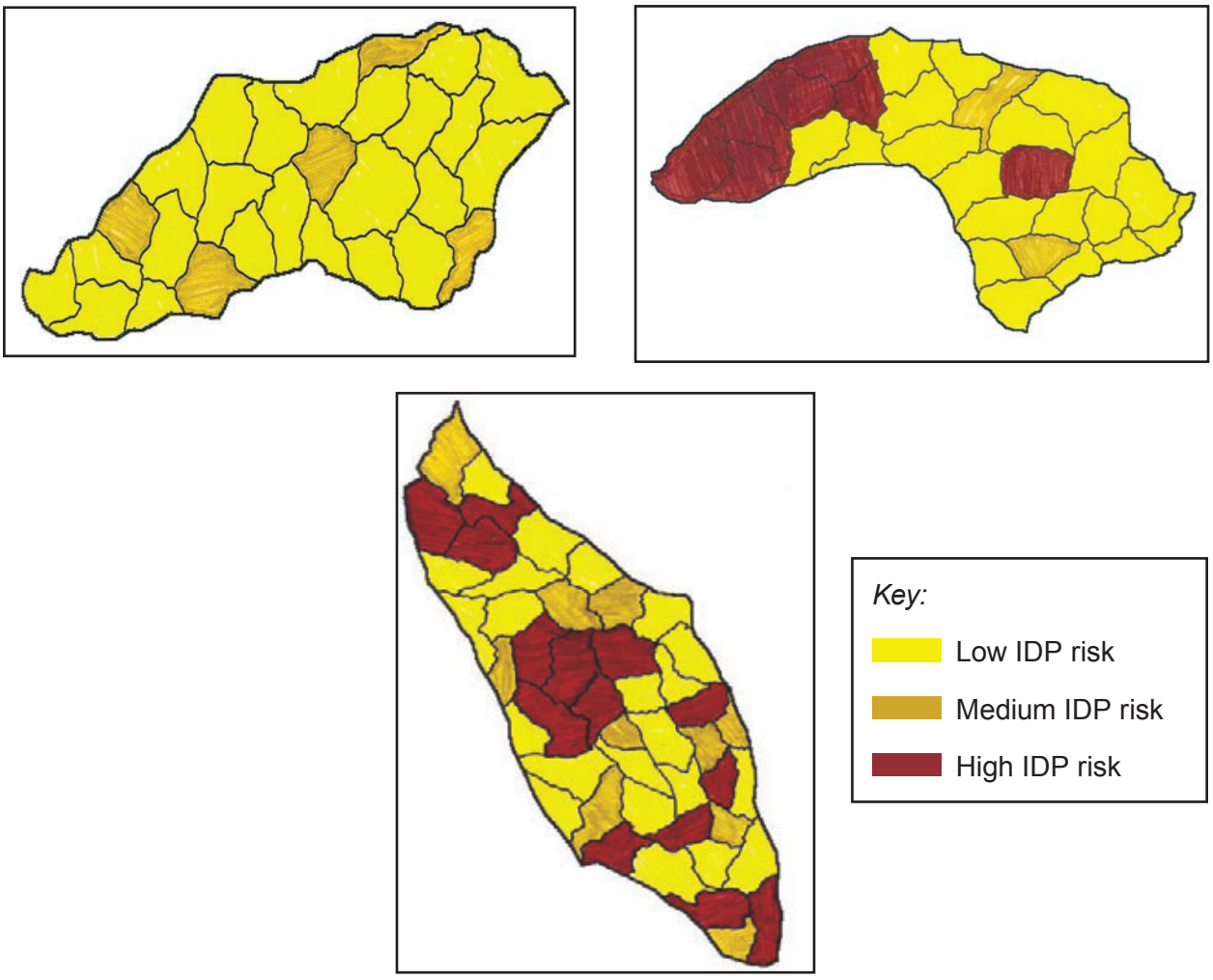
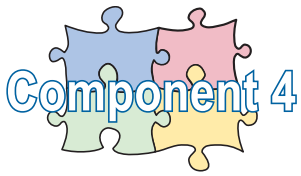


Figure 9: Communities with Minimal (a), Clustered (b), and Severe (c) Illicit Discharge Problems



Chapter 6: Developing Program Goals and Implementation Strategies

Purpose: This program component defines the goals and performance milestones to measure progress in IDDE program implementation during the first permit cycle, and selects the most appropriate and cost-effective strategies to find, fix and prevent illicit discharges. The goals and strategies ensure that scarce local resources are allocated to address the most severe illicit discharge problems that cause the greatest water quality problems in the community.

Method: The basic method is to analyze the results of the IDDE audit, desktop analysis and local water quality conditions to develop realistic, achievable and measurable goals for the program. The public and other stakeholders should be involved in the goal setting process. Once goals are selected, program managers need to select the appropriate implementation strategies and develop a timeline to make them happen. Both goals and strategies should closely align with the type and severity of water quality problems and local watershed management priorities. The probable contribution of illicit discharges to specific water quality problems should be estimated or modeled to determine the degree to which control efforts can meet local TMDLs, bacteria standards for water contact recreation, or other local water quality concerns.

Desired Product or Outcome(s): Agreement on program goals, measurable indicators and implementation strategies that address four key areas:

- Overall program administration
- Outfall assessment
- Finding and fixing illicit discharges
- Prevention of illicit discharges

Budget and/or Staff Resources Required: Staff effort to draft the goals and strategies, conduct needed meetings, respond to comments and finalize ranges from two to six weeks. Goals and strategies should be revisited and updated annually and at the end of each permit cycle. Staff and budget costs are not anticipated to be high unless a fundamental shift in program goals occurs.

Integration with Other Programs: Goal setting is always a good opportunity for public involvement, storm water education and watershed outreach. Effective implementation strategies often involve cost sharing with other departments and even other communities for monitoring equipment and lab facilities, hotlines, and education (e.g., public health/septic system programs).

6.1 Overview of Goals and Strategies Development

Communities can define program goals and implementation strategies once they understand the extent of their illicit discharge problem and how it influences local water quality. Initial program goals should be realistic and provide specific completion milestones to measure program compliance. Measurable goals enable a community to track and evaluate permit compliance over time, and to reassess and modify the program over time. The most basic measure of program effectiveness is to assess whether program goals are being met. So, if a program goal is to walk all stream miles and inventory all outfalls in the MS4 within the first permit cycle, this becomes a benchmark that determines program effectiveness. If a community finds that they only managed to walk and inventory 80% of stream miles, the program may need to be modified so that a full screening sweep is completed in a permit cycle, or they may need to adjust the goal or benchmark.

6.2 Develop Initial Program Goals

The NPDES Phase II MS4 permit regulations grant communities considerable flexibility to develop program goals, as long as they are defined in a measurable way to gauge permit compliance and program effectiveness. EPA (2000e) states that goals "should reflect the needs and characteristics of the operator and the area served by its small MS4. Furthermore, they should be chosen using an integrated approach that fully addresses the requirements and intent of the minimum control measure."

With this in mind, a series of representative goals that might be set for an IDDE program are presented in Table 17, along with proposed milestones. Four broad types of goals should be developed for every program:

1. Overall program administration
2. Outfall assessment
3. Preventing illicit discharges
4. Finding and fixing illicit discharge

The assumed timeframe is based on a five-year permit cycle. Some of the program goals outlined in Table 17 are considered essential while others are optional or recommended. Communities should feel free to adapt these suggested program goals to reflect their unique conditions and capabilities, or create new ones. The key point is that program goals should always have a timeframe to serve as a benchmark for whether the goal has been achieved.

Implementation strategies are designed to achieve program goals, and vary depending on the types and severity of illicit discharge problems in the community. These are outlined in more detail in the next section.

Table 17: Measurable Goals for an IDDE Program		
EXAMPLE MEASURABLE GOALS	**TIMEFRAME**	**PRIORITY**
Goals related to overall program administration		
Audit existing capabilities and identify needs	Immediately	●
Designate one program head and identify key support staff		●
Develop a complete list of ongoing activities related to IDDE		❍
Coordinate and communicate with other affected agencies	At program start up and continuously and regularly after that	●
Develop a projected 5-year budget		●
Secure funding to match 5-year goals		●
Draft and promulgate new or modified ordinance	Year 1	●
Establish a tracking and reporting system	Year 1	●
Goals related to outfall assessment		
Define and characterize drainage areas or sewer sheds	Year 1	●
Walk all stream miles	Begin in Year 1 and complete first screening by end of permit cycle. Repeat once per permit cycle	●
Develop a digital (e.g., GIS) map of all outfalls, land use, and other relevant infrastructure	Year 1 and continuously and regularly after that	●
Secure analytical laboratory services either internally or by arrangement with a private laboratory	Initiate in conjunction with field screening	●
Sample and trace the source of a percentage of flowing outfalls each year of permit cycle	Initiate during first permit cycle and expand and enhance where problems are observed	●
Conduct regular in-stream assessments		❍
Conduct investigations at a percentage of non-flowing outfalls with poor in-stream water quality to look for intermittent flows		❍
Integrate all collected stream data and citizen complaints into the GIS system	Initiate during first year and expand and enhance with time	❍
Goals related to preventing illicit discharges		
Distribute educational materials to citizens and industries	Initiate during first year and expand and enhance with time	❍
Conduct storm drain stenciling	Initiate during first permit cycle and expand and enhance where problems are observed	❍
Hold hazardous waste collection days at least annually		❍
Conduct upland subwatershed site reconnaissance surveys to better characterize generating site potential		❍
Goals related to finding and fixing illicit discharges		
Develop a spill response plan and coordinate emergency response with other agencies	Immediately	●
Remove all obvious illicit discharges	Ongoing in conjunction with field screening and in response to hotline reports	●

Table 17: Measurable Goals for an IDDE Program		
EXAMPLE MEASURABLE GOALS	**TIMEFRAME**	**PRIORITY**
Train staff on techniques to find the source of an illicit discharge	Initiate during first year and expand and enhance with time	●
Repair a fraction of the illicit discharges identified through field screening or citizen complaints	Initiate during first permit cycle and expand and enhance where problems are observed	●
Establish a hotline for public to call in and report incidents (consider establishing performance standards, such as guaranteed response time)	Initiate during first year and expand and enhance with time	❍
Inspect and dye-test all industrial facilities	Initiate during first permit cycle and expand and enhance where problems are observed	❍
Develop a system to track results of on-site inspections	Initiate during first year and expand and enhance with time	❍
Establish an Adopt-a-Stream program	Initiate during first permit cycle and expand and enhance where problems are observed	❍
Establish pre-approved list of plumbers and contractors to make corrections	Initiate during first year and expand and enhance with time	❍
Key: ● Essential ❍ Optional but Recommended		

Ultimately, IDDE program goals should be linked to water quality goals. Some common examples of water quality goals include:

- Keep raw or poorly-treated sewage out of streams
- Reduce pollutant loads during dry weather to help meet the TMDL for a water body
- Meet bacteria water quality standards for contact recreation during dry weather flows
- Reduce toxicant and other pollutant discharges to a stream to restore the abundance and diversity of aquatic insects or fish

A well-designed IDDE program may not guarantee that water quality goals will be always be achieved. Indeed, if program managers can document that illicit discharges do not contribute to poor water quality, they may want to shift resources to other pollution sources or practices that do. Burton and Pitt (2002) offer a complete discussion on designing and conducting a receiving water investigation.

6.3 Crafting Implementation Strategies

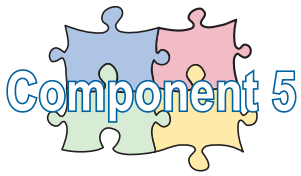
In order to meet program goals, managers must devise cost-effective implementation strategies that are most appropriate for the types of illicit discharge problems they actually have. The community-wide illicit discharge potential (IDP) developed during the desktop analysis can be quite helpful in choosing implementation strategies. Table 18 presents implementation strategies that are geared to the findings of the community-wide IDP. As the community acquires more program experience, they can refine the strategies to better address program goals or unique watershed conditions (Table 19).

Perhaps the most important implementation strategy is targeting—screening, education and enforcement efforts should always be focused on subwatersheds, catchments or generating sites with the greatest IDP. Adaptability after program startup is also an important strategy. Strategies developed from the desktop analysis should be constantly adjusted to reflect knowledge gained from field screening, hotline reports and other monitoring information.

Table 18: Linking Implementation Strategies to Community–wide IDP

Type	Examples of Implementation Strategy
Minimal IDP	• Conduct field screening of outfalls in the context of broader watershed assessment and restoration initiatives using the Unified Stream Assessment (CWP, 2004) or a comparable physical stream assessment approach that has broader focus and benefits. • Integrate IDDE program efforts into more comprehensive watershed assessment and restoration efforts where multiple objectives are being pursued (e.g., storm water education). • Target and coordinate with existing small watershed organizations as partners to accomplish inventory and data collection efforts. • Establish hotline to report suspicious discharges.
Clustered IDP	• Conduct limited sampling in the suspect areas. The most cost-effective approach will likely involve using outside laboratory services to avoid capital costs for special equipment (in some cases a municipal laboratory may be available for limited cost). • Select a small set of indicator parameters using the nature of historic problems and land use as a guide. • Target education program in problem areas. • Look for partnerships with local watershed groups to regularly monitor problem areas. • Establish a hotline to report suspicious discharges.
Severe IDP	• Establish a hotline to report suspicious discharges. • Conduct and repeat screening in all subwatersheds • Plan for more rigorous sampling approach to make establishment of internal laboratory set up more cost effective (i.e., plan for equipment expenditures for sample collection and analysis). Considerations include: expanding set of parameters to use as indicators, adopting a strategy for targeting intermittent discharges, and establishing in-stream stations to supplement screening effort. • Develop a community-specific chemical “fingerprint” of various flow sources to facilitate differentiation between likely flow sources. • Develop community-wide educational messages aimed at increasing public awareness and targeted education programs tailored to problem areas. • Look for partnerships with local watershed groups to be regular monitors of problem areas through an adopt-a-stream approach. • Emphasize cross-training of municipal employees to develop a broader reach of program efforts and lead by example by ensuring municipal facilities are not contributing to illicit discharge problem.

Table 19: Customizing Strategies for Unique Subwatershed Screening Factors		
Initial Problem Assessment	**Screening Factor** (from Table 14)	**Example Implementation Strategies**
Aging Sewer Infrastructure and/or Converted Combined System	• Complaints of sewage discharges • Poor dry weather quality • High outfall density • Septic to sewer conversion • Historic combined system • Aging sewers	• Institute a point of sale inspection and verification process. • Select a small set of indicator parameters that focuses on sewage connections. • Develop cost share program to assist property owners with connection correction.
Aging Septic Infrastructure and/or Converted Combined System	• Aging septic systems	• Develop targeted education program for septic system maintenance and institute a point of sale inspection and verification process. • Develop cost share capabilities to assist property owners with upgrade of system.
Discharges from Generating Sites	• Density of generating sites • Older industry • Past complaints and reports	• Link IDDE program to existing industrial NPDES discharge permits, and inspect storm water management pollution prevention plans. • Develop targeted training and technical assistance programs tailored to specific generating sites. • Aggressively enforce fines and other measures on chronic violators.
High Spill or Dumping Potential	• Past complaints and reports	• Establish a hotline and develop community-wide educational messages aimed at increasing public awareness. • Look for partnerships with local watershed groups to regularly monitor or adopt problem sites. • Increase number and frequency of used oil and hazardous waste recycling stations. • Post signs, with hotline reporting number at dumping sites.



Chapter 7: Searching for Illicit Discharge Problems in the Field

Purpose: This program component consists of detective work, and involves rapid field screening of outfalls in priority subwatersheds followed by indicator monitoring at suspect outfalls to characterize flow types and trace sources.

Method(s): The primary field screening tool is the Outfall Reconnaissance Inventory (ORI), which is used to find illicit discharge problems and develop a systematic outfall inventory and map of the MS4. The ORI is frequently supplemented with more intensive indicator monitoring methods to test suspect outfalls. A wide range of monitoring methods can be used; this chapter describes a framework for choosing the safest, most accurate and repeatable methods for a community.

Desired Product or Outcome(s): The search for illicit discharge problems yields several important management products, including:

- An updated map of the locations of all outfalls within the MS4
- Incorporation of ORI data into the outfall inventory/tracking system
- Design and implementation of an indicator monitoring strategy to test suspect outfalls
- Creation of a local chemical "fingerprint" library of pollutant concentrations for various discharge flow types
- Data reports that evaluate the significance and distribution of illicit discharge problems in the community

Budget and/or Staff Resources Required: Field screening and indicator monitoring can consume substantial staff and budget resources. Monitoring costs are closely related to the number of outfalls screened and the complexity of illicit discharge problems discovered. An MS4 that screens 10 stream miles and analyzes 80 indicator samples each year can expect to spend about $15,000 to $35,000. Consequently, choosing which indicator(s) to use in a community (and when and where to use them) ranks as one of the most important budget decisions for any project manager.

Integration with Other Programs: Program managers should explore two strategies to integrate field screening and indicator monitoring with other programs to achieve cost savings. The first strategy links outfall screening to broader stream corridor assessments that support local watershed restoration efforts. Often, watershed organizations and "stream waders" can be enlisted and trained to conduct outfall screening. The second strategy is to find a local agency partner to conduct laboratory analysis (such as a drinking water or wastewater treatment plant).

7.1 Overview of Searching for Illicit Discharge Problems in the Field

This chapter provides basic information about the field and laboratory strategies needed to detect illicit discharges, beginning with a field screening technique designed to gather basic information and identify highly suspect outfalls or obvious discharges. Next, it provides a basic framework for using the data from this screening to address obvious discharges, develop a chemical monitoring program, and make future program decisions. Finally, it summarizes the basic options for conducting an ongoing chemical monitoring program. The approaches outlined here are only summarized briefly, and primarily in the context of overall program management. Much more detailed and "hands-on" information is provided in Chapters 11 and 12 that provide specific methods and technical guidance for field crew and laboratory staff.

7.2 The Outfall Reconnaissance Inventory (ORI)

The field screening technique recommended for an IDDE program is the Outfall Reconnaissance Inventory or ORI. The ORI is a stream walk designed to inventory and measure storm drain outfalls, and find and correct continuous and intermittent discharges without in-depth laboratory analysis (Figure 10). The ORI should be completed for every stream mile or open channel within the community during the first permit cycle, starting with priority subwatersheds identified in the desktop analysis. Outfall screening requires relatively little expertise, and can be incorporated into other stream assessments such as the Unified Stream Assessment (Kitchell and Schueler, 2004).

The ORI can discover obvious discharges that are indicated by flowing outfalls with very high turbidity, strong odors and colors, or an "off the chart" value on a simple field test strip. When obvious discharges are found, field crews should immediately track down and remove the source (see Chapters 8 and 13). In other instances, ORI crews may encounter a transitory discharge, such as a liquid or oil spill that should be immediately referred to the appropriate agency for cleanup (Figure 11).



Figure 10: Measuring an outfall as part of the ORI



Figure 11: Some discharges are immediately obvious

The ORI is not meant to be a "one size fits all" method, and should be adapted to suit the unique needs of each community. Program managers should also modify the ORI over time to reflect field observations, crew experience, new or modified indicators, and any other innovations that make fieldwork easier or faster. Table 20 summarizes the four basic steps to conduct an ORI, and more detail on ORI protocols is provided in Chapter 11.

7.3 Interpreting ORI Data

Once the first few ORI surveys are conducted, data can be analyzed to confirm and update the desktop analysis originally used for targeting subwatersheds. The ORI data analysis follows four basic steps, which are described in Table 21. Ideally, ORI data should be stored within a continuously-updated geospatial tracking system.

Table 20: Field Screening for an IDDE Program

Step	Strategies
Step 1. Acquire necessary mapping, equipment and staff	• Use basic street maps or detailed maps from initial assessment • Minimal field equipment required; use a portable spectrophotometer if desired • Two staff per crew with basic field training required; more specialized staff or training is optional
Step 2. Determine when to conduct field screening	• During dry season and leaf off conditions • After a dry period of at least 48 hours • Low groundwater levels
Step 3. Identify where to conduct field screening (based on desktop assessment)	• Minimal: integrate field screening with broader watershed or stream assessments • Clustered: screen drainage areas ranking High and Medium first for illicit discharge potential • Severe: screen all outfalls systematically
Step 4. Conduct field screening	• Mark and photograph all outfalls • Record outfall characteristics • Simple monitoring at flowing outfalls • Take flow sample at outfalls with likely problems • Deal with major problems immediately

Table 21: Field Data Analysis for an IDDE Program	
Step	**Considerations**
Step 1. Compile data from the ORI	• Compile GPS data and photographs of outfall locations • Enter ORI data into database • Send any samples for lab analysis
Step 2. Develop ORI designation for outfalls	• Use ORI data to designate outfalls as having obvious, suspect, potential, or unlikely discharge potential
Step 3. Characterize the extent of illicit discharge problems	• Use data from initial assessment • Use outfall designation data • Update initial assessment of illicit discharge problems as minimal, clustered, severe
Step 4. Develop a monitoring strategy	• At a minimum, sample 10% of flowing outfalls per year • Repeat field screening in second permit cycle • Use various monitoring methods depending on outfall designation and subwatershed characteristics

7.4 Design and Implementation of an Indicator Monitoring Strategy

The next step is to design an indicator monitoring program to test suspect or problem outfalls to confirm whether they are actually an illicit discharge, and determine the type of flow. From a program management standpoint, six core issues need to be considered during the design of the monitoring strategy, as shown in Table 22.

The indicator monitoring strategy should be concentrated primarily on continuous and intermittent discharges, and can be adapted to isolate the specific flow type found in a discharge. Figure 12 presents an overall monitoring design framework that organizes some of the key indicators and monitoring techniques that may be needed. In general, different indicators and monitoring methods are used depending on whether flow is present at an outfall or not. The details of the discharge monitoring framework are described in Chapter 12. The basic framework should be adapted to reflect the unique discharge problems and analytical capabilities of individual communities.

Some of the recommended monitoring strategies are discussed below. The preferred method to test flowing outfalls is the **flow chart method** that uses a small set of indicator parameters to determine whether a discharge is clean or dirty, and predicts its or flow type (Pitt, 2004). The flow chart method is particularly suited to distinguish sewage and washwater flow types. Industrial sites may require special testing, and the **benchmark concentrations method** includes several supplemental indicators to distinguish industrial sources.

Table 22: Indicator Monitoring Considerations
• Use ORI data to prioritize problem outfalls or drainage areas • Select the type of indicators needed for your discharge problems • Decide whether to use in-house or contract lab analytical services • Consider the techniques to detect intermittent discharges • Develop a chemical library of concentrations for various flow types • Estimate staff time, and costs for equipment and disposable supplies

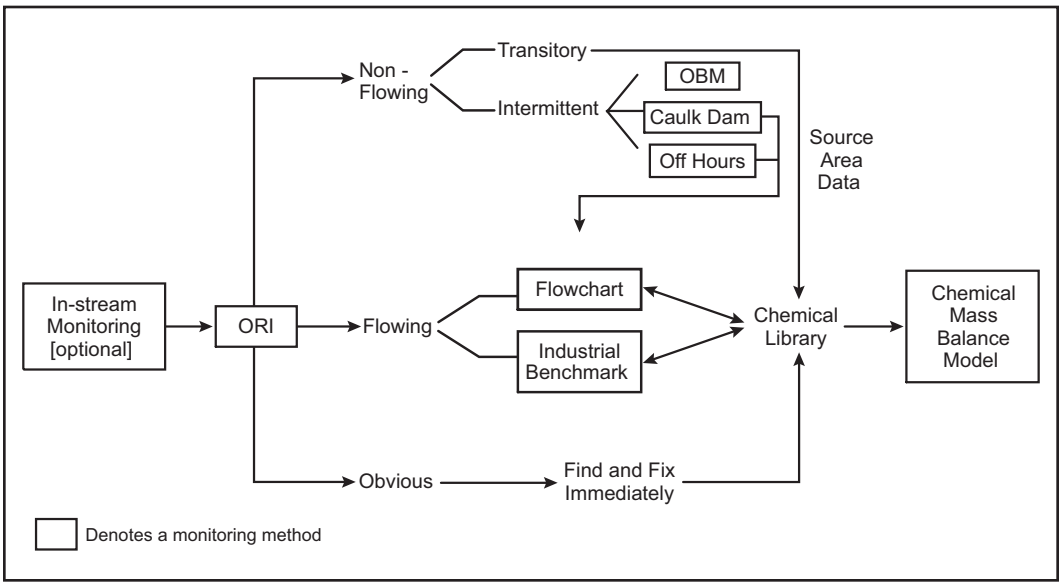


Figure 12: IDDE Monitoring Framework

Non-flowing outfalls are more challenging to diagnose. Intermittent flows can be diagnosed using specialized monitoring techniques such as:

- Off hours monitoring
- Caulk dams
- Optical brightener monitoring traps

When intermittent discharges are captured by these specialized techniques, samples are normally diagnosed using the flow chart method.

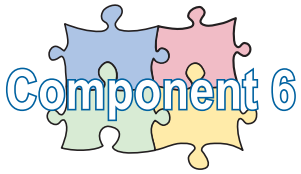
Transitory discharges are extremely difficult to detect with routine indicator monitoring, and are frequently identified from hotline reports. Transitory discharges are usually diagnosed by inspection, although water quality samples may be collected to support enforcement measures.

As communities acquire more monitoring data, they should consider creating a **chemical "fingerprint" library**, which is a database of the chemical make-up of the many different flow types in the community. Chemical libraries should include sewage, septage, washwater, and common industrial flows. Default values for the chemical library can initially be established based on existing research and literature values. Data are then updated based on local monitoring to develop more accurate decision points in the flow chart or benchmark methods. Clean water sources such as tap water, groundwater, spring water, and irrigation water are also important entries in the chemical library. The chemical library should also characterize the water quality of known or unknown transitory discharges sampled in the field. Over time, chemical library data should help a community better understand the potential pollutant loads delivered to receiving waters from various generating activities.

These library data can be used to support more advanced strategies such as the **Chemical Mass Balance Model** (CMBM) method. This method, developed by the University of Alabama as part of this project (Karri, 2004), is particularly useful in identifying flow types in blended discharges, where groundwater or tap water is diluted or commingled with sewage and other illicit discharges. The CMBM requires substantial upfront work to develop an accurate chemical library for local flow types. Specifically, the library requires 10-12 samples for each flow type (for industrial flow types, samples can be obtained in association with NPDES pre-treatment programs). A user's guide for the CMBM can be found in Appendix I.

Section 7.5 Field and Lab Safety Considerations

Program managers should take into account and fully plan for all necessary field and laboratory safety precautions. Most communities already have well established standard operating procedures they follow when conducting field and lab work, and these typically provide an excellent starting point for IDDE programs. Chapters 11, 12, and 13 along with Appendices F and G provide guidance on specific considerations associated with IDDE programs. Of particular note is that program managers may want to consider requiring/recommending field crews be vaccinated against Hepatitis B, particularly if the crews will be accessing waters known to be contaminated with illicit sewage discharges. Program managers should contact local health department officials to explore this issue in more detail prior to making a decision.



Chapter 8: Isolating and Fixing Individual Illicit Discharges

Purpose: This program component uses a variety of tools to trace illicit discharge problems back up the pipe to isolate the specific source or improper connection that generates the discharge. This often requires improved local capacity to locate specific discharges, make needed corrections and maintain an enforcement program to ensure repairs.

Method(s): Five basic tools exist to isolate and fix individual discharges, including:

- Pollution reporting hotline
- Drainage area investigations
- Trunk investigations
- On-site discharge investigations
- Correction and enforcement

Desired Product or Outcome(s): Finding and fixing illicit discharges is the core goal of any IDDE program. The process of finding and fixing discharges has several desirable outcomes, such as:

- Improved water quality
- Increased homeowner and business awareness about pollution prevention
- Maintenance of a tracking system to document repairs and identify repeat offenders.

Budget and/or Staff Resources Required: Budget and staff resources needed to find illicit discharges vary greatly. Some discharge sources will be immediately obvious, while others will require extensive investigations up the pipe until the source can be sufficiently narrowed. Fixing the problem once it is identified is more predictable and can often involve qualified contractors. Costs associated with repairs can also be fully incurred by the offending party or shared, depending on the nature and extent of the illicit discharge.

Integration with Other Programs: Two important aspects of this program component can be integrated with other NPDES minimum management measures and storm water permitting. First, the pollution hotline can be an important element of any local storm water education initiative. Second, on-site illicit discharge investigations should be closely coordinated with industrial NPDES storm water site inspections.

8.1 Overview of Isolating and Fixing Individual Illicit Discharges

The ultimate goal of every IDDE program is to find and fix illicit discharges, and a range of tools are available to meet this objective. The ensuing chapter discusses each of the tools in more detail. The choice of which tools are used depends on the nature of the local storm drain system, and the type and mode of entry of the discharges.

8.2 Isolating Illicit Discharges

Outfall screening and monitoring are excellent for finding illicit discharge problems, but they often cannot detect most intermittent or transient flows, nor can they always isolate the exact source, particularly when the outfall has a large contributing area and an extensive pipe network. This section provides guidance on four tools to find individual illicit discharges. The first tool is a pollution complaint hotline, which is particularly effective at finding obvious illicit discharges, such as transitory flows from generating sites and sewer overflows. Citizens provide free surveillance around the clock, and their reports should prompt rapid investigations and enforcement. The other three investigative tools involve drainage area, trunk, and on-site investigations.

Pollution Complaint Hotline

A complaint hotline is a dedicated phone number or website where citizens can easily report illicit discharge and pollution concerns. The hotline should always be supported by prompt investigations of each complaint by trained inspectors, usually within 24 hours. Many Phase I communities have utilized hotlines to track down intermittent and transitory discharges, and regard them as one of their most effective tools to isolate illicit discharges (CWP, 2002). Some of the benefits and challenges Phase I communities have encountered in administering an IDDE complaint hotline in summarized in Table 23.

Six basic steps are needed to establish and maintain a successful IDDE complaint hotline, which are outlined in Table 24. More detailed guidance on establishing a hotline is provided in Appendix C, along with a sample illicit discharge incident tracking form.

It is important to keep in mind that a successful hotline requires considerable advertising and outreach to keep the phone number fresh in the public's mind. Also, program managers should continuously monitor response times, inspection outcomes, and any enforcement taken. All complaints should be entered into the IDDE tracking system so that complaints can be analyzed.

The cost to establish and maintain a hotline varies, but savings can be realized if it can

Table 23: Benefits and Challenges of a Complaint Hotline

Benefits	Challenges
• Leads to early detection and correction of illicit discharges • Encourages active public stewardship • Can "piggyback" on other call response needs • Identifies suspected facilities for further investigation and education • Increases facilities' and municipalities' sense of accountability • Increases likelihood of discovering intermittent discharges	• Time and money to provide 24/7 service • Marketing the hotline number • Establishing inter- and intra-departmental process

Table 24: Steps to Creating and Maintaining Successful IDDE Hotline	
Steps	**Key Elements**
1. Define the scope	• Determine if a hotline is needed • Define the intent of the hotline • Define the extent of the hotline
2. Create a tracking and reporting system	• Design reporting method • Design response method
3. Train personnel	• The basics and importance of IDDE • The complaint hotline reporting, investigation and tracking process • How to provide good customer service • Expected responsibilities of each department/agency
4. Advertise	• Advertise hotline frequently through flyers, magnets, newspapers, displays, etc. • Publicize success stories
5. Respond to complaints	• Provide friendly, knowledgeable customer service • Send an investigator to respond to complaints in a timely manner • Submit incident reports to the hotline database system
6. Track incidents	• Identify recurring problems and suspected offenders • Measure program success • Comply with annual report requirements

be piggy-backed on an existing community hotline or cost shared with other communities in the region. Also, hotline costs are related to the volume of calls and the staff effort needed for follow-up investigations. A budgeting framework for establish and maintaining a hotline from scratch is provided in Table 25.

Illicit Discharge Investigations

Once an illicit discharge is detected at an outfall or stream, one of four types of illicit discharge investigations is triggered to track down the individual source. These investigations are often time consuming and expensive, require special training and staff expertise, and may result in legal action. They include:

- Storm drain network investigations
- Drainage area investigations
- On-site investigations
- Septic system investigations

Each type of investigation handles a different type of discharge problem and has its advantages and disadvantages. More detail on these investigations is provided in Chapter 13.

Storm drain network investigations

Storm drain or "trunk" investigations narrow the source of a discharge

Table 25: IDDE Complaint Hotline Costs		
Steps	**Initial Cost**	**Annual Costs**
Define the scope	$1,500	$0
Create a tracking and reporting system	$2,500	$2,440
Train personnel	$2,200	$1,000
Advertise	$1,500	$2,920
Respond to complaints	$0	$5,000
Track incidents		
TOTAL	**$7,700**	**$11,360**

problem to a single segment of a storm sewer. The investigation starts at the outfall, and the field crew must decide how it will explore the upstream pipe network. The three options include:

- Work progressively up the trunk from the outfall and test manholes along the way
- Split the trunk into equal segments and test manholes at strategic points of the storm drain system
- Work progressively down the trunk (i.e., from the headwaters of the storm drain network and move downstream)

The decision to move up, split, or move down the trunk depends on the nature of the drainage system and the surrounding land use. The three options also require different levels of advance preparation. Moving up the trunk can begin immediately when an illicit discharge is detected at an outfall, and only a map of the storm drain system is required. Splitting the trunk requires a little more preparation to examine the storm drain system and find the most strategic manholes to sample. Moving down the trunk requires even more advance preparation, since the most upstream segments of the storm drain network may be poorly understood.

Once crews choose one of these options, they need to select the most appropriate investigative methods to track down the source. Common methods include:

- Visual inspection at manholes
- Sandbagging or damming the trunk
- Dye testing
- Smoke testing
- Video testing

Drainage area investigations

Drainage area investigations are initially conducted in the office, but quickly move into the field. They involve a parcel by parcel analysis of potential generating sites within the drainage area of a problem outfall. They are most appropriate when the drainage area to the outfall is large or complex, and when the flow type in the discharge appears to be specific to a certain type of land use or generating site. These investigations may include the following techniques:

- Land use investigations
- SIC code review (see Appendix A)
- Permit review
- As-built review
- Aerial photography analysis
- Infrared aerial photography analysis
- Property ownership certification

On-site investigations

Once the illicit discharge has been isolated to a specific section of storm drain, an on-site investigation can be performed to find the specific source of the discharge. In some situations, such as subwatersheds dominated by industrial land uses or many generating sites, on-site investigations may be immediately pursued.

On-site investigations are typically performed by dye testing the plumbing systems of households and buildings. Where septic systems are prevalent, inspections of tanks and drain fields may be needed.

On-site investigations are excellent opportunities to combine IDDE efforts with industrial site inspections that target review and verification of proper Storm Water

Pollution Prevention Plans. Appendix A provides a list of industrial activities that typically require industrial NPDES discharge permits.

Septic system investigations

Communities with areas of on-site sewage disposal systems (i.e., septic systems) need to consider alternative investigatory methods to track illicit discharges that enter streams as indirect discharges, through surface breakouts of septic fields, or through straight pipe discharges from bypassed septic systems. Techniques can involve on-site investigations or imagery analysis (e.g., infrared aerials).

8.3 Fixing Illicit Discharges

Once the source of an illicit discharge has been identified, steps should be taken to fix or eliminate the discharge. Four questions should be answered for each individual illicit discharge to determine how to proceed; the answers will usually vary depending on the source of the discharge.

- Who is responsible?
- What methods will be used to repair?
- How long will the repair take?
- How will removal be confirmed?

Financial responsibility for source removal will typically fall on property owners, MS4 operators, or a combination of the two. Methods for removing illicit discharges usually involve a combination of education and enforcement. A process for addressing illicit discharges that focuses on identifying the responsible party and enforcement procedures is presented in Figure 13, while Table 26 presents various options for removing illicit discharges from various sources. Additional information on common removal actions and associated costs can be found in Chapter 14.

Program managers should use judgment in exercising the right mix of compliance assistance and enforcement. The authority and responsibility for correction and enforcement should be clearly defined in the local IDDE ordinance developed earlier in the program. An escalating enforcement approach is often warranted and is usually a reasonable process to follow. Voluntary compliance should be used for first-time, minor offenders. Often, property owners are not even aware of a problem, and are willing to fix it when educated. More serious violations or continued non-compliance may warrant a more aggressive, enforcement-oriented approach.

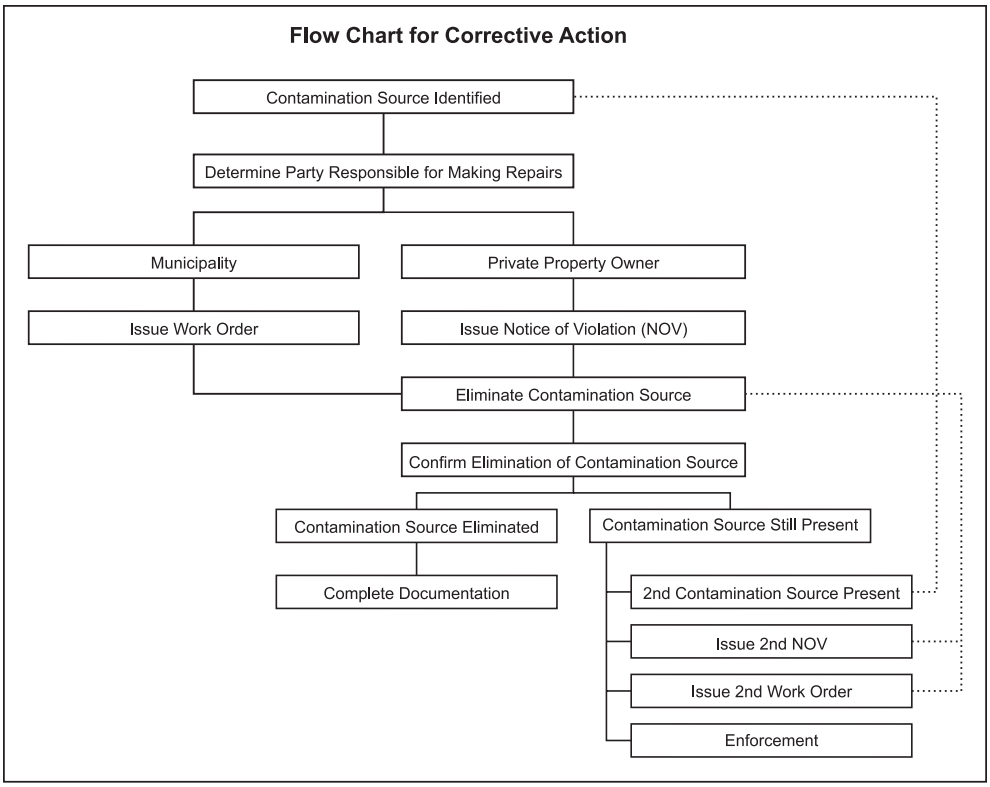
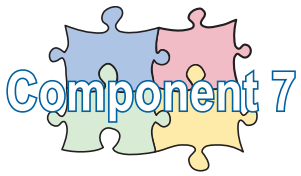


Figure 13: Process for Removing or Correcting an Illicit Discharge

Table 26: Methods to Fix Illicit Discharges

Type of Discharge	Source	Removal Action(s)
Sewage	Break in right-of-way	Repair by municipality
	Commercial or industrial direct connection	Enforcement
	Residential direct connection	Enforcement; Incentive or aid
	Infrequent discharge (e.g., RV dumping)	Enforcement; Spill response
	Straight pipes/septic	Enforcement; Incentive or aid
Wash water	Commercial or industrial direct connection	Enforcement; Incentive or aid
	Residential direct connection	Enforcement; Incentive or aid
	Power wash/car wash (commercial)	Enforcement
	Commercial wash down	Enforcement
	Residential car wash or household maintenance-related activities	Education
Liquid wastes	Professional oil change/car maintenance	Enforcement; Spill response
	Heating oil/solvent dumping	Enforcement; Spill response
	Homeowner oil change and other liquid waste disposal (e.g., paint)	Warning; Education; Fines
	Spill (trucking)	Spill response
	Other industrial wastes	Enforcement; Spill response



Chapter 9: Preventing Illicit Discharges

Purpose: This program component identifies key behaviors of neighborhoods, generating sites, and municipal operations that produce intermittent and transitory discharges. These key "discharge behaviors" are then targeted for improved pollution prevention practices that can prevent or reduce the risk of discharge. Communities then apply a wide range of education and enforcement tools to promote the desired pollution prevention practices.

Method(s): The Unified Subwatershed and Site Reconnaissance (USSR; Wright *et al.*, 2004) and the desktop analysis of potential generating sites (Chapter 5) are two methods used to identify the major behaviors that generate intermittent and transitory discharges. These methods, used alone or in combination, are extremely helpful to identify the specific discharge behaviors and generating sites that will be targeted for education and enforcement efforts. A Source Control Plan is then performed to select the right pollution prevention message, choose the appropriate combination of carrots and sticks to change behaviors, and develop a budget and delivery system to implement the prevention program. Refer to Schueler *et al.* (2004) for information on developing a Source Control Plan and the many carrots and sticks available to communities.

Desired Product or Outcome(s): The desired outcome is a mix of local prevention programs that target the most common intermittent and transitory discharges in the community. Program managers need to develop targeted pollution prevention programs for three sectors of the community:

- *Neighborhood Discharges.* The pollution prevention practices related to discharge prevention in residential neighborhoods include storm drain stenciling, lawn care, septic system maintenance, vehicle fluid changing, car washing, household hazardous waste disposal and swimming pool draining.
- *Generating Sites.* This group of pollution prevention practices can reduce spills and transitory discharges generated during common business operations. Practices include business outreach, spill prevention and response plans, employee training and site inspections.
- *Municipal Housekeeping.* This group of pollution prevention practices is performed during municipal operations, such as sewer and storm drain maintenance, plumbing code revision, and provision of household hazardous waste and used oil collection services.

Budget and/or Staff Resources Required: The budget and staff resources needed for prevention programs can be considerable, and should be coordinated with other storm water education, public involvement and municipal housekeeping initiatives required under NPDES Phase II MS4 permits. Special emphasis should be placed on cross-training staff, partnering with local watershed groups, and pooling educational resources with other communities.

Integration with Other Programs: Illicit discharge prevention is linked to three of the

six NPDES Phase II minimum management measures, and should be closely integrated with local watershed restoration efforts.

9.1 Overview of Preventing Illicit Discharges

Intermittent and transitory discharges are difficult to detect through outfall screening or indicator monitoring. Indeed, the best way to manage these discharges is to promote pollution prevention practices in the community that prevent them from occurring. Effective IDDE programs develop education and outreach materials targeted toward neighborhoods, generating sites, and municipal operations. The discharge prevention message is normally integrated with other storm water education programs required under MS4 NPDES Phase II permits such as

- Public education and outreach
- Public participation/involvement
- Municipal pollution prevention/good housekeeping

9.2 Methods to Identify Opportunities for Illicit Discharge Prevention

The USSR and the desktop analysis of potential generating sites both help identify the major behaviors that generate intermittent and transitory discharges. These assessment methods are briefly described below:

The Unified Subwatershed and Site Reconnaissance (USSR)

The USSR is a field survey that rapidly evaluates potential pollution sources and restoration potential in urban subwatersheds. The survey quickly characterizes upland areas in order to inventory problem sites that may contribute pollutants and identifies pollution source controls and other restoration projects. For more information on how to conduct the USSR, consult Wright *et al.* (2004). The USSR has four major assessment components, three of which directly relate to illicit discharge prevention:

- *Neighborhood Source Assessment (NSA)*, which helps discover residential pollution source areas and potential restoration opportunities within the many neighborhoods found in urban subwatersheds
- *Hotspot Site Investigation (HSI)*, which ranks the potential severity of each commercial, industrial, institutional, municipal or transport-related hotspot site found within a subwatershed
- *Analysis of Streets and Storm Drains (SSD)*, which measures the average pollutant accumulation in the streets, curbs, and catch basins of a subwatershed

Desktop Analysis of Generating Sites

The desktop analysis method screens local business and permit databases to identify specific commercial, industrial, institutional, municipal, and transport-related sites that are known to have a higher risk of producing illicit discharges. Chapter 5 and Appendix A provide discussions of this analysis.

9.3 Preventing Illicit Discharges from Neighborhoods

Many common neighborhood behaviors can cause transitory discharges that are seldom defined or regulated as illicit discharges by most communities. Individually, these behaviors cause relatively small discharges, but collectively, they can produce significant

pollutant loads. Most communities use outreach and education to promote pollution prevention practices, and some of the more effective practices to influence these behaviors are described in this section:

- Storm drain stenciling
- Septic system maintenance
- Vehicle fluid changing
- Car washing
- Household hazardous waste storage and disposal
- Swimming pool draining

Storm Drain Stenciling

Storm drain stenciling sends a clear message to keep trash and debris, leaf litter, and pollutants out of the storm drain system, and may deter illegal dumping and discharges (Figure 14). Stenciling may increase watershed awareness and neighborhood stewardship and can be used in any neighborhood with enclosed storm drains.

Stenciling is an excellent way to involve the public, and just a few trained volunteers can systematically stencil all the storm drains within a neighborhood in a short time. Volunteers can be recruited from scouting, community service, and watershed organizations, or from high schools and neighborhood associations. Program managers should designate a staff person to coordinate storm drain stenciling and be responsible for recruiting, training, managing, and supplying volunteers.



Figure 14: Storm drain stenciling may help reduce illicit discharges.

Storm drain stenciling programs are relatively inexpensive. Most communities use stencils, although some are now using permanent markers made of tile, clay, or metal. Stencils cost about 45 cents per linear inch and can be used for 25 to 500 drains, depending on whether paint is sprayed or applied with a brush or roller. Permanent signs are generally more costly; ceramic tiles cost $5 to $6 each and metal stencils can cost $100 or more. More guidance on designing a stenciling program can be found in Schueler *et al.* (2004).

Septic System Maintenance

Failing septic systems can be a major source of bacteria, nitrogen, and phosphorus, depending on the overall density of systems present in a subwatershed (Swann, 2001). Failure results in illicit surface or subsurface discharges to streams. According to U.S. EPA (2002), more than half of all existing septic systems are more than 30 years old, which is well past their design life. The same study estimates that about 10% of all septic systems are not functioning properly at any given time, with even higher failure rates in some regions and soil conditions.

Septic systems are a classic case of out of sight and out of mind. Many owners take their septic systems for granted, until they back up or break out on the surface of their lawn. Subsurface failures, which are the most common, go unnoticed. In addition, inspections, pump outs, and repairs can be costly, so many homeowners tend to put off the expense until there is a real problem. Lastly, many septic system owners are not

CASE STUDY

In 1997, Madison County, NC implemented a project to address straight piping problems. In 1999, a survey identified 205 households with black water straight-piping (toilet waste), 243 households with gray water straight-piping (sink, shower, washer waste), and 104 households with failing septic systems. The project facilitated more than 10 community meetings, and issued more than 20 educational articles on straight-piping and water quality in the local papers. In addition, the project leveraged $903,000 from the N.C. Clean Water Management Trust Fund to establish a Revolving Loan and Grant Program for low and moderate income county residents that need assistance installing a septic system or repairing a failing one. (Land of Sky Regional Council website, 2002).

aware of the link between septic systems and water quality. Communities can employ a range of tools to improve septic system maintenance. These include:

- Media campaigns and conventional outreach materials to increase awareness about septic system maintenance and water quality (e.g., billboards, radio, newspapers, brochures, bill inserts, and newsletters)
- Discount coupons for septic system maintenance
- Low interest loans for septic system repairs
- Mandatory inspections
- Performance certification upon property transfer
- Creation of septic management districts
- Certification and training of operation/ maintenance professionals
- Termination of public services for failing systems

Vehicle Fluid Changing

Dumping of automotive fluids into storm drains can cause major water quality problems, since only a few quarts of oil or a few gallons of antifreeze can severely degrade a small stream. Dumping delivers hydrocarbons, oil and grease, metals, xylene and other pollutants to streams, which can be toxic during dry-weather conditions when existing flow cannot dilute these discharges. The major culprit has been the backyard mechanic who changes his or her own automotive fluids (Figure 15). Communities have a range of tools to prevent illegal dumping of car fluids, including:

- Outreach materials distributed at auto parts store and service stations
- Community oil recycling centers
- Directories of used oil collection stations
- Free or discounted oil disposal containers
- Pollution hotlines
- Fines and other enforcement actions



Figure 15: Home mechanic changing his automotive fluids

Car Washing

Car washing is a common neighborhood behavior that can produce transitory discharges of sediment, nutrients and other pollutants to the curb, and ultimately the storm drain. Communities have utilized many innovative outreach tools to promote environmentally safe car washing, including:

- Media campaigns
- Brochures promoting nozzles with shut off valves
- Storm drain plug and wet vac provisions for charity car wash events
- Water bill inserts promoting environmentally safe car washing products
- Discounted tickets for use at commercial car washes

Household Hazardous Waste Storage and Disposal

The average garage contains a lot of products that are classified as hazardous wastes, including paints, stains, solvents, used motor oil, pesticides and cleaning products. While some household hazardous waste (HHW) may be dumped into storm drains, most enters the storm drain system as a result of outdoor rinsing and cleanup. Improper disposal of HHW can result in acute toxicity to downstream aquatic life. The desired neighborhood behavior is to participate in HHW collection days, and to use appropriate pollution prevention techniques when conducting rinsing, cleaning and fueling operations (Figure 16).

Convenience and awareness appear to be the critical factors in getting residents to participate in household hazardous waste collection programs. Participation depends on the number of days each year collection events are held and is inversely related to both the distance homeowners must travel to recycle waste and the restrictions on what is accepted. Communities have used a variety of techniques to promote and expand HHW collection, including:



Figure 16: Household hazardous wastes should be properly contained to avoid indirect discharges

- Mass media campaigns to educate residents about proper outdoor cleaning/ rinsing techniques
- Conventional outreach materials notifying residents about HHW and collection days
- More frequent HHW collection days
- Providing curbside disposal options for some HHW
- Establishing permanent collection facilities at solid waste facilities
- Providing mobile HHW pickup
- Waiving disposal fees at landfills

Swimming Pool Draining

Routine and end-of-season maintenance tasks for aboveground or in-ground pools can cause the discharge of chlorinated water or filter back flush water into the storm drain

system or the stream (Figure 17). The ideal practice is to discharge chlorinated pool water into the sanitary sewer system, or hold it until chlorine and temperature levels are acceptable to permit spreading it over a suitable pervious surface.

Most pool owners understand that regular maintenance is essential to keep pools safe and clean, and they may be more receptive to changing discharge behaviors with proper education. Effective outreach methods include:

- Conventional outreach techniques on proper discharge (pamphlets, water bill inserts, posters)
- Educational kiosks at the retail outlets selling pool chemicals
- Changes in local plumbing codes to require discharge to sanitary sewer systems
- Local ordinances that allow for fines/ enforcement for unsafe pool discharges



Figure 17: Swimming pools can be a source of illicit discharges.

9.4 Preventing Illicit Discharges from Generating Sites

Many indirect discharges can be identified and prevented using the concept of generating sites, which are a small subset of commercial, industrial, institutional, municipal and transport-related operations that have the greatest risk of generating indirect discharges. Program managers should become intimately familiar with the types of generating sites found in their community, particularly those regulated by industrial NPDES storm water permits. Some of the more common operations that generate spills and transitory discharges are profiled in Table 27.

Most communities consider nearly all non-storm water discharges from generating sites to be illicit, and take a more regulatory approach. Consequently, pollution prevention practices are more prescriptive, and are frequently incorporated into a pollution prevention plan for a facility or operation. Like anyone else, businesses respond better to carrots than sticks, but often need both. Communities possess four broad tools to promote effective pollution prevention practices at generating sites:

- Business outreach and education
- Spill prevention and response planning
- Employee training
- Site inspections

Table 27: Common Discharges Produced at Generating Sites	
Generating Site	**Activity Generating the Discharge**
Vehicle Operations (Maintenance, Repair, Fueling, Washing, Storage)	• Improper disposal of fluids down shop and storm drains • Spilled fuel, leaks and drips from wrecked vehicles • Hosing of outdoor work areas • Wash water from cleaning • Spills
Outdoor Materials (Loading/unloading, Outdoor storage)	• Liquid spills at loading areas • Hosing/washing of loading areas into shop or storm drains • Leaks and spills of liquids stored outside
Waste Management (Spill prevention and response, Dumpster management)	• Spills and leaks of liquids • Dumping into storm drains • Leaking dumpsters
Physical Plant Maintenance (Building Repair, Remodeling and maintenance, Parking lot maintenance)	• Discharges from power washing and steam cleaning • Rinse water and wash water discharges during cleanup • Runoff from degreasing and re-surfacing
Turf and Landscaping (Turf Management Landscaping/Grounds care)	• Non-target irrigation • Improper rinsing of fertilizer/pesticide applicators
Unique Hotspot Operations (Pools, Golf Courses, Marinas, Construction, Restaurants, Hobby farms)	• Discharge of chlorinated water from pools • Dumping of sewage and grease

Business Outreach and Education

Targeted distribution of educational materials to specific business sectors in the subwatershed is the most common method of promoting pollution prevention. Outreach materials are designed to educate owners and employees about polluting behaviors, recommend appropriate pollution prevention practices, and notify them of any local or state regulations. Useful outreach materials include brochures, training manuals, posters, directories of pollution prevention vendors, and signs. Passive business outreach works best when it is specially adapted and targeted to a specific business sector (e.g., vehicle repair, landscaping, restaurants) and is routinely and directly presented to local business groups and trade associations. Business outreach materials require employees to read or hear them, and then take active steps to change their behavior.

Communities can also provide direct technical assistance to develop a customized pollution prevention prescription for individual generating sites. In this case, local staff work closely with owners and operators to inspect the site and develop an effective pollution prevention plan. In other cases, pollution prevention workshops or model plans are offered to businesses and trade groups that represent specific groups of generating sites. In either case, the locality acts as a technical partner to provide ongoing consultation to individual businesses to support their pollution prevention efforts.

Spill Prevention and Response

A spill prevention and response plan is useful for any potential generating site, and is mandatory for any operation that uses, generates, produces, or transports hazardous materials, petroleum products or fertilizers. These operations are known as SARA 312 operators and are regulated by state environmental agencies. In addition, all industrial sites regulated by individual or group NPDES storm water permits must have an updated spill prevention and response plan on its premises. Spill containment and response plans should also be prepared for major highways that cross streams and other water bodies, since truck and tanker accidents often represent the greatest potential spill risk in most communities (Figure 18).

Spill prevention and response plans describe the operational procedures to reduce the risks of spills and accidental discharge and ensure that proper controls are in place in the event they do occur. Spill prevention plans standardize everyday procedures and rely on employee training to reduce potential liability, fines and costs associated with clean up. Planning begins with an analysis of how pollutants are handled at the site and how they interact with storm water. Spill prevention and response plans have five major components:

1. A site map and evaluation of past spills and leaks
2. An inventory of materials at the site
3. Identification of potential spill areas
4. A list of required spill response equipment
5. Employee training

When spills do occur, a good spill prevention and response plan will clearly:

- Identify potential spill sites and their drainage points
- Specify material handling procedures
- Describe spill response procedures
- Ensure that adequate spill clean-up equipment is available

Employee Training

Effective and repeated employee training is essential to maintain pollution prevention practices at generating sites. Indeed, continuous employee training is an essential component of any pollution prevention plan, particularly at generating sites where the work force turns over frequently. Many businesses perceive time devoted to pollution prevention training as reducing their bottom line, and may be hesitant to develop training materials or allocate time for training. In some cases, local agencies supply free or low cost videos, posters, shop signs, or training brochures (often in multilingual formats). In other cases, short training classes are offered for employees or supervisors that are scheduled for down times of the year (e.g., winter classes for landscaping companies or construction contractors) or coincide with regular employee safety meetings.



Figure 18: Spill response often involves portable booms and pumps

Program managers can refer to Schueler *et al.* (2004) for more guidance on developing effective pollution practices at generating sites and storm water hotspots. Employee training should be conducted at least annually to educate workers on the proper practices to avoid illicit discharges and respond to spills. Training can be reinforced with signs, and posters.

Site Inspections

Regular inspections of generating sites are a key tool to foster pollution prevention and reduce the risk of illicit discharges. Communities that possess an MS4 permit should ensure that they have the authority to inspect non-regulated sites that connect to the municipal storm drain system they operate. These inspections can be used to assess the site and educate owners/operators about recommended pollution prevention practices. Site inspections are staff intensive and therefore are best suited to high-risk generating sites.

An industrial NPDES storm water permit is an extremely important compliance tool at many generating sites. NPDES permits require operators to prepare a pollution prevention plan for the site and implement the practices specified in the plan. Significant penalties can be imposed for non-compliance.

To date, compliance with the industrial storm water permit program has been spotty, and a significant fraction of regulated industries has failed to file their required permits. According to Duke and Shaver (1999) and Pronold (2000), as many as 50% of industrial sites that are required to have a permit do not actually have one. These sites are termed "non-filers," and are often small businesses or operations that are unaware of the relatively new regulations. It is therefore quite likely that many hotspots in a subwatershed may not have a valid NPDES permit. These operations should be educated about the industrial permit program, and encouraged to apply for permit coverage. Non-filers should be referred to the NPDES permitting authority for details on how to obtain permit coverage.

Inspections are an important stick to improve compliance at generating sites subject to industrial NPDES permits. Inspectors should frequently observe site operations to ensure that the right mix of pollution prevention practices is routinely employed. Communities with MS4 permits have the authority to inspect storm water NPDES sites that discharge to their storm drain system, and refer any violations for subsequent state or federal enforcement.

Voluntary inspections of non-regulated generating sites are a good tool to educate owners/operators about recommended pollution prevention practices. When generating sites are inspected, existing fire, building or health inspectors should be considered since they are already acquainted with how to deal with small businesses.

9.5 Preventing Illicit Discharges from Municipal Operations

Many municipal operations and services have the potential to create or reduce illicit discharges. Program managers should review all municipal operations and services to make sure good housekeeping is practiced. In addition, program managers should examine:

- Routine sewer and storm drain maintenance
- Plumbing code revisions
- HHW collection services
- Used motor oil collection services

Routine Sewer And Storm Drain Maintenance

Failure to regularly inspect and maintain local sewer and storm water infrastructure can cause illicit discharges to receiving waters. Within the storm drain system, maintenance should focus on frequent cleaning to keep trash, debris and illegally dumped material from entering the storm drain system. In the sanitary sewer network, maintenance should focus on finding damaged infrastructure that allows sewage discharges from the sanitary sewer. In-stream monitoring, historical data reviews of past complaints, or aging sewer infrastructure can often be used to identify likely problem areas.[8]

Plumbing Code Revisions

Communities need to establish the legal authority to prohibit illicit connections to the storm drain system. When the illicit discharge ordinance is being prepared, communities should thoroughly review all of their plumbing codes to prevent any misinterpretation that might create cross connections to the storm drain system. Program managers should also specifically target licensed plumbers to educate them on any code changes.

Household Hazardous Waste Collection Services

Households generate a lot of hazardous wastes, and communities need to educate residents about proper household hazardous waster (HHW) handling and disposal, and provide convenient options for pick up and disposal. Communities have experimented with several innovative ways to deal with HHW including:

- A permanent facility that accepts HHW year-round and can serve as a central location for HHW exchange and recycling
- Mobile collection at temporary facilities. On designated special collection days, mobile units can move through communities accepting HHW and take the form of curbside pickup or central collection locations
- Some local businesses may act as drop off centers for certain products. Some local garages, for example, may accept used motor oil for recycling

Overall, the costs for implementing HHW collection programs can be high. Factors such as frequency of the collection, size of community, environmental awareness, level of staff training, and level of outreach all contribute to the overall cost. Participation in collection programs usually ranges from 1% to 5% of the population (HGAC, 2001), and the cost per participant can vary greatly (Table 28).

Used Motor Oil Collection Services

Used motor oil collection has been a common municipal service for many years, however, program managers may need to refine their programs to increase participation. Suggested outreach approaches include:

- Conventional outreach materials provided at points of sale (e.g., auto parts stores, service stations)
- Multilingual outreach materials
- Directories of used oil collection stations
- Free or discounted oil disposal containers

[8] Preliminary sewer system investigations are not discussed further in this manual. For more detail on how to conduct these investigations consult the EPA handbook, "Sewer System Infrastructure Analysis and Rehabilitation." (U.S. EPA, 1991)

CASE STUDY

The City of Denver operates a pilot, door-to-door collection program to assist residents in the proper disposal and recycling of HHW. To be eligible for collection, residents must currently be receiving trash collection service from City Solid Waste Management crews. Residents are permitted one HHW collection annually and are asked to have at least three different materials before calling for a pickup. Residents then receive a collection date and an HHW Kit that holds up to 75 pounds. Residents are instructed on what items can be placed inside the Kit, and can have additional items picked up for a small fee. The program also educates citizens on how to prevent the accumulation of chemicals in the home environment. The key element of this service is convenience for area residents. Customers can make a phone call, put their waste in a container, and schedule a pickup (City of Denver, 2003).

Table 28: Summary of Local Household Hazardous Waste Collection Programs

Location	Budget	Households Served	Participants	Cost per Participant	Program Description
Fort Worth TX (2002)	$937,740	26 cities	15,629	$60	Accept 3 days a week at permanent facility, plus approx 24 mobile units
Monmouth County, NJ (2002)	$900,000	620,000	6,200	$145.16	Permanent facility plus 2-3 remote days
Nashville, TN (2002)	$149,000	180,000	5,800	$26	361 day drop off at permanent facility
Putnam County, NY (1997)	$20,279	27,409	349	$58.10	One collection day per year
Town of East Hampton, NY (1997)	$36,495	4,878	452	$80	Three collection days per year

CASE STUDY

Municipal cross-training is a proven and effective tool for identifying illicit discharges. Wayne County, Michigan has a very active IDDE program that has included efforts to train all County "field" staff to identify and report suspicious discharges in the course of their duties. The Illicit Discharge Elimination Training Program includes presentations for general field staff that instructs them in the identification and reporting of suspicious discharges. To date, 734 people from various agencies and communities throughout Michigan have attended the training sessions (Tuomari and Thompson, 2002). The information these individuals gained from attending the training session helped identify 82 illicit discharges in the counties of Oakland, Washtenaw, and Wayne. Road division staff trained in recognizing illicit discharges discovered 12 septic systems in Wayne County that were failing or had direct discharges to surface water. Other counties found 70 illicit discharges during their investigations. The elimination of these illicit discharges will prevent an estimated 3.5 million gallons of polluted water from reaching Michigan surface waters each year (associated load reductions are estimated at 7,200 pounds/year of Biological Oxygen Demand and 25, 000 lbs/yr of Total Suspended Solids)

9.6 Budgeting and Scoping Pollution Prevention

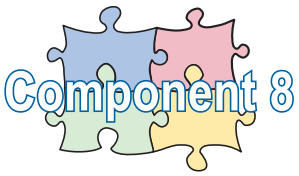
The cost of preventing illicit discharges is directly related to the scope of the education effort. Larger communities often employ education staff on a full-time basis, or at least have one staff member who spends much of their time doing outreach on issues such as illicit discharges. Smaller communities often spread the education effort out over several departments, and try to use already established programs such as cooperative extensions or citizen watershed groups. Table 29 provides some cost data for storm water education in one community.

In reality, program managers have to do a lot of homework to scope and budget their pollution prevention education program. Normally, these education efforts are integrated with other storm water education programs. One of the best tools to develop an overall education budget is the Source Control Plan, which is described in Schueler *et al.* (2004).

Table 29: Estimated Costs for Public Awareness Program Components
(Adapted from Wayne County, MI. 2001)

Education Component	Estimated Cost	Assumptions
Information Brochures	$100/hour for development $0.10-$0.20/pamphlet for black and white printing $0.30/pamphlet for mailing	160-320 hours
Technical Manuals	$100/hour for development $100.00/manual for printing	160-480 hours
Business Education	$50/hour for business/activity list $100/hour for development $50/hour for employee presentation	40-80 hours for compilation 80-160 hours for development. 8 hours for presentation, including prep time.
Program Planning and Administration	$10,000 per year	0.2 Full Time Equivalents (FTE) per year

Source: Wayne County, MI. 2001. Planning and Cost Estimating Criteria for Best Management Practices. Rouge River Wet Weather Demonstration Project. TR-NPS25.00



Chapter 10: IDDE Program Tracking and Evaluation

Purpose: This last program component addresses the ongoing management of the IDDE program and reviews progress made in meeting the measurable program goals established earlier in the permit cycle. Adaptive management is critical since most communities initially have a poor understanding of the scope and nature of their illicit discharge problem. Frequent program review can ensure that the most severe illicit discharges are eliminated in the most cost-effective way during the permit cycle. Program evaluation should also be directly tied to program goals (see Chapter 6 on Developing Program Goals and Implementation Strategy)

Method(s): The primary method is frequent maintenance and analysis of the IDDE tracking system developed as part of the program. The integrated tracking system contains geospatial data on ORI results, indicator monitoring, on-site investigations, dumping and spill sites and hotline calls. The tracking system is important from both an enforcement and program evaluation standpoint. Each of the eight program components should be reviewed annually and prior to new permit negotiation, using data collected, compiled, and assessed from the tracking system.

Desired Product or Outcome(s): Updated tracking database and annual report with summary of progress to date, findings, recommendations for program revisions, and work plan (including milestones and goals) for the upcoming year.

Budget and/or Staff Resources Required: Program assessment is an ongoing responsibility of the program manager. The staff effort to prepare an annual report is about three to four weeks. In general, the first annual report will require more effort than subsequent ones.

Integration with Other Programs: Program managers should always consider other programs and regulatory requirements when assessing program performance and revising goals. At a minimum, the annual report should be shared with other departments and agencies to head off duplication of efforts and to look for opportunities to pool resources.

10.1 Establish a Tracking and Reporting System

An accurate and user-friendly system to track, report and respond to illicit discharge problems is critical for program managers. Ideally, the tracking system should be designed and operational within the first year of the program. The tracking system enables managers to measure program indicators, and gives field crews a home to store the data they collect. The ideal tracking system consists of a relational database that is linked to a GIS system, which can be used to store and analyze data and produce maps.

The fundamental units to track are individual outfalls, along with any supporting information about their contributing drainage area. Some of the key information to include when tracking outfalls includes:

- Geospatial coordinates of each outfall location
- The subwatershed and watershed address
- Any supporting information about the contributing land use
- Diameter and physical characteristics of the outfall
- Outfall Reconnaissance Inventory (ORI) data, as it is collected
- Any accompanying digital photos
- Any follow-up monitoring at the outfall or further up the pipe
- Any hotline complaints logged for the outfall, along with the local response
- Status and disposition of any enforcement actions
- Maintenance and inspection data

10.2 Evaluate the Program

Since IDDE programs are a first time endeavor for many communities, program managers need to be extremely adaptable in how they allocate their resources. Effective IDDE programs are dynamic and flexible to respond to an ever-changing set of discharge problems, program obstacles, and emerging technologies. At a minimum, program managers should maintain and evaluate their IDDE tracking system annually, and modify program components as needed. Tracking systems should be designed so that progress toward measurable goals (see Chapter 6) can be easily reported. Communities that develop and maintain a comprehensive tracking system should realize program efficiencies. The tracking system should contain the following features at a minimum:

- Updated mapping to reflect outfalls located during the ORI
- Surveyed stream reaches with locations of obvious, suspect, and potential discharges, and locations of dumping sites
- Indicator sampling results for specific streams, outfalls and storm drains
- Frequency of hotline use and associated number of “hits” or confirmed illicit discharges
- Costs for each of the eight program components (e.g., office, field, lab, education, enforcement, etc.)
- Number of discharges corrected
- Status and disposition of enforcement actions

Regular analysis of the tracking system sheds light on program strengths and

deficiencies, and improves targeting of limited program resources. For example, if hotline complaints are found to uncover the most severe illicit discharge problems, program managers may want to allocate more resources to increase public awareness about the hotline, and shift resources from outfall screening and indicator monitoring.

Chapter 11: The Outfall Reconnaissance Inventory

This chapter describes a simple field assessment known as the Outfall Reconnaissance Inventory (ORI). The ORI is designed to fix the geospatial location and record basic characteristics of individual storm drain outfalls, evaluate suspect outfalls, and assess the severity of illicit discharge problems in a community. Field crews should walk all natural and man-made streams channels with perennial and intermittent flow, even if they do not appear on available maps (Figure 19). The goal is to complete the ORI on every stream mile in the MS4 within the first permit cycle, starting with priority subwatersheds identified during the desktop analysis. The results of the ORI are then used to help guide future outfall monitoring and discharge prevention efforts.

11.1 Getting Started

The ORI requires modest mapping, field equipment, staffing and training resources. A complete list of the required and optional resources needed to perform an ORI is presented in Table 30. The ORI can be combined with other stream assessment tools, and may be supplemented by simple indicator monitoring. Ideally, a Phase II community should plan on surveying its entire drainage network at least once over the course of each five-year permit cycle. Experience suggests that it may take up to three stream walks to identify all outfalls.



Figure 19: Walk all streams and constructed open channels

Best Times to Start

Timing is important when scheduling ORI field work. In most regions of the country, spring and fall are the best seasons to perform the ORI. Other seasons typically have challenges such as over-grown vegetation or high groundwater that mask illicit discharges, or make ORI data hard to interpret[9].

Prolonged dry periods during the non-growing season with low groundwater levels are optimal conditions for performing an ORI. Table 31 summarizes some of the regional factors to consider when scheduling ORI surveys in your community. Daily weather patterns also determine whether ORI field work should proceed. In general, ORI field work should be conducted at least 48 hours after the last runoff-producing rain event.

Field Maps

The field maps needed for the ORI are normally generated during the desktop assessment phase of the IDDE program described in Chapter 5. This section

[9] Upon initial program start-up, the ORI should be conducted during periods of low groundwater to more easily identify likely illicit discharges. However, it should be noted that high water tables can increase sewage contamination in storm drain networks due to infiltration and inflow interactions. Therefore, in certain situations, seasonal ORI surveys may be useful at identifying these types of discharges. Diagnosis of this source of contamination, however, can be challenging.

Table 30: Resources Needed to Conduct the ORI		
Need Area	**Minimum Needed**	**Optional but Helpful**
Mapping	• Roads • Streams	• Known problem areas • Major land uses • Outfalls • Specific industries • Storm drain network • SIC-coded buildings • Septics
Field Equipment	• 5 one-liter sample bottles • Backpack • Camera (preferably digital) • Cell phones or hand-held radios • Clip boards and pencils • Field sheets • First aid kit • Flash light or head lamp • GPS unit • Spray paint (or other marker) • Surgical gloves • Tape measure • Temperature probe • Waders (snake proof where necessary) • Watch with a second hand	• Portable Spectrophotometer and reagents (can be shared among crews) • Insect repellant • Machete/clippers • Sanitary wipes or biodegradable soap • Wide-mouth container to measure flow • Test strips or probes (e.g., pH and ammonia)
Staff	• Basic training on field methodology • Minimum two staff per crew	• Ability to track discharges up the drainage system • Knowledge of drainage area, to identify probable sources. • Knowledge of basic chemistry and biology

Table 31: Preferred Climate/Weather Considerations for Conducting the ORI		
Preferred Condition	**Reason**	**Notes/Regional Factors**
Low groundwater (e.g., very few flowing outfalls)	High groundwater can confound results	In cold regions, do not conduct the ORI in the early spring, when the ground is saturated from snowmelt.
No runoff-producing rainfall within 48 hours	Reduces the confounding influence of storm water	The specific time frame may vary depending on the drainage system.
Dry Season	Allows for more days of field work	Applies in regions of the country with a “wet/ dry seasonal pattern.” This pattern is most pronounced in states bordering or slightly interior to the Gulf of Mexico or the Pacific Ocean.
Leaf Off	Dense vegetation makes finding outfalls difficult	Dense vegetation is most problematic in the southeastern United States. This criterion is helpful but not required.

provides guidance on the basic requirements for good field maps. First, ORI field maps do not need to be fancy. The scale and level of mapping detail will vary based on preferences and navigational skills of field crews. At a minimum, maps should have labeled streets and hydrologic features (USGS blue line streams, wetlands, and lakes), so field crews can orient themselves and record their findings spatially.

Field maps should delineate the contributing drainage area to major outfalls, but only if they are readily available. Urban landmarks such as land use, property boundaries, and storm drain infrastructure are also quite useful in the field. ORI field maps should be used to check the accuracy and quality of pre-existing mapping information, such as the location of outfalls and stream origins.

Basic street maps offer the advantage of simplicity, availability, and well-labeled road networks and urban landmarks. Supplemental maps such as a 1": 2000' scale USGS Quad sheet or finer scale aerial photograph are also recommended for the field. USGS Quad sheets are readily available and display major transportation networks and landmarks, "blue line" streams, wetlands, and topography. Quad maps may be adequate for less developed subwatersheds, but are not always accurate in more urban subwatersheds.

Recent aerial photographs may provide the best opportunity to navigate the subwatershed and assess existing land cover. Aerial photos, however, may lack topography and road names, can be costly, and are hard to record field notes on due to their darkness. GIS-ready aerial photos and USGS Quad sheets can be downloaded from the internet or obtained from local planning, parks, or public works agencies.

Field Sheets

ORI field sheets are used to record descriptive and quantitative information about each outfall inventoried in the field. Data from the field sheets represent the building blocks of an outfall tracking system allowing program managers to improve IDDE monitoring and management. A copy of the ORI field sheet is provided in Appendix D, and is also available as a Microsoft Word™ document. Program managers should modify the field sheet to meet the specific needs and unique conditions in their community.

Field crews should also carry an authorization letter and a list of emergency phone numbers to report any emergency leaks, spills, obvious illicit discharges or other water quality problems to the appropriate local authorities directly from the field. Local law enforcement agencies may also need to be made aware of the field work. Figure 20 shows an example of a water pollution emergency contact list developed by Montgomery County, MD.

Equipment

Basic field equipment needed for the ORI includes waders, a measuring tape, watch, camera, GPS unit, and surgical gloves (see Table 30). GPS units and digital cameras are usually the most expensive equipment items; however, some local agencies may already have them for other applications. Adequate ranging, water-resistant, downloadable GPS units can be purchased for less than $150. Digital cameras are preferred and can cost between $200 and $400, however, conventional or disposable cameras can also work, as long as they have flashes. Hand-held data recorders and customized software can be used to record text, photos, and GPS coordinates electronically in the field. While

these technologies can eliminate field sheets and data entry procedures, they can be quite expensive. Field crews should always carry basic safety items, such as cell phones, surgical gloves, and first aid kits.

Staffing

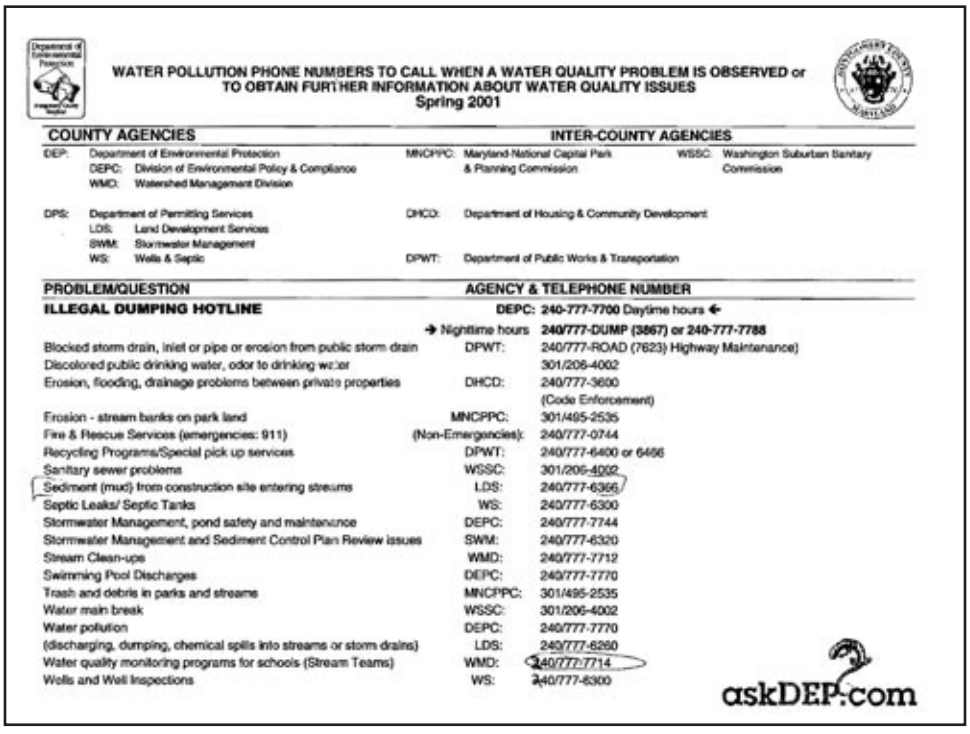
The ORI requires at least a two-person crew, for safety and logistics. Three person crews provide greater safety and flexibility, which helps divide tasks, allows one person to assess adjacent land uses, and facilitates tracing outfalls to their source. All crew members should be trained on how to complete the ORI and should have a basic understanding of illicit discharges and their water quality impact. ORI crews can be staffed by trained volunteers, watershed groups and college interns. Experienced crews can normally expect to cover two to three stream miles per day, depending on stream access and outfall density.

11.2 Desktop Analysis to Support the ORI

Two tasks need to be done in the office before heading out to the field. The major ORI preparation tasks include estimating the total stream and channel mileage in the subwatershed and generating field maps. The total mileage helps program managers scope out how long the ORI will take and how much it will cost. As discussed before, field maps are an indispensable navigational aid for field crews working in the subwatershed.

Delineating Survey Reaches

ORI field maps should contain a preliminary delineation of **survey reaches**. The stream network within your subwatershed should be delineated into discrete segments of relatively uniform character. Delineating survey reaches provides good stopping and starting points for field crews, which



WATER POLLUTION PHONE NUMBERS TO CALL WHEN A WATER QUALITY PROBLEM IS OBSERVED or TO OBTAIN FURTHER INFORMATION ABOUT WATER QUALITY ISSUES
Spring 2001

COUNTY AGENCIES

DEP: Department of Environmental Protection
DEPC: Division of Environmental Policy & Compliance
WMD: Watershed Management Division

DPS: Department of Permitting Services
LDS: Land Development Services
SWM: Stormwater Management
WS: Wells & Septic

INTER-COUNTY AGENCIES

MNCPPC: Maryland-National Capital Park & Planning Commission

WSSC: Washington Suburban Sanitary Commission

DHCD: Department of Housing & Community Development

DPWT: Department of Public Works & Transportation

PROBLEM/QUESTION	AGENCY & TELEPHONE NUMBER	
ILLEGAL DUMPING HOTLINE	**DEPC:**	**240-777-7700** Daytime hours ←
	→ Nighttime hours	**240/777-DUMP (3867) or 240-777-7788**
Blocked storm drain, inlet or pipe or erosion from public storm drain	DPWT:	240/777-ROAD (7623) Highway Maintenance)
Discolored public drinking water, odor to drinking water		301/206-4002
Erosion, flooding, drainage problems between private properties	DHCD:	240/777-3600 (Code Enforcement)
Erosion - stream banks on park land	MNCPPC:	301/495-2535
Fire & Rescue Services (emergencies: 911)	(Non-Emergencies):	240/777-0744
Recycling Programs/Special pick up services	DPWT:	240/777-6400 or 6456
Sanitary sewer problems	WSSC:	301/206-4002
Sediment (mud) from construction site entering streams	LDS:	240/777-6366
Septic Leaks/ Septic Tanks	WS:	240/777-6300
Stormwater Management, pond safety and maintenance	DEPC:	240/777-7744
Stormwater Management and Sediment Control Plan Review issues	SWM:	240/777-6320
Stream Clean-ups	WMD:	240/777-7712
Swimming Pool Discharges	DEPC:	240/777-7770
Trash and debris in parks and streams	MNCPPC:	301/495-2535
Water main break	WSSC:	301/206-4002
Water pollution	DEPC:	240/777-7770
(discharging, dumping, chemical spills into streams or storm drains)	LDS:	240/777-6260
Water quality monitoring programs for schools (Stream Teams)	WMD:	240/777-7714
Wells and Well Inspections	WS:	240/777-6300

askDEP.com

Figure 20: Example of a comprehensive emergency contact list for Montgomery County, MD

is useful from a data management and logistics standpoint. Each survey reach should have its own unique identifying number to facilitate ORI data analysis and interpretation. Figure 21 illustrates some tips for delineating survey reaches, and additional guidance is offered below:

- Survey reaches should be established above the confluence of streams and between road crossings that serve as a convenient access point.
- Survey reaches should be defined at the transition between major changes in land use in the stream corridor (e.g. forested land to commercial area).
- Survey reaches should generally be limited to a quarter mile or less in length. Survey reaches in lightly developed subwatersheds can be longer than those in more developed subwatersheds, particularly if uniform stream corridor conditions are expected throughout the survey reach.
- Access through private or public property should be considered when delineating survey reaches as permission may be required.

It should be noted that initial field maps are not always accurate, and changes may need to be made in the field to adjust survey reaches to account for conditions such as underground streams, missing streams or long culverts. Nevertheless, upfront time invested in delineating survey reaches makes it easier for field crews to perform the ORI.

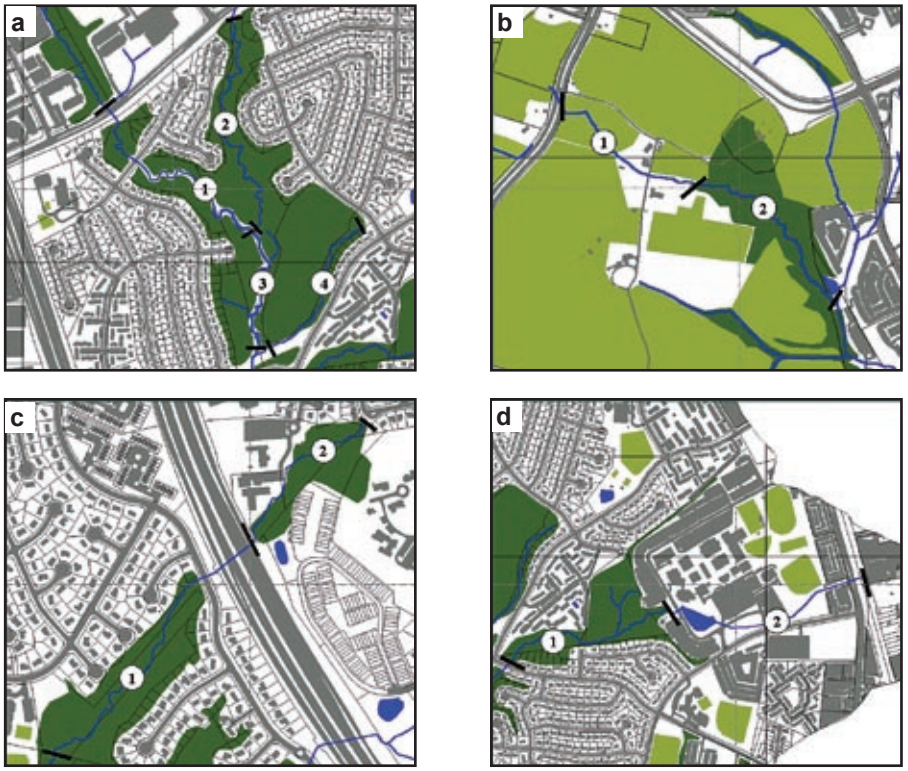


Figure 21: Various physical factors control how survey reaches are delineated. (a) Survey reaches based on the confluence of stream tributaries. (b) A long tributary split into ¼ mile survey reaches. (c) Based on a major road crossing (include the culvert in the downstream reach). (d) Based on significant changes in land use (significant changes in stream features often occur at road crossings, and these crossings often define the breakpoints between survey reaches).

11.3 Completing the ORI

Field crews conduct an ORI by walking all streams and channels to find outfalls, record their location spatially with a GPS unit and physically mark them with spray paint or other permanent marker. Crews also photograph each outfall and characterize its dimensions, shape, and component material, and record observations on basic sensory and physical indicators. If dry weather flow occurs at the outfall, additional flow and water quality data are collected. Field crews may also use field probes or test strips to measure indicators such as temperature, pH, and ammonia at flowing outfalls.

The ORI field sheet is divided into eight sections that address both flowing and non-flowing outfalls (Appendix D). Guidance on completing each section of the ORI field sheet is presented below.

Outfalls to Survey

The ORI applies to **all** outfalls encountered during the stream walk, regardless of diameter, with a few exceptions noted in Table 32. Common outfall conditions seen in communities are illustrated in Figure 22 As a rule, crews should only omit an outfall if they can definitively conclude it has no potential to contribute to a transitory illicit discharge. While EPA's Phase I guidance only targeted major outfalls (diameter of 36 inches or greater), documenting all outfalls is recommended, since smaller pipes make up the majority of all outfalls and frequently have illicit discharges (Pitt *et al.*, 1993 and Lalor, 1994). A separate ORI field sheet should be completed for each outfall.

Table 32: Outfalls to Include in the Screening

Outfalls to Record	Outfalls to Skip
• Both large and small diameter pipes that appear to be part of the storm drain infrastructure • Outfalls that appear to be piped headwater streams • Field connections to culverts • Submerged or partially submerged outfalls • Outfalls that are blocked with debris or sediment deposits • Pipes that appear to be outfalls from storm water treatment practices • Small diameter ductile iron pipes • Pipes that appear to only drain roof downspouts but that are subsurface, preventing definitive confirmation	• Drop inlets from roads in culverts (unless evidence of illegal dumping, dumpster leaks, etc.) • Cross-drainage culverts in transportation right-of-way (i.e., can see daylight at other end) • Weep holes • Flexible HDPE pipes that are known to serve as slope drains • Pipes that are clearly connected to roof downspouts via above-ground connections

 Ductile iron round pipe	 4-6” HDPE; Check if roof leader connection (legal)	 Field connection to inside of culvert; Always mark and record.
 Small diameter (<2”) HDPE; Often a sump pump (legal), or may be used to discharge laundry water (illicit).	 Elliptical RCP; Measure both horizontal and vertical diameters.	 Double RCP round pipes; Mark as separate outfalls unless known to connect immediately up-pipe
 Culvert (can see to other side); Don’t mark as an outfall	 Open channel “chute” from commercial parking lot; Very unlikely illicit discharge. Mark, but do not return to sample (unless there is an obvious problem).	 Small diameter PVC pipe; Mark, and look up-pipe to find the origin.
 CMP outfall; Crews should also note upstream sewer crossing.	 Box shaped outfall	 CMP round pipe with two weep holes at bridge crossing. (Don’t mark weep holes)

Figure 22: Typical Outfall Types Found in the Field

Obvious Discharges

Field crews may occasionally encounter an obvious illicit discharge of sewage or other pollutants, typified by high turbidity, odors, floatables and unusual colors. When obvious discharges are encountered, field crews should STOP the ORI survey, track down the source of the discharge and immediately contact the appropriate water pollution agency for enforcement. Crews should photo-document the discharge, estimate its flow volume and collect a sample for water quality analysis (if this can be done safely). All three kinds of evidence are extremely helpful to support subsequent enforcement. Chapter 13 provides details on techniques to track down individual discharges.

11.4 ORI Section 1 - Background Data

The first section of the ORI field sheet is used to record basic data about the survey, including time of day, GPS coordinates for the outfall, field crew members, and current and past weather conditions (Figure 23). Much of the information in this section is self-explanatory, and is used to create an accurate record of when, where, and under what conditions ORI data were collected.

Every outfall should be photographed and marked by directly writing a unique identifying number on each outfall that serves as its subwatershed "address" (Figure 24). Crews can use spray paint or another temporary marker to mark outfalls, but may decide to replace temporary markings with permanent ones if the ORI is repeated later. Markings help crews confirm outfall locations during future investigations, and gives citizens a better way to report the location of spills or discharges when calling a water pollution hotline. Crews should mark the spatial location of all outfalls they encounter directly on field maps, and record the coordinates with a GPS unit that is accurate to within 10 feet. Crews should take a digital photo of each outfall, and record photo numbers in Section 1 of the field sheet.

Section 1: Background Data

Subwatershed:		Outfall ID:	
Today's date:		Time (Military):	
Investigators:		Form completed by:	
Temperature (°F):	Rainfall (in.): Last 24 hours: Last 48 hours:		
Latitude:	Longitude:	GPS Unit:	GPS LMK #:
Camera:		Photo #s:	
Land Use in Drainage Area (Check all that apply):			
☐ Industrial		☐ Open Space	
☐ Ultra-Urban Residential		☐ Institutional	
☐ Suburban Residential		Other: _____	
☐ Commercial		Known Industries: _____	
Notes (e.g., origin of outfall, if known):			

Figure 23: Section 1 of the ORI Field Sheet



Figure 24: Labeling an outfall (a variety of outfall naming conventions can be used)

The land use of the drainage area contributing to the outfall should also be recorded. This may not always be easy to characterize at large diameter outfalls that drain dozens or even hundreds of acres (unless you have aerial photographs). On the other hand, land use can be easily observed at smaller diameter outfalls, and in some cases, the specific origin can be found (e.g., a roof leader or a parking lot; Figure 25). The specific origin should be recorded in the "notes" portion of Section 1 on the field sheet.

11.5 ORI Section 2 - Outfall Description

This part of the ORI field sheet is where basic outfall characteristics are noted (Figure 26). These include material, and presence of flow at the outfall, as well as the pipe's dimensions (Figure 27). These measurements are used to confirm and supplement existing storm drain maps (if they are available). Many communities only map storm drain outfalls that exceed a given pipe diameter, and may not contain data on the material and condition of the pipe.



Figure 25: The origin of this corrugated plastic pipe was determined to be a roof leader from the house up the hill.

Section 2 of the field sheet also asks if the outfall is submerged in water or obstructed by sediment and the amount of flow, if present. Figure 28 provides some photos that illustrate how to characterize relative submergence, deposition and flow at outfalls. If no flow is observed at the outfall, you can skip the next two sections of the ORI field sheet and continue with Section 5.

Section 2: Outfall Description

LOCATION	MATERIAL	SHAPE		DIMENSIONS (IN.)	SUBMERGED
☐ **Closed Pipe**	☐ RCP ☐ CMP ☐ PVC ☐ HDPE ☐ Steel ☐ Other: _____	☐ Circular ☐ Eliptical ☐ Box ☐ Other: _____	☐ Single ☐ Double ☐ Triple ☐ Other: _____	Diameter/Dimensions: _____	In Water: ☐ No ☐ Partially ☐ Fully With Sediment: ☐ No ☐ Partially ☐ Fully
☐ **Open drainage**	☐ Concrete ☐ Earthen ☐ rip-rap ☐ Other: _____	☐ Trapezoid ☐ Parabolic ☐ Other: _____		Depth: _____ Top Width: _____ Bottom Width: _____	
☐ **In-Stream**	**(applicable when collecting samples)**				
Flow Present?	☐ Yes ☐ No *If No, Skip to Section 5*				
Flow Description (If present)	☐ Trickle ☐ Moderate ☐ Substantial				

Figure 26: Section 2 of the ORI Field Sheet



Figure 27: Measuring Outfall Diameter



Submerged: More than ½ below water



Partially submerged: Bottom is below water



Fully submerged: Can't see outfall



Outfall fully submerged by debris



Fully submerged from downstream trees trapping debris



Partially submerged by leaf debris "back water"



Trickle Flow: Very narrow stream of water



Moderate Flow: Steady stream, but very shallow depth



Significant flow (Source is a fire hydrant discharge)

Figure 28: Characterizing Submersion and Flow

11.6 ORI Section 3 - Quantitative Characterization for Flowing Outfalls

This section of the ORI records direct measurements of **flowing outfalls**, such as flow, temperature, pH and ammonia (Figure 29). If desired, additional water quality parameters can be added to this section. Chapter 12 discusses the range of water quality parameters that can be used.

Field crews measure the rate of flow using one of two techniques. The first technique simply records the time it takes to fill a container of a known volume, such as a one liter sample bottle. In the second technique,

Section 3: Quantitative Characterization

FIELD DATA FOR FLOWING OUTFALLS				
PARAMETER		**RESULT**	**UNIT**	**EQUIPMENT**
☐Flow #1	Volume		Liter	Bottle
	Time to fill		Sec	
☐Flow #2	Flow depth		In	Tape measure
	Flow width	____' ____"	Ft, In	Tape measure
	Measured length	____' ____"	Ft, In	Tape measure
	Time of travel		S	Stop watch
Temperature			°F	Thermometer
pH			pH Units	Test strip/Probe
Ammonia			mg/L	Test strip

Figure 29: Section 3 of the ORI Field Sheet

the crew measures the velocity of flow, and multiplies it by the estimated cross sectional area of the flow.

To use the flow volume technique, it may be necessary to use a "homemade" container to capture flow, such as a cut out plastic milk container that is marked to show a one liter volume. The shape and flexibility of plastic containers allows crews to capture relatively flat and shallow flow (Figure 30). The flow volume is determined as the volume of flow captured in the container per unit time.

The second technique measures flow rate based on velocity and cross sectional area, and is preferred for larger discharges where containers are too small to effectively capture the flow (Figure 31). The crew measures and marks off a fixed flow length (usually about five feet), crumbles leaves or other light material, and drops them into the discharge (crews can also carry peanuts or ping pong balls to use). The crew then measures the time it takes the marker to travel across the length. The velocity of flow is computed as the length of the flow path (in feet) divided by the travel time (in seconds). Next, the cross-sectional flow area is measured by taking multiple readings of the depth and width of flow. Lastly, cross-sectional area (in square feet) is multiplied by flow velocity (feet/second) to calculate the flow rate (in cubic feet/second).

Crews may also want to measure the quality of the discharge using relatively inexpensive probes and test strips (e.g., water temperature, pH, and ammonia). The choice of which indicator parameters to measure is usually governed by the overall IDDE monitoring framework developed by the community. Some communities have used probes or test strips to measure additional indicators such as conductivity, chlorine, and hardness. Research by Pitt (for this project) suggests that probes by Horiba for pH and conductivity are the most reliable and



Figure 30: Measuring flow (as volume per time)

accurate, and that test strips have limited value.

When probes or test strips are used, measurements should be made from a sample bottle that contains flow captured from the outfall. The exact measurement recorded by the field probe should be recorded in Section 3 of the field sheet. Some interpolation may be required for test strips, but do not interpolate further than the mid-range between two color points.

11.7 ORI Section 4 – Physical Indicators for Flowing Outfalls Only

This section of the ORI field sheet records data about four sensory indicators associated with **flowing outfalls**—odor, color, turbidity and floatables (Figure 32). Sensory indicators can be detected by smell or sight, and require no measurement equipment. Sensory indicators do not always reliably predict illicit discharge, since the senses can be fooled, and may result in a "false negative" (i.e., sensory indicators fail to detect an illicit discharge when one is actually present). Sensory indicators are important, however, in detecting the most severe or obvious discharges. Section 4 of the field sheet asks whether the sensory indicator is present, and if so, what is its severity, on a scale of one to three.

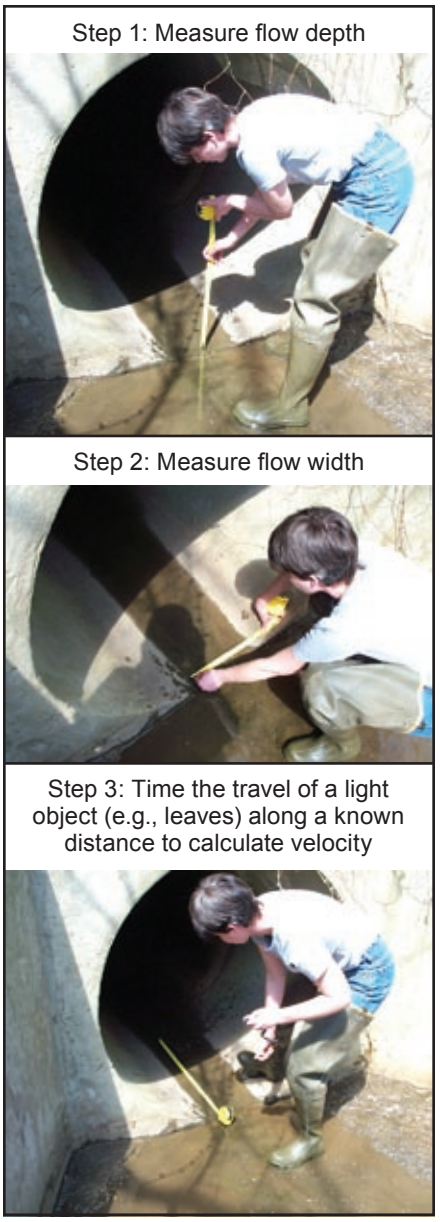


Figure 31: Measuring flow (as velocity times cross-sectional area)

Section 4: Physical Indicators for Flowing Outfalls Only

Are Any Physical Indicators Present in the flow? ☐ Yes ☐ No *(If No, Skip to Section 5)*

INDICATOR	CHECK if Present	DESCRIPTION	RELATIVE SEVERITY INDEX M(1-3)		
Odor	☐	☐ Sewage ☐ Rancid/sour ☐ Petroleum/gas ☐ Sulfide ☐ Other:	☐ 1 – Faint	☐ 2 – Easily detected	☐ 3 – Noticeable from a distance
Color	☐	☐ Clear ☐ Brown ☐ Gray ☐ Yellow ☐ Green ☐ Orange ☐ Red ☐ Other:	☐ 1 – Faint colors in sample bottle	☐ 2 – Clearly visible in sample bottle	☐ 3 – Clearly visible in outfall flow
Turbidity	☐	See severity	☐ 1 – Slight cloudiness	☐ 2 – Cloudy	☐ 3 – Opaque
Floatables -Does Not Include Trash!!	☐	☐ Sewage (Toilet Paper, etc.) ☐ Suds ☐ Petroleum (oil sheen) ☐ Other:	☐ 1 – Few/slight; origin not obvious	☐ 2 – Some; indications of origin (e.g., possible suds or oil sheen)	☐ 3 - Some; origin clear (e.g., obvious oil sheen, suds, or floating sanitary materials)

Figure 32: Section 4 of the ORI Field Sheet

Odor

Section 4 asks for a description of any odors that emanate from the outfall and an associated severity score. Since noses have different sensitivities, the entire field crew should reach consensus about whether an odor is present and how severe it is. A severity score of one means that the odor is faint or the crew cannot agree on its presence or origin. A score of two indicates a moderate odor within the pipe. A score of three is assigned if the odor is so strong that the crew smells it a considerable distance away from the outfall.

TIP

Make sure the origin of the odor is the outfall. Sometimes shrubs, trash or carrion, or even the spray paint used to mark the outfall can confuse the noses of field crews.

Color

The color of the discharge, which can be clear, slightly tinted, or intense is recorded next. Color can be quantitatively analyzed in the lab, but the ORI only asks for a visual assessment of the discharge color and its intensity. The best way to measure color is to collect the discharge in a clear sample bottle and hold it up to the light (Figure 33). Field crews should also look for downstream plumes of color that appear to be associated with the outfall. Figure 34 illustrates the spectrum of colors that may be encountered during an ORI survey, and offers insight on how to rank the relative intensity or strength of discharge color. Color often helps identify industrial discharges; Appendix K provides guidance on colors often associated with specific industrial operations.

Turbidity

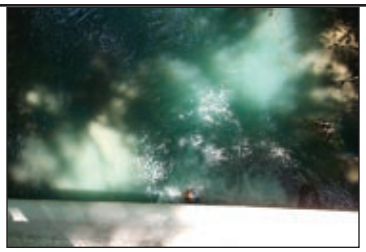
The ORI asks for a visual estimate of the turbidity of the discharge, which is a measure of the cloudiness of the water. Like color, turbidity is best observed in a clear sample bottle, and can be quantitatively measured using field probes. Crews should also look for turbidity in the plunge pool below the outfall, and note any downstream turbidity plumes that appear to be related to the outfall. Field crews can sometimes confuse turbidity with color, which are related but are not the same. Remember, turbidity is a measure of how easily light can penetrate through the sample bottle, whereas color is defined by the tint or intensity of the color observed. Figure 34 provides some examples of how to distinguish turbidity from color, and how to rank its relative severity.



Figure 33: Using a sample bottle to estimate color and turbidity



Color: Brown; Severity: 2
Turbidity Severity: 2



Color: Blue-green; Severity: 3
Turbidity Severity: 2



Highly Turbid Discharge
Color: Brown; Severity: 3
Turbidity Severity: 3



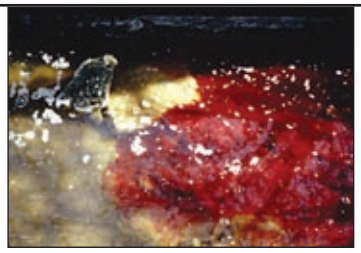
Sewage Discharge
Color: 3
Turbidity: 3



Paint
Color: White; Severity: 3
Turbidity: 3



Industrial Discharge
Color: Green; Severity: 3
Turbidity Severity: 3



Blood
Color: Red; Severity: 3
Turbidity Severity: None



Failing Septic System:
Turbidity Severity: 3



Turbidity in Downstream Plume
Turbidity Severity: 2
(also confirm with sample bottle)



High Turbidity in Pool
Turbidity Severity: 2
(Confirm with sample bottle)



Iron Floc
Color: Reddish Orange; Severity: 3
(Often associated with a natural source)



Slight Turbidity
Turbidity: 1
(Difficult to interpret this observation; May be natural or an illicit discharge)

Construction Site Discharge
Turbidity Severity: 3





Discharge of Rinse from Floor Sanding
(Found during wet weather)
Turbidity Severity: 3

Figure 34: Interpreting Color and Turbidity

Floatables

The last sensory indicator is the presence of any floatable materials in the discharge or the plunge pool below. Sewage, oil sheen, and suds are all examples of floatable indicators; trash and debris are generally not in the context of the ORI. The presence of floatable materials is determined visually, and some guidelines for ranking their severity are provided in Figure 35, and described below.

If you think the floatable is sewage, you should automatically assign it a severity score of three since no other source looks quite like it. Surface oil sheens are ranked based on their thickness and coverage. In some cases, surface sheens may not be related to oil discharges, but instead are created by in-stream processes, such as shown in Figure 36. A thick or swirling sheen associated with a petroleum-like odor may be diagnostic of an oil discharge.

Suds are rated based on their foaminess and staying power. A severity score of three is designated for thick foam that travels many feet before breaking up. Suds that break up quickly may simply reflect water turbulence, and do not necessarily have an illicit origin. Indeed, some streams have naturally occurring foams due to the decay of organic matter. On the other hand, suds that are accompanied by a strong organic or sewage-like odor may indicate a sanitary sewer leak or connection. If the suds have a fragrant odor, they may indicate the presence of laundry water or similar wash waters.

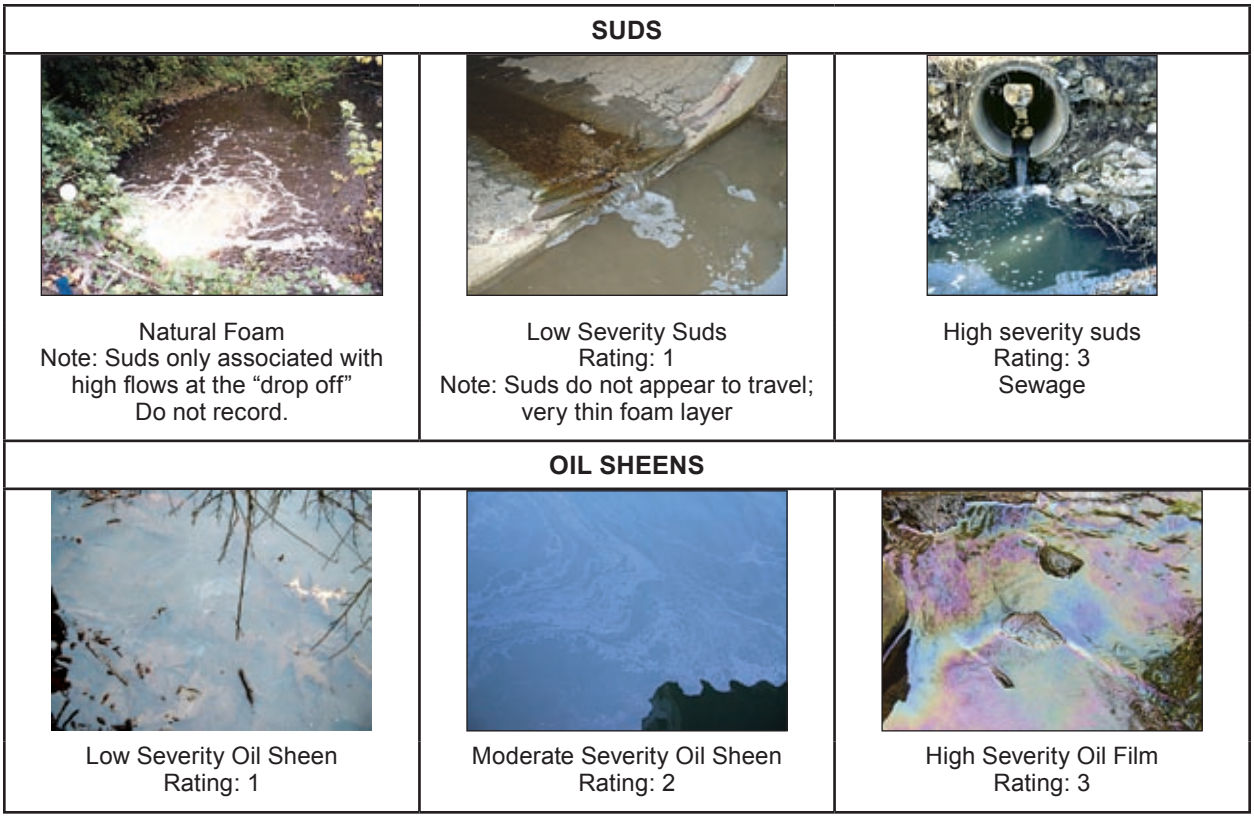


Figure 35: Determining the Severity of Floatables

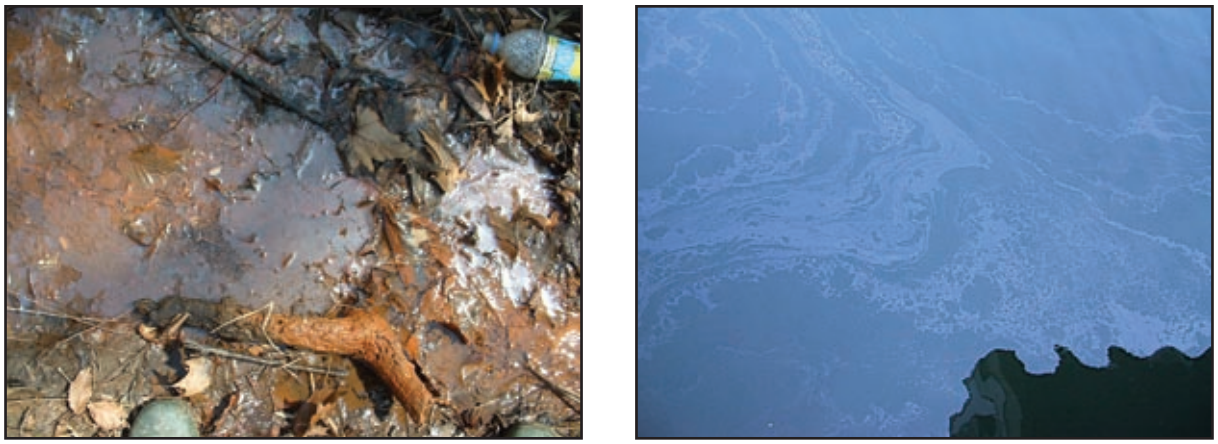


Figure 36: Synthetic versus Natural Sheen (a) Sheen from bacteria such as iron floc forms a sheet-like film that cracks if disturbed (b) Synthetic oil forms a swirling pattern

11.8 ORI Section 5 - Physical Indicators for Both Flowing and Non-Flowing Outfalls

Section 5 of the ORI field sheet examines physical indicators found at both **flowing and non-flowing** outfalls that can reveal the impact of past discharges (Figure 37). Physical indicators include outfall damage, outfall deposits or stains, abnormal vegetation growth, poor pool quality, and benthic growth on pipe surfaces. Common examples of physical indicators are portrayed in Figures 38 and 39. Many of these physical conditions can indicate that an intermittent or transitory discharge has occurred in the past, even if the pipe is not currently flowing. Physical indicators are not ranked according to their severity, because they are often subtle, difficult to interpret and could be caused by other sources. Still, physical indicators can provide strong clues about the discharge history of a storm water outfall, particularly if other discharge indicators accompany them.

Section 5: Physical Indicators for Both Flowing and Non-Flowing Outfalls
Are physical indicators that are not related to flow present? ☐ Yes ☐ No *(If No, Skip to Section 6)*

INDICATOR	CHECK if Present	DESCRIPTION	COMMENTS
Outfall Damage	☐	☐ Spalling, Cracking or Chipping ☐ Peeling Paint ☐ Corrosion	
Deposits/Stains	☐	☐ Oily ☐ Flow Line ☐ Paint ☐ Other:	
Abnormal Vegetation	☐	☐ Excessive ☐ Inhibited	
Poor pool quality	☐	☐ Odors ☐ Colors ☐ Floatables ☐ Oil Sheen ☐ Suds ☐ Excessive Algae ☐ Other:	
Pipe benthic growth	☐	☐ Brown ☐ Orange ☐ Green ☐ Other:	

Figure 37: Section 5 of the ORI Field Sheet



Bacterial growth at this outfall indicates nutrient enrichment and a likely sewage source.



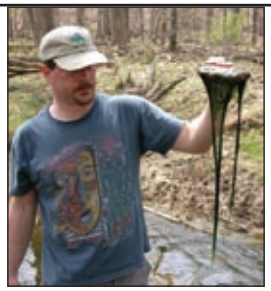
This bright red bacterial growth often indicates high manganese and iron concentrations. Surprisingly, it is not typically associated with illicit discharges.



Sporalitis filamentous bacteria, also known as “sewage fungus” can be used to track down sanitary sewer leaks.



Algal mats on lakes indicate eutrophication. Several sources can cause this problem. Investigate potential illicit sources.



Illicit discharges or excessive nutrient application can lead to extreme algal growth on stream beds.



The drainage to this outfall most likely has a high nutrient concentration. The cause may be an illicit discharge, but may be excessive use of lawn chemicals.



This brownish algae indicates an elevated nutrient level.

Figure 38: Interpreting Benthic and Other Biotic Indicators



Reddish staining on the rocks below this outfall indicate high iron concentrations.



Toilet paper directly below the storm drain outlet.



Watershed Protection??



Trash is not an indicator of illicit discharges, but should be noted.



Staining at the base of the outfall may indicate a persistent, intermittent discharge.



Excessive vegetation may indicate enriched flows associated with sewage.



Brownish stain of unclear origin. May be from degradation of the brick infrastructure.



Cracked rock below the outfall may indicate an intermittent discharge.



Poor pool quality. Consider sampling from the pool to determine origin.

Figure 39: Typical Findings at Both Flowing and Non-Flowing Outfalls

11.9 ORI Sections 6-8 - Initial Outfall Designation and Actions

The last three sections of the ORI field sheet are where the crew designates the illicit discharge severity of the outfall and recommends appropriate management and monitoring actions (Figure 40). A discharge rating is designated as obvious, suspect, potential or unlikely, depending on the number and severity of discharge indicators checked in preceding sections.

It is important to understand that the ORI designation is only an initial determination of discharge potential. A more certain determination as to whether it actually is an illicit discharge is made using a more sophisticated indicator monitoring method. Nevertheless, the ORI outfall

designation gives program managers a better understanding of the distribution and severity of illicit discharge problems within a subwatershed.

Section 7 of the ORI field sheet records whether indicator samples were collected for laboratory analysis, or whether an intermittent flow trap was installed (e.g., an optical brightener trap or caulk dam described in Chapter 13). Field crews should record whether the sample was taken from a pool or directly from the outfall, and the type of intermittent flow trap used, if any. This section can also be used to recommend follow-up sampling, if the crew does not carry sample bottles or traps during the survey.

The last section of the ORI field sheet is used to note any unusual conditions near the outfall such as dumping, pipe failure, bank erosion or maintenance needs. While these maintenance conditions are not directly related to illicit discharge detection, they often are of interest to other agencies and utilities that maintain infrastructure.

11.10 Customizing the ORI for a Community

The ORI method is meant to be adaptable, and should be modified to reflect local conditions and field experience. Some indicators can be dropped, added or modified in the ORI form. This section looks at four of the most common adaptations to the ORI:

- Open Channels
- Submerged/Tidally Influenced Outfalls
- Cold Climates
- Use of Biological Indicators

In each case, it may be desirable to revise the ORI field sheet to collect data reflecting these conditions.

Open Channels

Field crews face special challenges in more rural communities that have extensive open channel drainage. The ditches and channels serve as the primary storm water conveyance system, and may lack storm drain and sewer pipes. The open channel network is often very long with only a few obvious outfalls that are located far apart. While the network can have illicit discharges from septic systems, they can typically only be detected in the ORI if a straight pipe is found. Some adaptations for open channel systems are suggested in Table 33.

Section 6: Overall Outfall Characterization

☐ Unlikely ☐ Potential (presence of two or more indicators) ☐ Suspect (one or more indicators with a severity of 3) ☐ Obvious

Section 7: Data Collection

1.	Sample for the lab?	☐ Yes	☐ No	
2.	If yes, collected from:	☐ Flow	☐ Pool	
3.	Intermittent flow trap set?	☐ Yes	☐ No	If Yes, type: ☐ OBM ☐ Caulk dam

Section 8: Any Non-Illicit Discharge Concerns (e.g., trash or needed infrastructure repairs)?

Figure 40: Sections 6-8 of the ORI Field Sheet

Submerged/Tidally Influenced Outfalls

The ORI can be problematic in coastal communities where outfalls are located along the waterfront and may be submerged at high tide. The ORI methods need to be significantly changed to address these constraints. Often, outfalls are initially located from offshore using canoes or boats, and then traced landward to the first manhole that is not tidally influenced. Field crews then access the storm drain pipe at the manhole and measure whatever indicators they can observe in the confined and dimly lit space. Table 33 recommends strategies to sample outfalls in the challenging environment of coastal communities.

Winter and Ice

Ice can be used as a discharge indicator in northern regions when ice forms in streams and pipes during the winter months (Figure 41). Because ice lasts for many weeks, and most illicit discharges are warm, astute field crews can interpret outfall history from ice melting patterns along pipes and streams. For example, exaggerated melting at a frozen or flowing outfall may indicate warm water from sewage or industrial discharge. Be careful, because groundwater is warm enough to cause some melting at below freezing temperatures. Also, ice acts like an intermittent flow trap, and literally freezes these discharges. Crews should also look for these traps to find any discolored ice within the pipe or below the outfall.

A final winter indicator is "rime ice," which forms when steam freezes. This beautiful ice formation is actually a good indicator of sewage or other relatively hot discharge that causes steam to form (Figure 41).

Biological Indicators

The diversity and pollution tolerance of various species of aquatic life are widely used as an indicator of overall stream health, and has sometimes been used to detect illicit discharges. One notable example is the presence of the red-eared slider turtle, which is used in Galveston, Texas to find sewage discharges, as they have a propensity for the nutrient rich waters associated with sewage (Figure 42).

Table 33: Special Considerations for Open Channels/Submerged Outfalls

OPEN CHANNELS	
Challenge	**Suggested Modification**
Too many miles of channel to walk	Stop walking at a given channel size or drainage area
Difficulty marking them	Mark on concrete or adjacent to earth channel
Interpreting physical indicators	For open channels with mild physical indicators, progress up the system to investigate further.
SUBMERGED/TIDALLY INFLUENCED OUTFALLS	
Challenge	**Suggested Modification**
Access for ORI – Tidal Influence	Access during low tide
Access for ORI – Always submerged	Access by boat or by shore walking
Interpreting physical indicators	For outfalls with mild physical indicators, also inspect from the nearest manhole that is not influenced by tides
Sampling (if necessary)	Sample "up pipe"



Figure 41: Cold climate indicators of illicit discharges



Figure 42: One biological indicator is this red-eared slider turtle

11.11 Interpreting ORI Data

The ORI generates a wealth of information that can provide managers with valuable insights about their illicit discharge problems, if the data are managed and analyzed effectively. The ORI can quickly define whether problems are clustered in a particular area or spread across the community. This section presents a series of methods to compile, organize and interpret ORI data, including:

1. Basic Data Management and Quality Control
2. Outfall Classification
3. Simple Suspect Outfall Counts
4. Mapping ORI Data
5. Subwatershed and Reach Screening
6. Characterizing IDDE Problems at the Community Level

The level of detail for each analysis method should be calibrated to local resources, program goals, and the actual discharge problems discovered in the stream corridor. In general, the most common conditions and problems will shape your initial monitoring strategy, which prioritizes the subwatersheds or reaches that will be targeted for more intensive investigations.

Program managers should analyze ORI data well before every stream mile is walked in the community, and use initial results to modify field methods. For example, if initial results reveal widespread potential problems, program managers may want to add more indicator monitoring to the ORI to track down individual discharge sources (see Chapter 12). Alternatively, if the same kind of discharge problem is repeatedly found, it may be wise to investigate whether there is a common source or activity generating it (e.g., high turbidity observed at many flowing outfalls as a result of equipment washing at active construction sites).

Basic Data Management and Quality Control

The ORI produces an enormous amount of raw data to characterize outfall conditions. It is not uncommon to compile dozens of individual ORI forms in a single subwatershed. The challenge is to devise a system to organize, process, and translate this data into simpler outputs and formats that can guide illicit discharge elimination efforts. The system starts with effective quality control procedures in the field.

Field sheets should be managed using either a three-ring binder or a clipboard. A small field binder offers the ability to quickly flip back and forth among the outfall forms. Authorization letters, emergency contact lists, and extra forms can also be tucked inside.

At the end of each day, field crews should regroup at a predetermined location to compare notes. The crew leader should confirm that all survey reaches and outfalls of interest have been surveyed, discuss initial findings, and deal with any logistical problems. This is also a good time to check whether field crews are measuring and recording outfall data in the same way, and are consistent in what they are (or are not) recording. Crew leaders should also use this time to review field forms for accuracy and thoroughness. Illegible handwriting should be neatened and details added to notes and any sketches. The crew leader should also organize the forms together into a single master binder or folder for future analysis.

Once crews return from the field, data should be entered into a spreadsheet or database. A Microsoft Access database is provided with this Manual as part of Appendix D (Figure 43), and is supplied on a compact disc with each hard copy. It can also be downloaded with Appendix D from http://www.stormwatercenter.net. Information stored in this database can easily be imported into a GIS for mapping purposes. The GIS can generate its own database table that allows the user to create subwatershed maps showing outfall characteristics and problem areas.

Once data entry is complete, be sure to check the quality of the data. This can be done quickly by randomly spot-checking 10% of the entered data. For example, if 50 field sheets were completed, check five of the spreadsheet or database entries. When transferring data into GIS, quality control maps that display labeled problem outfalls should be created. Each survey crew is responsible for reviewing the accuracy of these maps.

Outfall Classification

A simple outfall designation system has been developed to summarize the discharge potential for individual ORI field sheets. Table 34 presents the four outfall designations that can be made.

Table 34: Outfall Designation System Using ORI Data

Designation	Description
1. Obvious Discharge	Outfalls where there is an illicit discharge that doesn't even require sample collection for confirmation
2. Suspect Discharge	Flowing outfalls with high severity on one or more physical indicators
3. Potential Discharge	Flowing or non-flowing outfalls with presence of two or more physical indicators
4. Unlikely Discharge	Non-flowing outfalls with no physical indicators of an illicit discharge

Simple Suspect Outfall Counts

The first priority is to count the frequency of each outfall designation in the subwatershed or the community as a whole. This simple screening analysis counts the number of problem outfalls per stream mile (i.e., the sum of outfalls designated as having potential, suspected or obvious illicit discharge potential). The density of problem outfalls per stream mile is an important metric to target and screen subwatersheds.

Based on problem outfall counts, program managers may discover that a particular monitoring strategy may not apply to the community. For example, if few problem outfalls are found, an extensive follow-up monitoring program may not be needed, so that program resources can be shifted to pollution hotlines to report and control transitory discharges such as illegal dumping. The key point of this method is to avoid getting lost in the raw data, but look instead to find patterns that can shape a cost-effective IDDE program.

Mapping ORI Data

Maps are an excellent way to portray outfall data. If a GIS system is linked to the ORI database, maps that show the spatial distribution of problem outfalls, locations of dumping, and overall reach conditions can be easily generated. Moreover, GIS provides flexibility that allows for rapid updates to maps as new data are collected and compiled. The sophistication and detail of maps will depend on the initial findings, program goals, available software, and GIS capability.

Subwatershed maps are also an effective and important communication and education tool to engage stakeholders (e.g., public officials, businesses and community residents), as they can visually depict reach quality and the location of problem outfalls. The key point to remember is that maps are tools for understanding data. Try to map with a purpose in mind. A large number of cluttered maps may only confuse, while a smaller number with select data may stimulate ideas for the follow-up monitoring strategy.

Subwatershed and Survey Reach Screening

Problem outfall metrics are particularly valuable to screen or rank priority subwatersheds or survey reaches. The basic approach is simple: select the outfall metrics that are most important to IDDE program goals, and then see how individual subwatersheds or reaches rank in the process. This screening process can help determine which subwatersheds will be priorities for initial follow-up monitoring efforts. When feasible, the screening process should incorporate non-ORI data, such as existing dry weather water quality data, citizen complaints, permitted facilities, and habitat or biological stream indicators.

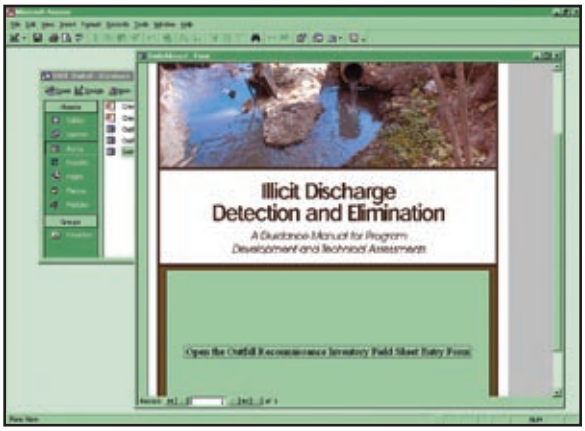


Figure 43: Sample screen from ORI Microsoft Access database

An example of how outfall metrics can screen subwatersheds is provided in Table 35. In this hypothetical example, four metrics were used to screen three subwatersheds within a community: number of suspect discharges, subwatershed population as a percent of the total community, number of industrial discharge permits, and number of outfalls per stream mile. Given these screening criteria, subwatershed C was selected for the next phase of detailed investigation.

Characterizing the IDDE Problem at the Community Level

ORI data should be used to continuously revisit and revise the IDDE program as more is learned about the nature and distribution of illicit discharge problems in the community. For example, ORI discharge designation should be compared against illicit discharge potential (IDP) predictions made during the original desktop analysis (Chapter 5) to refine discharge screening factors, and formulate new monitoring strategies.

In general, community illicit discharge problem can be characterized as minimal, clustered, or severe (Table 36). In the minimal scenario, very few and scattered problems exist; in the clustered scenario, problems are located in isolated subwatersheds; and in the severe scenario, problems are widespread.

Table 35: An Example of ORI Data Being Used to Compare Across Subwatersheds

	# of suspect discharges	Population as % of total community	# of industrial discharge permits	# of outfalls per stream/ conveyance mile
Subwatershed A	2	30	4	6
Subwatershed B	1	10	0	3
Subwatershed C	8	60	2	12

Table 36: Using Stream and ORI Data to Categorize IDDE Problems

Extent	ORI Support Data
Minimal	• Less than 10% of total outfalls are flowing • Less than 20% of total outfalls with obvious, suspect or potential designation
Clustered	• Two thirds of the flowing outfalls are located within one third of the subwatersheds • More than 20% of the communities subwatersheds have greater than 20% of outfalls with obvious, suspect or potential designation
Severe	• More than 10% of total outfalls are flowing • More than 50% of total outfalls with obvious, suspect or potential designation • More than 20% of total outfalls with obvious or suspect designation

11.12 Budgeting and Scoping the ORI

Many different factors come into play when budgeting and scoping an ORI survey: equipment needs, crew size and the stream miles that must be covered. This section presents some simple rules of thumb for ORI budgeting.

Equipment costs for the ORI are relatively minor, with basic equipment to outfit one team of three people totaling about $800 (Table 37). This cost includes one-time expenses to acquire waders, a digital camera and a GPS unit, as well as disposable supplies.

The majority of the budget for an ORI is for staffing the desktop analysis, field crews and data analysis. Field crews can consist of two or three members, and cover about two to three miles of stream (or open channel) per day. Three staff-days should be allocated for pre- and post-field work for each day spent in the field.

Table 38 presents example costs for two hypothetical communities that conduct the ORI. Community A has 10 miles of open channel to investigate, while Community B has 20 miles. In addition, Community A has fewer staff resources available and therefore uses two-person field crews, while Community B uses three-person field crews. Total costs are presented as annual costs, assuming that each community is able to conduct the ORI for all miles in one year.

Table 37: Typical Field Equipment Costs for the ORI

Item	Cost
100 Latex Disposable Gloves	$25
5 Wide Mouth Sample Bottles (1 Liter)	$20
Large Cooler	$25
3 Pairs of Waders	$150
Digital Camera	$200
20 Cans of Spray Paint	$50
Test Kits or Probes	$100-$500
1 GPS Unit	$150
1 Measuring Tape	$10
1 First Aid Kit	$30
Flashlights, Batteries, Labeling tape, Clipboards	$25
Total	**$785-$1185**

Table 38: Example ORI Costs		
Item	**Community A**	**Community B**
Field Equipment[1]	$700	$785
Staff Field Time[2]	$2,000	$6,000
Staff Office Time[3]	$3,000	$6,000
Total	**$5,700**	**$12,785**

[1] From Table 44
[2] Assumes $25/hour salary (2 person teams in Community A and three- person teams in Community B) and two miles of stream per day.
[3] Assumes three staff days for each day in field.

Chapter 12: Indicator Monitoring

Indicator monitoring is used to confirm illicit discharges, and provide clues about their source or origin. In addition, indicator monitoring can measure improvements in water quality during dry weather flow as a result of the local IDDE program. This chapter reviews the suite of chemical indicator parameters that can identify illicit discharges, and provides guidance on how to collect, analyze and interpret each parameter.

Program managers have a wide range of indicator parameters and analytical methods to choose from when determining the presence and source of illicit discharges. The exact combination of indicator parameters and methods selected for a community is often unique. This chapter recommends some general approaches for communities that are just starting an indicator monitoring program or are looking for simple, cost-effective, and safe alternatives to their current program.

Organization of the Chapter

This chapter provides technical support to implement the basic IDDE monitoring framework shown in Figure 44, and is organized into eight sections as follows:

1. Review of indicator parameters
2. Sample collection considerations
3. Methods to analyze samples
4. Methods to distinguish flow types
5. Chemical library
6. Special monitoring methods for intermittent and transitory discharges
7. In-stream dry weather monitoring
8. Costs for indicator monitoring

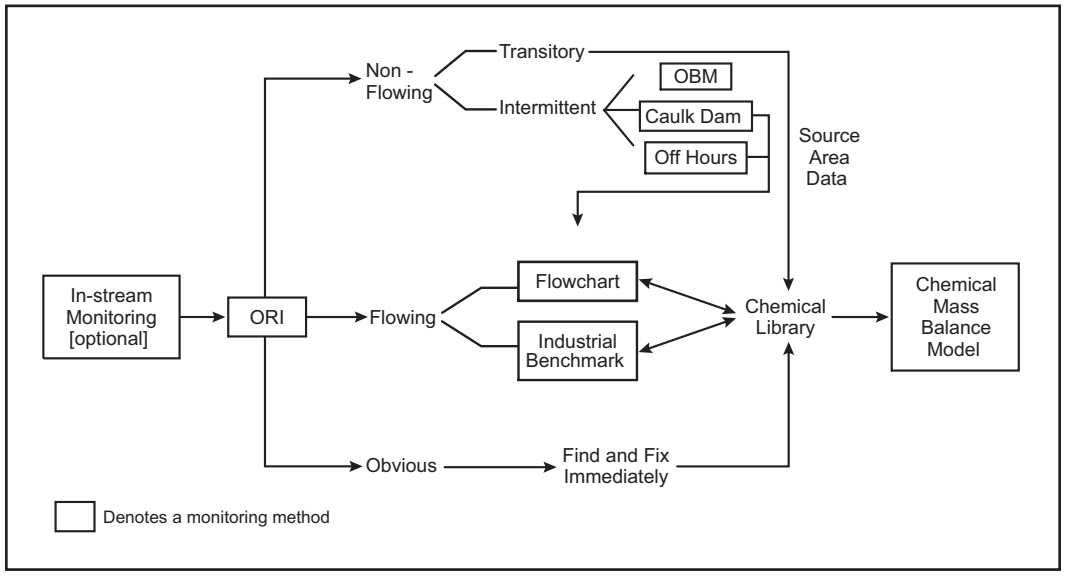


Figure 44: IDDE Monitoring Framework

Program managers developing an indicator monitoring program need a solid background in basic water chemistry, and field and laboratory methods. This chapter describes the major factors to consider when designing an indicator monitoring program for illicit discharges, and assumes some familiarity with water quality sampling and analysis protocols.

Indicator monitoring terminology can be confusing, so some of the basic terms are defined as they specifically relate to illicit discharge control. Some of the common terms introduced in this Chapter are defined below:

Chemical Library: A database and statistical summary of the chemical characteristics, or "fingerprint" of various discharge flow types in a community (e.g., sewage, wash water, shallow groundwater, tap water, irrigation water, and liquid wastes). The library is assembled by collecting and analyzing representative samples from the source of each major flow type in the community.

Chemical Mass Balance Model (CMBM): A computer model that uses flow characteristics from a chemical library file of flow types to estimate the most likely source components that contribute to dry weather flows.

Detergents: Commercial or retail products used to wash clothing. Presence of detergents in flow is usually measured as surfactants or fluorescence.

False Negative: An indicator sample that identifies a discharge as uncontaminated when it actually is contaminated.

False Positive: An indicator sample that identifies a discharge as contaminated when it is not.

Flow Chart Method: The use of four indicators (surfactants, ammonia, potassium, and fluoride) to identify illicit discharges.

Indicator Parameter: A water quality measurement that can be used to identify a specific discharge flow type, or discriminate between different flow types.

Monitoring: A strategy of sample collection and laboratory analysis to detect and characterize illicit discharges.

Optical Brightener Monitoring (OBM) Traps: Traps that use absorbent pads to capture dry weather flows, which can later be observed under a fluorescent light to determine if detergents using optical brighteners were present.

Reagent: A chemical added to a sample to create a reaction that enables the measurement of a target chemical parameter.

Sampling: Water sample collection from an outfall, pipe or stream, along with techniques to store and preserve them for subsequent laboratory analysis.

Surfactants: The main component of commercial detergents that detaches dirt from the clothing. The actual concentration of surfactants is much lower than the concentration of detergent, but analytical methods that measure surfactants are often referred to as "detergents." To avoid confusion, this chapter expresses the concentration of surfactants as "detergents as surfactants."

12.1 Indicator Parameters to Identify Illicit Discharges

At least fifteen different indicator parameters can confirm the presence or origin of an illicit discharge. These parameters are discussed in detail in Appendix F and include:

- Ammonia
- Boron
- Chlorine
- Color
- Conductivity
- Detergents
- *E. coli*, enterococci, and total coliform
- Fluorescence
- Fluoride
- Hardness
- pH
- Potassium
- Surface Tension
- Surfactants
- Turbidity

In most cases, however, only a small subset of indicator parameters (e.g., three to five) is required to adequately characterize an illicit discharge. This section summarizes the different indicator parameters that have been used.

An ideal indicator parameter should reliably distinguish illicit discharges from clean water and provide clues about its sources. In addition, they should have the following characteristics:

- Have a significantly different concentration for major flow or discharge types
- Exhibit relatively small variations in concentrations within the same flow or discharge type
- Be conservative (i.e., concentration will not change over time due to physical, chemical or biological processes)
- Be easily measured with acceptable detection limits, accuracy, safety and repeatability.

No single indicator parameter is perfect, and each community must choose the combination of indicators that works best for their local conditions and discharge types. Table 39 summarizes the parameters that meet most of the indicator criteria, compares their ability to detect different flow types, and reviews some of the challenges that may be encountered when measuring them. More details on indicator parameters are provided in Appendix F.

Data in Table 39 are based on research by Pitt (Appendix E) conducted in Alabama, and therefore, the percentages shown to distinguish "hits" for specific flow types should be viewed as representative and may shift for each community. Also, in some instances, indicator parameters were "downgraded" to account for regional variation or dilution effects. For example, both color and turbidity are excellent indicators of sewage based on discharge fingerprint data, but both can vary regionally depending on the composition of clean groundwater.

Table 39: Indicator Parameters Used to Detect Illicit Discharges

Parameter	Discharge Types It Can Detect				Laboratory/Analytical Challenges
	Sewage	Washwater	Tap Water	Industrial or Commercial Liquid Wastes	
Ammonia	●	◉	○	◉	Can change into other nitrogen forms as the flow travels to the outfall
Boron	◉	◉	○	N/A	
Chlorine	○	○	○	◉	High chlorine demand in natural waters limits utility to flows with very high chlorine concentrations
Color	◉	◉	○	◉	
Conductivity	◉	◉	○	◉	Ineffective in saline waters
Detergents – Surfactants	●	●	○	◉	Reagent is a hazardous waste
E. coli Enterococci Total Coliform	◉	○	○	○	24-hour wait for results Need to modify standard monitoring protocols to measure high bacteria concentrations
Fluoride*	○	○	●	◉	Reagent is a hazardous waste Exception for communities that do not fluoridate their tap water
Hardness	◉	◉	◉	◉	
pH	○	◉	○	◉	
Potassium	◉	○	○	●	May need to use two separate analytical techniques, depending on the concentration
Turbidity	◉	◉	○	◉	

● Can almost always (>80% of samples) distinguish this discharge from clean flow types (e.g., tap water or natural water). For tap water, can distinguish from natural water.
◉ Can sometimes (>50% of samples) distinguish this discharge from clean flow types depending on regional characteristics, or can be helpful in combination with another parameter
○ Poor indicator. Cannot reliably detect illicit discharges, or cannot detect tap water
N/A: Data are not available to assess the utility of this parameter for this purpose.
Data sources: Pitt (this study)
*Fluoride is a poor indicator when used as a single parameter, but when combined with additional parameters (such as detergents, ammonia and potassium), it can almost always distinguish between sewage and washwater.

12.2 Sample Collection Considerations

Sample collection is an important aspect of an IDDE program. Program managers need to be well informed about the key facets of sampling such as sample handling, QA/QC, and safety. The guidance in this section is limited to an overview of sample collection considerations including: equipment needed for collecting samples, elements of sampling protocols, and general tips. Several useful documents are available that detail accepted water quality sampling protocols such as the following:

- Burton and Pitt (2002) - Stormwater Effects Handbook: A Toolbox for Watershed Managers, Scientists, and Engineers

- USGS National Field Manual for the Collection of Water-Quality Data http://water.usgs.gov/owq/FieldManual/
- *Standard Methods for the Examination of Water and Wastewater* http://www.standardmethods.org/
- *EPA NPDES Stormwater Sampling Guidance Document* http://cfpub.epa.gov/npdes (Note: while this document is oriented towards wet weather sampling, there are still many sampling procedures that apply to dry weather sampling)

State environmental agencies are also a good resource to contact for recommended or required sampling protocols.

Equipment Needed for Field Sampling

The basic equipment needed to collect samples is presented in Table 40. Most sampling equipment is easily available for purchase from scientific supply companies and various retail stores.

Developing a Consistent Sample Collection Protocol

Samples should never be collected haphazardly. To get reliable, accurate, and defensible data, it is important to develop a consistent field sampling protocol to collect each indicator sample. A good field sampling protocol incorporates eight basic elements:

1. Where to collect samples
2. When to collect samples
3. Sample bottle preparation
4. Sample collection technique
5. Storage and preservation of samples
6. Sample labeling and chain of custody plan
7. Quality assurance/control samples
8. Safety considerations

Appendix G provides more detail on each monitoring element. Some communities already have established sampling protocols that are used for in-stream or wet weather sampling. In most cases these existing sampling protocols are sufficient to conduct illicit discharge sampling.

Tips for Collecting Illicit Discharge Samples

The following tips can improve the quality of your indicator monitoring program.

1. Remember to fill out an ORI field form at every outfall where samples are collected. The ORI form documents sample conditions, outfall characteristics and greatly aids in interpreting indicator monitoring data.
2. Most state water quality agencies have detailed guidance on sampling protocols. These resources should be consulted and the appropriate guidelines followed. Another useful guidance on developing a quality assurance plan is the "Volunteer Monitor's Guide to Quality Assurance Project Plans" (EPA, 1996).

Table 40: Equipment Needed for Sample Collection

- A cooler (to be kept in the vehicle)
- Ice or "blue ice" (to be kept in the vehicle)
- Permanent marker (for labeling the samples)
- Labeling tape or pre-printed labels
- Several dozen one-liter polyethylene plastic sample bottles
- A "dipper," a measuring cup at the end of a long pole, to collect samples from outfalls that are hard to reach
- Bacteria analysis sample bottles (if applicable), typically pre-cleaned 120mL sample bottles, to ensure against contamination

3. Sample in batches where feasible to cut down on field and mobilization time.

4. Avoid sampling lagged storm water flows by sampling at least 48 to 72 hours after runoff producing events.

5. It may be necessary to collect multiple samples at a single outfall if preservatives are going to be used. Preservatives are typically necessary when long hold times are required for samples before analysis occurs. Appendix G contains guidance on the required preservation and maximum allowable hold times for various parameters.

12.3 Methods to Analyze Indicator Samples

This section reviews methods to analyze indicator samples, and begins with a discussion of whether they should be analyzed in-house or sent to an independent contract lab. Next, recommended methods for analyzing indicator parameters are outlined, along with data on their comparative cost, safety, and accuracy. Lastly, tips are offered to improve an indicator monitoring program.

Analyzing Samples In-house vs. Contract Lab

Program managers need to decide whether to analyze samples in-house, or through an independent monitoring laboratory. The decision on which route to take is often based on the answers to the following questions:

- *What level of precision or accuracy is needed for the indicator parameter(s)?* Precise and accurate data are needed when indicator monitoring is used to legally document a violation or enforcement action. The lab setting is important, since the quality of the data may be challenged. Precise data are also needed for outfalls that have very large drainage areas. These discharges are often diluted by groundwater, so lab methods must be sensitive and have low detection limits to isolate illicit discharges that are masked or blended with other flow types. Accurate data are also needed for large outfalls since the cost and effort triggered by a false positive reading to track and isolate discharges in a large and complex drainage area is much greater.

- *How quickly are sampling results needed?* Fast results are essential if the community wants to respond instantly to problem outfalls. In this case, the capability to collect and analyze indicator samples in-house is desirable to provide quick response.

- *How much staff time and training is needed to support in-house analysis?* Local staff that perform lab analysis must be certified in laboratory safety, quality control and proper analytical procedures. Communities that do not expect to collect many indicator samples may want to utilize a contract lab to reduce staff training costs.

- *Does a safe environment exist to analyze samples and dispose of wastes?* A safe environment is needed for lab analysis including storage in a fireproof environment, eyewash stations, safety showers, fume hoods and ventilation. Lab workers should have standard safety equipment such as gloves, safety glasses and lab coats. Lastly, many of the recommended analytical methods create small quantities of hazardous wastes that need to be properly disposed. Program

managers should carefully evaluate in-house work space to determine if a safe lab environment can be created.

- *What is the comparative cost for sample analysis in each option?* The initial up-front costs to use an independent laboratory are normally lower than those required to establish an in-house analysis capability. An in-house analysis capability normally becomes cost-effective when a community expects to analyze more than 100 indicator samples per year. Section 12.8 outlines some of the key budget factors to consider when making this decision, but program managers should always get bids from reputable and certified contract labs to determine analysis costs.
- *Are existing monitoring laboratories available in the community?* Cost savings are often realized if an existing wastewater treatment or drinking water lab can handle the sample analysis. These labs normally possess the equipment, instruments and trained staff to perform the water quality analyses for indicator parameters.

Considerations for In-house Analysis Capability

Three basic settings can be used to analyze indicator parameters in-house: direct field measurements, small office lab, and a more formal municipal lab. The choice of which in-house setting to use depends on the indicator parameters selected, the need for fast and accurate results and safety/disposal considerations.

In-Field Analysis – A few indicator parameters can be analyzed in the field with probes and other test equipment (Figure 45). While most field parameters can identify problem outfalls, they generally cannot distinguish the specific type of discharge. Some of the situations where in-field analysis[10] is best applied are:

- When a community elects to use one or two indicator parameters, such as ammonia and potassium, that can be measured fairly easily in the field
- When field crews measure indicator parameters to trace or isolate a discharge in a large storm drain pipe network, and need quick results to decide where to go next

Office Analysis – Many of the recommended indicator parameters can be analyzed in an informal "office" lab with the possible exception of surfactants and fluoride (Figure 46). The office analysis option makes sense in communities that have available and trained staff, and choose analytical methods that are safe and have few hazardous waste disposal issues. Another option is to use the office lab to conduct most indicator analyses, but send out fluoride and surfactant indicator samples to a contract lab.

TIP

The methodology for any bacteria analysis also has a waste disposal issue (e.g., biohazard). Check state guidance for appropriate disposal procedures.

[10] Some communities have had success with in-field analysis; however, it can be a challenging environment to conduct rapid and controlled chemical analysis. Therefore, it is generally recommended that the majority of analyses be conducted in a more controlled "lab" setting.

Formal Laboratory Setting – The ideal option in many communities is to use an existing municipal or university laboratory. Existing labs normally have systems in place to dispose of hazardous material, have room and facilities for storing samples, and are equipped with worker safety features. Be careful to craft a schedule that does not interfere with other lab activities.

When in-house analysis is used, program managers need to understand the basic analytical options, safety considerations, equipment needs and analysis costs for each analytical method used to measure indicator parameters. This understanding helps program managers choose what indicator parameters to collect and where they should be analyzed. Much of this information is detailed in Appendix F and summarized below.

Supplies and Equipment

The basic supplies needed to perform lab analysis are described in Table 41, and are available from several scientific equipment suppliers. In addition, reagents, disposable supplies and some specialized instruments may be needed, depending on the specific indicator parameters analyzed. For a partial list of suppliers, consult the Volunteer Stream Monitoring Manual (US EPA, 1997), which can be accessed at www.epa.gov/owow/monitoring/volunteer/stream/appendb.html. Table 42 summarizes the equipment needed for each analytical method.



Figure 45: Analyzing samples in the back of a truck



Figure 46: Office/lab set up in Fort Worth, TX

Table 41: Basic Lab Supplies

Disposable Supplies	Glassware/Tools
• Deionized water (start with about 10 gallons, unless a reverse osmosis machine is available) • Nitric acid for acid wash (one or two gallons to start)	• About two dozen each of 100 and 200 mL beakers • Two or three 100 mL graduated cylinders • Two or three tweezers • Pipettes to transfer samples in small quantities
Safety	
• Lab or surgical gloves • Lab coats • Safety glasses	

Table 42: Analytical Methods Supplies Needed				
Indicator Parameter	**Specific Glassware**	**Equipment**	**Reagents or Kits**	**Unique Suppliers**
Ammonia	Sample Cells	Spectrophotometer or Colorimeter	Hach reagents for method 8155	www.hach.com
Boron	None	Spectrophotometer or Colorimeter	Hach reagents for method 10061	www.hach.com
Chlorine	None	Spectrophotometer or Colorimeter	Hach reagents for method 8021	www.hach.com
Color	None	None	Color Kit	www.hach.com
Conductivity	None	Horiba probe	Standards	www.horiba.com
Detergents - Surfactants (MBAS)	None	None	Chemets Detergents Test	www.chemetrics.com
E. Coli	None	Sealer Black Light Comparator	Colilert Reagent Quanti-Tray Sheets	IDEXX Corporation www.idexx.com
Fluorescence	Cuvettes	Fluorometer	None	Several
Fluoride	None	Spectrophotometer or Colorimeter	Hach reagents for method 8029	www.hach.com
Hardness	Erlenmeyer Flask	Burette and Stand or Digital Titrator	EDTA Cartridges or Reagent and Buffer Solution	www.hach.com
pH	None	Horiba Probe	Standards	www.horiba.com
Potassium	None	Horiba Probe	Standards	www.horiba.com
Potassium (Colorimetric)	None	Spectrophotometer or Colorimeter	Hach Reagents for method 8012	www.hach.com

Cost

Table 43 compares the per sample cost to analyze indicator parameters. In general, the per sample cost is fairly similar for most parameters, with the exception of bacteria analyses for *E. coli*, total coliform, or Enterococci. Reagents typically cost less than $2.00 per sample, and equipment purchases seldom exceed $1,000. The typical analysis time averages less than 10 minutes per sample. More information on budgeting indicator monitoring programs can be found in Section 12.8.

Table 43: Chemical Analysis Costs					
Parameter	Analysis Cost				
	Per Sample Costs				Approximate Initial Equipment Cost (Item)
	Disposable Supplies	Analysis Time (min/ sample)	Staff Cost (@$25/hr)	Total Cost Per Sample	
Ammonia	$1.81	25[3]	$10.42	$12.23	$950[4] (Colorimeter)
Boron	$0.50	20[3]	$8.33	$8.83	$950[4] (Colorimeter)
Chlorine	$0.60	5	$2.08	$2.68	$950[4] (Colorimeter)
Color	$0.52	1	$0.42	$0.94	$0
Conductivity	$0.65[2]	4[3]	$1.67	$2.32	$275 (Probe)
Detergents – Surfactants[1]	$3.15	7	$2.92	$6.07	$0
Enterococci, *E. Coli* or Total Coliform[1]	$6.75	7 (24 hour waiting time)	$2.92	$9.67	$4,000 (Sealer and Incubator)
Fluoride[1]	$0.68	3	$1.25	$1.93	$950[4] (Colorimeter)
Hardness	$1.72	5	$2.08	$3.80	$125 (Digital Titrator)
pH	$0.65[2]	3.5[3]	$1.46	$2.11	$250 (Probe)
Potassium (High Range)	$0.50[2]	5.5[3]	$2.29	$2.79	$250 (Probe)
Potassium (Low Range)	$1.00	5	$2.08	$3.08	$950[4] (Colorimeter)
Turbidity	$0.50[2]	6[3]	$2.50	$3.00	$850 (Turbiditimeter)

[1] Potentially high waste disposal cost for these parameters.
[2] The disposable supplies estimates are based on the use of standards to calibrate a probe or meter.
[3] Analysts can achieve significant economies of scale by analyzing these parameters in batches.
[4] Represents the cost of a colorimeter. The price of a spectrophotometer, which measures a wider range of parameters, is more than $2,500. This one-time cost can be shared among chlorine, fluoride, boron, potassium and ammonia.

Additional Tips for In-house Laboratory Analysis

The following tips can help program managers with in-house laboratory analysis decisions:

- Program managers may want to use both in-house analysis and contract labs to measure the full range of indicator parameters needed in a safe and cost-effective manner. In this case, a split sample analysis strategy is used, where some samples are sent to the contract lab, while others are analyzed in house.

- Remember to order enough basic lab supplies, because they are relatively cheap and having to constantly re-order supplies and wash glassware can be time-consuming. In addition, some scientific supply companies have minimum order amounts, below which additional shipping and handling is charged.
- Be careful to craft a sample analysis schedule that doesn't interfere with other lab operations, particularly if it is a municipal lab. With appropriate preservation, many samples can be stored for several weeks.

Considerations for Choosing a Contract Lab

When a community elects to send samples to an independent contract lab for analysis, it should investigate seven key factors:

1. Make sure that the lab is EPA-certified for the indicator parameters you choose. A state-by-state list of EPA certified labs for drinking water can be found at: http://www.epa.gov/safewater/privatewells/labs.html. State environmental agencies are also good resources to contact for pre-approved laboratories.
2. Choose a lab with a short turn-around time. Some Phase I communities had problems administering their programs because of long turn-around times from local labs (CWP, 2002). As a rule, a lab should be able to produce results within 48 hours.
3. Clearly specify the indicator parameter and analysis method you want, using the guidance in this manual or advice from a water quality expert.
4. Ensure that the maximum hold time for each indicator parameter exceeds the time it takes to ship samples to the lab for analysis.
5. Carefully review and understand the shipping and preservation instructions provided by the contract lab.
6. Look for labs that offer electronic reporting of sample results, which can greatly increase turn-around time, make data analysis easier, and improve response times.
7. Periodically check the lab's QA/QC procedures, which should include lab spikes, lab blanks, and split samples. The procedures for cleaning equipment and calibrating instruments should also be evaluated. These QA/QC procedures are described below.
   - *Lab spikes* – Samples of known concentration are prepared in the laboratory to determine the accuracy of instrument readings.
   - *Lab blanks* – Deionized water samples that have a known zero concentration are used to test methods, or in some methods to "zero" the instruments.
   - *Split samples* – Samples are divided into two separate samples at the laboratory for a comparative analysis. Any difference between the two sample results suggests the analysis method may not be repeatable.
   - *Equipment cleaning and instrument maintenance protocols* – Each lab should have specific and routine procedures to maintain equipment and clean glassware and tubing. These procedures should be clearly labeled on each piece of equipment.

- *Instrument calibration* – Depending on the method, instruments may come with a standard calibration curve, or may require calibration at each use. Lab analysts should periodically test the default calibration curve.

Table 44 summarizes estimated costs associated with sample analyses at a contract lab.

12.4 Techniques to Interpret Indicator Data

Program managers need to decide on the best combination of indicator parameters that will be used to confirm discharges and identify flow types. This section presents guidance on four techniques to interpret indicator parameter data:

- Flow Chart Method (recommended)
- Single Parameter Screening
- Industrial Flow Benchmarks
- Chemical Mass Balance Model (CMBM)

Table 44: Typical Per Sample Contract Lab Costs

Parameter	Costs
Ammonia	$12 - $25
Boron	$16 - $20
Chlorine	$6 - $10
Color	$7 - $11
Conductivity	$2 - $6
Detergents – Surfactants	$17- $35
Enterococci, *E. Coli* or Total Coliform	$17 - $35
Fluoride	$14 - $25
Hardness	$8 - $16
pH	$2 - $7
Potassium	$12 - $14
Turbidity	$9 - $12

All four techniques rely on benchmark concentrations for indicator parameters in order to distinguish among different flow types. Program managers are encouraged to adapt each technique based on local discharge concentration data, and some simple statistical methods for doing so are provided throughout the section.

The Flow Chart Method

The Flow Chart Method is recommended for most Phase II communities, and was originally developed by Pitt *et al.* (1993) and Lalor (1994) and subsequently updated based on new research by Pitt during this project. The Flow Chart Method can distinguish four major discharge types found in residential watersheds, including sewage and wash water flows that are normally the most common illicit discharges. Much of the data supporting the method were collected in Alabama and other regions, and some local adjustment may be needed in some communities. The Flow Chart Method is recommended because it is a relatively simple technique that analyzes four or five indicator parameters that are safe, reliable and inexpensive to measure. The basic decision points involved in the Flow Chart Method are shown in Figure 47 and described below:

Step 1: Separate clean flows from contaminated flows using detergents

The first step evaluates whether the discharge is derived from sewage or washwater sources, based on the presence of detergents. Boron and/or surfactants are used as the primary detergent indicator, and values of boron or surfactants that exceed 0.35 mg/L and 0.25 mg/L, respectively, signal that the discharge is contaminated by sewage or washwater.

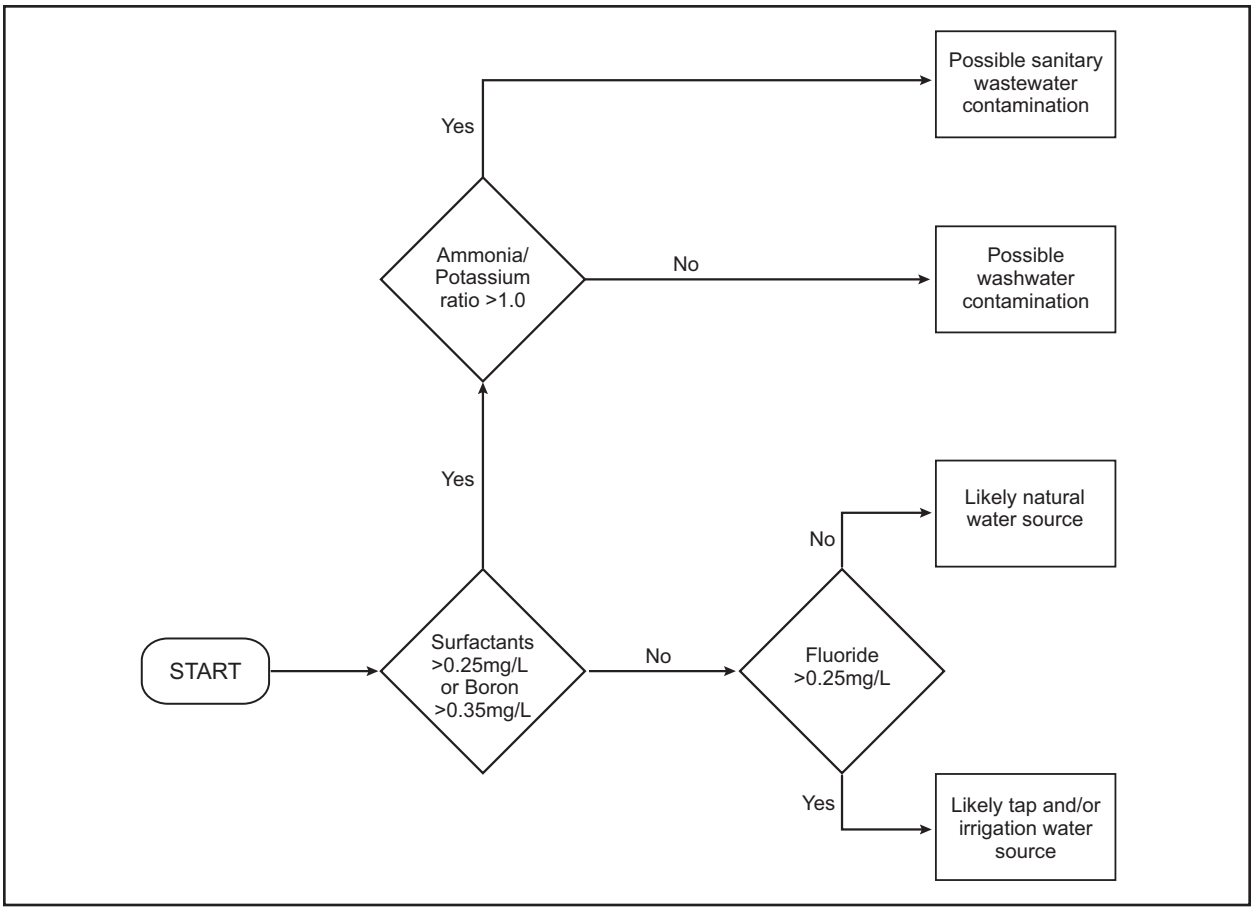


Figure 47: Flow Chart to Identify Illicit Discharges in Residential Watersheds

Step 2: Separate washwater from wastewater using the Ammonia/ Potassium ratio

If the discharge contains detergents, the next step is to determine whether they are derived from sewage or washwater, using the ammonia to potassium ratios. A ratio greater than one suggests sewage contamination, whereas ratios less than one indicate washwater contamination. The benchmark ratio was developed by Pitt *et al.* (1993) and Lalor (1994) based on testing in urban Alabama watersheds.

Step 3: Separate tap water from natural water

If the sample is free of detergents, the next step is to determine if the flow is derived from spring/groundwater or comes from tap water. The benchmark indicator used in this step is fluoride, with concentrations exceeding 0.60 mg/L indicating that potable water is the source. Fluoride levels between 0.13 and 0.6 may indicate non-target irrigation water. The purpose of determining the source of a relatively "clean discharge" is that it can point to water line breaks, outdoor washing, non-target irrigation and other uses of municipal water that generate flows with pollutants.

Adapting the Flow Chart Method

The Flow Chart Method is a robust tool for identifying illicit discharge types, but may need to be locally adapted, since much of the supporting data was collected in one region of the country. Program managers should look at four potential modifications to the flow chart in their community.

1) Is boron or surfactants a superior local indicator of detergents?

Surfactants are almost always a more reliable indicator of detergents, except for rare cases where groundwater has been contaminated by sewage. The disadvantage of surfactants is that the recommended analytical method uses a hazardous chemical as the reagent. Boron uses a safer analytical method. However, if boron is used as a detergent indicator, program managers should sample boron levels in groundwater and tap water, since they can vary regionally. Also, not all detergent formulations incorporate boron at high levels, so it may not always be a strong indicator.

2) Is the ammonia/potassium ratio of one the best benchmark to distinguish sewage from washwater?

The ammonia/potassium ratio is a good way to distinguish sewage from washwater, although the exact ratio appears to vary in different regions of the country. The benchmark value for the ratio was derived from extensive testing in one Alabama city. In fact, data collected in another Alabama city indicated an ammonia/potassium ratio of 0.6 distinguished sewage from wash water. Clearly, program managers should evaluate the ratio in their own community, although the proposed ratio of 1.0 should still capture the majority of sewage discharges. The ratio can be refined over time using indicator monitoring at local outfalls, or through water quality sampling of sewage and washwater flow types for the chemical library.

3) Is fluoride a good indicator of tap water?

Usually. The two exceptions are communities that do not fluoridate their drinking water or have elevated fluoride concentrations in groundwater. In both cases, alternative indicator parameters such as hardness or chlorine may be preferable.

4) Can the flow chart be expanded?

The flow chart presented in Figure 47 is actually a simplified version of a more complex flow chart developed by Pitt for this project, which is presented in Appendix H. An expanded flow chart can provide more consistent and detailed identification of flow types, but obviously requires more analytical work and data analysis. Section 12.5 provides guidance on statistical techniques to customize the flow chart method based on your local discharge data.

Single Parameter Screening

Research by Lalor (1994) suggests that detergents is the best single parameter to detect the presence or absence of the most common illicit discharges (sewage and washwater). The recommended analytical method for detergents uses a hazardous reagent, so the analysis needs to be conducted in a controlled laboratory setting with proper safety equipment. This may limit the flexibility of a community if it is conducting analyses in the field or in a simple office lab.

Ammonia is another single parameter indicator that has been used by some communities with widespread or severe

sewage contamination. An ammonia concentration greater than 1 mg/L is generally considered to be a positive indicator of sewage contamination. Ammonia can be analyzed in the field using a portable spectrophotometer, which allows for fairly rapid results and the ability to immediately track down sources and improper connections (see Chapter 13 for details on tracking down illicit discharges) [11]. Since ammonia can be measured in the field, crews can get fast results and immediately proceed to track down the source of the discharge using pipe testing methods (see Chapter 13 for details).

As a single parameter, ammonia has some limitations. First, ammonia by itself may not always be capable of identifying sewage discharges, particularly if they are diluted by "clean" flows. Second, while some washwaters and industrial discharges have relatively high ammonia concentrations, not all do, which increases the prospects of false negatives. Lastly, other dry weather discharges, such as non-target irrigation, can also have high ammonia concentrations that can occasionally exceed 1 mg/L. Supplementing ammonia with potassium and looking at the ammonia/potassium ratio is a simple adjustment to the single parameter approach that helps to further and more accurately characterize the discharge. Ratios greater than one indicate a sewage source, while ratios less than or equal to one indicate a washwater source. Potassium is easily analyzed using a probe (Horiba Cardy™ is the recommended probe).

[11] In-field analysis may be appropriate when tracking down illicit flows, but it is typically associated with challenging and uncontrollable conditions. Therefore, it is generally recommended that analyses be conducted in a controlled lab setting.

Industrial Flow Benchmark

If a subwatershed has a high density of industrial generating sites, additional indicator parameters may be needed to detect and trace these unique discharges. They are often needed because industrial and commercial generating sites produce discharges that are often not composed of either sewage or washwater. Examples include industrial process water, or wash down water conveyed from a floor drain to the storm drain system.

This guidance identifies seven indicator parameters that serve as industrial flow benchmarks to help identify illicit discharges originating from industrial and other generating sites. The seven indicators (ammonia, color, conductivity, hardness, pH, potassium and turbidity) are used to identify liquid wastes and other industrial discharges that are not always picked up by the Flow Chart Method. Table 45 summarizes typical benchmark concentrations that can distinguish between unique industrial or commercial liquid wastes. Note that two of the seven indicator parameters, ammonia and potassium, are already incorporated into the flow chart method.

Table 46 illustrates how industrial benchmark parameters can be used independently or as a supplement to the flow chart method, based on data from Alabama (Appendix E). The best industrial benchmark parameters are identified in pink shading and can distinguish industrial sources from residential washwater in 80% of samples. Supplemental indicator parameters denoted by yellow shading, can distinguish industrial source from residential washwater in 50% of samples, or roughly one in two samples.

Most industrial discharges can consistently be identified by extremely high potassium levels. However, these discharges would be misclassified as washwater when just the Flow Chart Method is used. Other benchmark parameters have value in identifying specific industrial types or operations. For example, metal plating bath waste discharges are often indicated by extremely high conductivity, hardness and potassium concentrations.

Adapting Industrial Flow Benchmark

By their very nature, industrial and other generating sites can produce a bewildering diversity of discharges that are hard to classify. Therefore, program managers will experience some difficulty in differentiating industrial sources. Over time, the composition of industrial discharges can be refined as chemical libraries for specific industrial flow types and sources are developed. This can entail a great deal of sampling, but can reduce the number of false positive or negative readings.

Table 45: Benchmark Concentrations to Identify Industrial Discharges

Indicator Parameter	Benchmark Concentration	Notes
Ammonia	≥50 mg/L	• Existing "Flow Chart" Parameter • Concentrations higher than the benchmark can identify a few industrial discharges.
Color	≥500 Units	• Supplemental parameter that identifies a few specific industrial discharges. Should be refined with local data.
Conductivity	≥2,000 µS/cm	• Identifies a few industrial discharges • May be useful to distinguish between industrial sources.
Hardness	≤10 mg/L as CaCO3 ≥2,000 mg/L as CaCO3	• Identifies a few industrial discharges • May be useful to distinguish between industrial sources.
pH	≤5	• Only captures a few industrial discharges • High pH values may also indicate an industrial discharge but residential wash waters can have a high pH as well.
Potassium	≥20 mg/L	• Existing "Flow Chart" Parameter • Excellent indicator of a broad range of industrial discharges.
Turbidity	≥1,000 NTU	• Supplemental parameter that identifies a few specific industrial discharges. Should be refined with local data.

Table 46: Usefulness of Various Parameters to Identify Industrial Discharges

Industrial Benchmark Concentration	Detergents as Surfactants (mg/L)	Ammonia (mg/L)	Potassium (mg/L)	Initial "Flow Chart" Class	Color (Units)	Conductivity (:S/cm)1	Hardness (mg/L as $CaCO_3$)	pH	Turbidity (NTU)	Best Indicator Parameters to Identify This Flow Type	Additional Indicator Parameters to Identify This Flow Type
	--	≥50	≥20		≥500	≥2000	≤10 ≥2,000	≤5	≥1,000		
Concentrations in Industrial and Commercial Flow Types											
Automotive Manufacturer[1]	5	0.6	66	**Wash water**	15	220	30	6.7	118	Potassium	
Poultry Supplier[1]	5	4.2	41	**Wash water**	23	618	31	6.3	111	Potassium	
Roofing Product Manufacturing[1]	8	10.2	27	**Wash water**	>100[2]	242	32	7.1	229	None	Potassium Color
Uniform Manufacturing[1]	6	6.1	64	**Wash water**	>100[2]	798	35	10.4	2,631	Potassium	Color Turbidity
Radiator Flushing	15	(26.3)	(2,801)	**Wash water**	(3,000)	(3,278)	(5.6)	(7.0)	-	Potassium Conductivity Color	Hardness
Metal Plating Bath	7	(65.7)	(1,009)	**Wash water**	(104)	(10,352)	(1,429)	(4.9)	-	Ammonia Potassium Conductivity Hardness	pH
Commercial Car Wash	140	0.9; (0.2)	4; (43)	**Wash water**	>61; (222)	274; (485)	71; (157)	7.7; (6.7)	156		Potassium Turbidity
Commercial Laundry	(27)	(0.8)	3	**Wash water**	47	(563)	(36)	(9.1)	-		

Best Indicators, shaded in pink, distinguish this source from residential wash water in 80% of samples in both Tuscaloosa and Birmingham, AL.
Supplemental indicators, shaded in yellow, distinguish this source from residential wash water in 50% of samples, or in only one community.
(Data in parentheses are mean values from Birmingham); Data not in parentheses are from Tuscaloosa
[1] Fewer than 3 samples for these discharges.
[2] The color analytical technique used had a maximum value of 100, which was exceeded in all samples. Color may be a good indicator of these industrial discharges and the benchmark concentration may need adjustment downward for this specific community.

Chemical Mass Balance Model (CMBM) for Blended Flows

The Chemical Mass Balance Model (CMBM) is a sophisticated technique to identify flow types at outfalls with blended flows (i.e., dry weather discharges originating from multiple sources). The CMBM, developed by Karri (2004) as part of this project is best applied in complex sewersheds with large drainage areas, and relies heavily on the local chemical library discussed in **the next section.**

The CMBM can quantify the fraction of each flow type present in dry weather flow at an outfall (e.g., 20% spring water; 40% sewage; 20% wash water). The CMBM relies on a computer program that generates and solves algebraic mass balance equations, based on the statistical distribution of specific flow types derived from the chemical library. The CMBM is an excellent analysis tool, but requires significant advance preparation and sampling support. More detailed guidance on how to use and interpret CMBM data can be found in Appendix I.

The chemical library requires additional statistical analysis to support the CMBM. Specifically, indicator parameter data for each flow type need to be statistically analyzed to determine the **mean**, the **coefficient of variation**, and the **distribution type**. In its current version, the CMBM accepts two distribution types: normal or lognormal distributions. Various statistical methodologies can determine the distribution type of a set of data. Much of this analysis can be conducted using standard, readily-available statistical software, such as the Engineering Statistics Handbook which is available from the National Institute of Standards and Technology, and can be accessed at http://www.itl.nist.gov/div898/handbook/.

12.5 The Chemical Library

The chemical library is a summary of the chemical composition of the range of discharge types found in a community. The primary purpose of the library is to characterize distinct flow types that may be observed at outfalls, including both clean and contaminated discharges. A good library includes data on the composition of tap water, groundwater, sewage, septage, non-target irrigation water, industrial process waters, and washwaters (e.g., laundry, car wash, etc.). The chemical library helps program managers customize the flow chart method and industrial benchmarks, and creates the input data needed to drive the CMBM.

To develop the library, samples are collected directly from the discharge source (e.g., tap water, wastewater treatment influent, shallow wells, septic tanks, etc.). Table 47 provides guidance on how and where to sample each flow type in your community. As a general rule, about 10 samples are typically needed to characterize each flow type, although more samples may be needed if the flow type has a high coefficient of variation. The measure of error can be statistically defined by evaluating the coefficient of variation of the sample data (variability relative to the mean value), and the statistical distribution for the data (the probable spread in the data beyond the mean). For more guidance on statistical techniques for assessing sampling data, consult Burton and Pitt (2002) and US EPA (2002), which can be accessed at http://galton.uchicago.edu/~cises/resources/EPA-QA-Sampling-2003.pdf.

Chemical libraries should also be compared to databases that summarize indicator monitoring of dry weather flows at suspect

outfalls. Outfall samples may not always be representative of individual flow types because of mixing of flows and dilution, but they can serve as a valuable check if the discharge source is actually confirmed. Program managers can also use both the chemical library and indicator database to refine flow chart or industrial benchmarks (see Appendix J for an example).

Over time, communities may want to add other flow types to the chemical library, such as transitory discharges that generate small volume flows such as "dumpster juice," power washing and residential car washing. Transitory discharges are hard to detect with outfall monitoring, but may cumulatively contribute significant dry weather loads. Understanding the chemical makeup of the transitory discharges can help program managers prioritize education and pollution prevention efforts.

Table 47: Where and How to Sample for Chemical "Fingerprint" Library

Flow Type	Places to Collect the Data	Any Other Potential Sources?
Shallow Groundwater	• From road cuts or stream banks • Samples from shallow wells • USGS regional groundwater quality data • Dry weather in-stream flows at headwaters with no illicit discharges	None. Locally distinct.
Spring Water	• Directly from springs	None. Locally distinct.
Tap water	• Individual taps throughout the community • or analyze local drinking water monitoring reports or annual consumer confidence reports	None. Locally distinct.
Irrigation	• Collect irrigation water from several different sites. May require a hand operated vacuum pump to collect these shallow flows (see Burton and Pitt, 2002)	None. Locally distinct.
Sewage	• Reported sewage treatment plant influent data provides a characterization of raw sewage and is usually available from discharge monitoring reports. Because the characteristics of sewage will vary within the collection system depending upon whether the area is serving residential or commercial uses, climate, residence time in the collection system, etc, it is often more accurate and valuable to collect "fingerprint" samples from within the system, rather than at the treatment plant.	Data in Appendix E can provide a starting point, but local data are preferred.
Septage	• Outflow of several individual septic tanks or leach fields	
Most Industrial Discharges	• Direct effluent from the industrial process (Obtain samples as part of industrial pre-treatment program in local community)	Data in Appendix E characterize some specific industrial flows. Industrial NPDES permit monitoring can also be used.
Commercial Car Wash; Commercial Laundry	• Sumps at these establishments	Data in Appendix E can provide a starting point, but local data are preferred.

Evaluating Interpretive Techniques Using Outfall Indicator Monitoring Data

Outfall sampling data for confirmed sources or flow types can be used to test the accuracy and reliability of all four interpretive techniques. The sampling record is used to determine the number of false positives or false negatives associated with a specific interpretive technique. A simple tabulation of false test readings can identify the types and levels of indicator parameters that are most useful.

Table 48 provides an example of how the Flow Chart Method was tested with outfall monitoring data from Birmingham, AL (Pitt *et al*., 1993). In this case, the Flow Chart Method was applied without adaptation to local conditions, and the number of correctly (and incorrectly) identified discharges was tracked. Tests on 10 Birmingham outfalls were mostly favorable, with the flow chart method correctly identifying contaminated discharges in all cases (i.e., washwater or sewage waste water). At one outfall, the flow chart incorrectly identified sewage as washwater, based on an ammonia (NH_3)/ potassium (K) ratio of 0.9 that was very close to the breakpoint in the Flow Chart Method (ratio of one). Based on such tests, program managers may want to slightly adjust the breakpoints in the Flow Chart Method to minimize the occurrence of errors.

12.6 Special Monitoring Techniques for Intermittent or Transitory Discharges

The hardest discharges to detect and test are intermittent or transitory discharges to the storm drain system that often have an indirect mode of entry. With some ingenuity, luck, and specialized sampling techniques, however, it may be possible to catch these discharges. This section describes some specific monitoring techniques to track down intermittent discharges. Transitory discharges cannot be reliably detected using conventional outfall monitoring techniques, and are normally found as a result of hotline complaints or spill events. Nevertheless, when transitory discharges are encountered, they should be sampled if possible.

Techniques for Monitoring Intermittent Discharges

An outfall may be suspected of having intermittent discharges based on physical indicators (e.g., staining), poor in-stream dry weather water quality, or the density of generating sites in the contributing subwatershed. The only sure way to detect an intermittent discharge is to camp out at the outfall for a long period of time, which is obviously not very cost-effective or feasible. As an alternative, five special monitoring techniques can be used to help track these elusive problems:

- Odd hours monitoring
- Optical brightener monitoring traps
- Caulk dams
- Pool sampling
- Toxicity monitoring

Table 48: Evaluation of the Flow Chart Method Using Data from Birmingham, Alabama
(Adapted from Pitt* et al.*, 1993)

Outfall ID	Outfall Concentrations (mg/L)					Predicted Flow Type	Confirmed Flow Type	Result
	Detergents-Surfactants (>0.25 is sanitary or wash water)	NH3	K	NH3/K (>1.0 is sanitary)	Fluoride (>0.25 is tap, if no detergents)			
14	0	0	0.69	0.0	0.04	Natural Water	Spring Water	Correct
20	0	0.03	1.98	0.0	0.61	Tap Water	Rinse Water (Tap) and Spring Water	Correct
21	20	0.11	5.08	0.0	2.80	Washwater	Washwater (Automotive)	Correct
26	0	0.01	0.72	0.0	0.07	Natural Water	Spring Water	Correct
28	0.25[1]	2.89	5.96	0.5	0.74	Washwater	Washwater (Restaurant)	Correct
31	0.95	0.21	3.01	0.1	1.00	Washwater	Laundry (Motel)	Correct
40z	0.25[1]	0.87	0.94	0.9	0.12	Washwater	Shallow Groundwater and Septage	Identifies Contaminated but Incorrect Flow Type
42	0	0	0.81	0.0	0.07	Natural Water	Spring Water	Correct
48	3.0	5.62	4.40	1.3	0.53	Sanitary Wastewater	Spring Water and Sewage	Correct
60a	0	0.31	2.99	0.1	0.61	Tap Water	Landscaping Irrigation Water	Correct

[1] These values were increased from reported values of 0.23 mg/L (outfall 28) and 0.2 mg/L (outfall 40z). The analytical technique used in Birmingham was more precise (but more hazardous) than the method used to develop the flow chart in Figure 47. It is assumed that these values would have been interpreted as 0.25 mg/L using the less precise method.

Odd Hours Monitoring

Many intermittent discharges actually occur on a regular schedule, but unfortunately not the same one used by field crews during the week. For example, some generating sites discharge over the weekend or during the evening hours. If an outfall is deemed suspicious, program managers may want to consider scheduling "odd hours" sampling at different times of the day or week. Some key times to visit suspicious outfalls include:

- Both morning and afternoon
- Weekday evenings
- Weekend mornings and evenings

Optical Brightener Monitoring Traps

Optical brightener monitoring (OBM) traps are another tool that crews can use to gain insight into the "history" of an outfall without being physically present. OBM traps can be fabricated and installed using a variety of techniques and materials. All configurations involve an absorbent, unbleached cotton pad or fabric swatch and a holding or anchoring device such as

a wire mesh trap (Figure 48) or a section of small diameter (e.g., 2-inch) PVC pipe. Traps are anchored to the inside of outfalls at the invert using wire or monofilament that is secured to the pipe itself or rocks used as temporary weights.

Field crews retrieve the OBM traps after they have been deployed for several days of dry weather, and place them under a fluorescent light that will indicate if they have been exposed to detergents. OBM traps have been used with some success in Massachusetts (Sargent *et al*., 1998) and northern Virginia (Waye, 2000). Although each community used slightly different methods, the basic sampling concept is the same. For more detailed guidance on how to use OBM traps and interpret the results, consult the guidance manual found at: http://www.naturecompass.org/8tb/sampling/index.html and http://www.novaregion.org/obm.htm.

Although OBM traps appear useful in detecting some intermittent discharges, research during this project has found that OBM traps only pick up the most contaminated discharges, and the detergent level needed to produce a "hit" was roughly similar to pure washwater from a washing machine (see Appendix F for results).

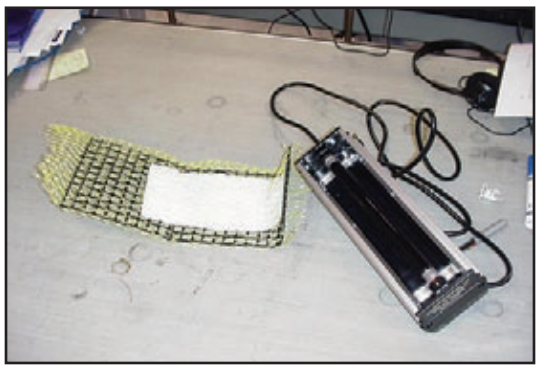


Figure 48: OBM Equipment includes a black light and an OBM Trap that can be placed at an outfall
Source: R. Pitt

Consequently, OBM traps may be best suited as a simple indicator of presence or absence of intermittent flow or to detect the most concentrated flows. OBM traps need to be retrieved before runoff occurs from the outfalls, which will contaminate the trap or wash it away.

Caulk Dams

This technique uses caulk, plumber's putty, or similar substance to make a dam about two inches high within the bottom of the storm drain pipe to capture any dry weather flow that occurs between field observations. Any water that has pooled behind the dam is then sampled using a hand-pump sampler, and analyzed in the lab for appropriate indicator parameters.

Pool Sampling

In this technique, field crews collect indicator samples directly from the "plunge pool" below an outfall, if one is present. An upstream sample is also collected to characterize background stream or ditch water quality that is not influenced by the outfall. The pool water and stream sample are then analyzed for indicator parameters, and compared against each other. Pool sampling results can be constrained by stream dilution, deposition, storm water flows, and chemical reactions that occur within the pool.

Toxicity Monitoring

Another way to detect intermittent discharges is to monitor for toxicity in the pool below the outfall on a daily basis. Burton and Pitt (2002) outline several options to measure toxicity, some of which can be fairly expensive and complex. The Fort Worth Department of Environmental Management has developed a simple low-cost outfall toxicity testing technique known as the Stream Sentinel program. Stream sentinels

place a bottle filled with minnows in the pool below suspected outfalls and measure the survival rate of the minnows as an indicator of the toxicity of the outfall [12] (see Figure 49).

One advantage of the sentinel program is that volunteer monitors can easily participate, by raising and caring for the minnows, placing bottles at outfalls, and visiting them everyday to record mortality. The long-term nature of sentinel monitoring can help pick up toxicity trends at a given outfall. For example, Fort Worth observed a trend of mass mortality on the second Tuesday of each month at some outfalls, which helped to pinpoint the industry responsible for the discharges, and improved sample scheduling (City of Fort Worth, 2003). More information about the Stream Sentinel program can be found at: www.fortworthgov.org/DEM/stream_sentinel.pdf.





Figure 49: Float and wire system to suspend a bottle in a stream sentinel station deployed in Fort Worth, TX (a); Minnows in the perforated bottle below the water surface (b).

Due to the cost and difficulty of interpreting findings, toxicity testing is generally not recommended for communities unless they have prior experience and expertise with the method.

Techniques for Monitoring Transitory Discharges

Transitory discharges, such as spills and illegal dumping, are primarily sampled to assign legal responsibility for enforcement actions or to reinforce ongoing pollution prevention education efforts. In most cases, crews attempt to trace transitory discharges back up the pipe or drainage area using visual techniques (see Chapter 13). However, field crews should always collect a sample to document the event. Table 49 summarizes some follow-up monitoring strategies to document transitory discharges.

12.7 Monitoring of Stream Quality During Dry Weather

In-stream water quality monitoring can help detect sewage and other discharges in a community or larger watershed. Stream monitoring can identify the subwatersheds with the greatest illicit or sewage discharge potential that is then used to target outfall indicator monitoring. At the smaller reach scale, stream monitoring may sometimes detect major individual discharges to the stream.

[12] It may be necessary to obtain approval from the appropriate state of federal regulatory agency before conducting toxicity monitoring using vertebrates.

Table 49: Follow-Up Monitoring for Transitory Discharges	
Condition	**Response**
Oils or solvents	Special hydrocarbon analysis to characterize the source of the oil
Unknown but toxic material	Full suite of metals, pesticides, other toxic materials
Probable sewage	Monitor for parameters associated with the Flow Chart Technique (detergents, ammonia, potassium, fluoride) for residential drainage areas

Stream Monitoring to Identify Problem Reaches or Subwatersheds

Stream monitoring data can be used to locate areas in subwatersheds where illicit discharges may be present, and where human or aquatic health risks are higher. To provide this information, stream monitoring should be conducted regularly during dry weather conditions to track water quality (at least monthly) and to document changes in water quality over a period of time. Stream monitoring data are particularly effective when combined with ORI data. For example, a subwatershed with many ORI physical indicators of illicit discharges (e.g., a high number of flowing outfalls) that also has poor stream water quality would be an obvious target for intensive outfall monitoring.

Stream monitoring parameters should reflect local water quality goals and objectives, and frequently include bacteria and ammonia. Bacteria are useful since sewage discharges can contribute to violations of water contact standards set for recreation during dry weather conditions. Table 50 summarizes water quality standards for *E. coli* that EPA recommends for water contact recreation. It is important to note that individual states may use different action levels or bacteria indicators (e.g., Enterococci or fecal coliform) to regulate water contact recreation. For a review of the impacts bacteria exert on surface waters, consult CWP (2000).

An important caveat when interpreting stream monitoring data is that a violation of bacteria standards during dry weather flow does not always mean that an illicit discharge or sewage overflow is present. While raw sewage has bacteria concentrations that greatly exceed bacteria standards (approximately 12,000 MPN/100 mL) other bacteria sources, such as urban wildlife, can also cause a stream to violate standards. Consequently, stream monitoring data need to be interpreted in the context of other information, such as upstream land use, past complaints, age of infrastructure, and ORI surveys.

Ideally, stream monitoring stations should be strategically located with a minimum of one station per subwatershed, and additional stations at stream confluences and downstream of reaches with a high outfall density. Stations should also be located at beaches, shellfish harvesting and other areas where discharges represent a specific threat to public health. See Burton and Pitt (2002) for guidance on stream monitoring.

Stream Monitoring to Identify Specific Discharges

Stream monitoring data can help field crews locate individual discharges within a specific stream reach. Immediate results are needed for this kind of monitoring, so indicator parameters should be analyzed using simple field test kits or portable analytical

instruments (e.g., spectrophotometer). Bacteria is not a good indicator parameter to use for this purpose because lab results cannot be received for at least one day (analytical method requires a "hold time" of 24 hours). Table 51 summarizes nutrient indicator parameters along with their "potential problem level" benchmarks. It is important to note that other factors, such as animal operations, can elevate stream nutrient concentrations, so data should always be interpreted in the context of surrounding land use. Stream monitoring benchmarks should be continuously refined as communities develop a better understanding of what dry weather baseline concentrations to expect.

If stream monitoring indicates that a potential problem level benchmark has been exceeded, field crews continue stream sampling to locate the discharge through a process of elimination. Crews walk upstream taking regular samples above and below stream confluences until the benchmark concentration declines. The crews then take samples at strategic points to narrow down the location of the discharge, using the in-pipe monitoring strategy described in Chapter 13.

Table 50: Typical "Full Body Contact Recreation" Standards for *E. coli*
(Source: EPA, 1986)[1]

Use	Criterion
Designated beach area	235 MPN /100 mL
Moderately-used full body contact recreation area	298 MPN /100 mL
Lightly-used full body contact recreation	406 MPN /100 mL
Infrequently-used full body contact recreation	576 MPN /100 mL

[1] These concentrations represent standards for a single sampling event. In all waters, a geometric mean concentration of 126 MPN/100 mL cannot be exceeded for five samples taken within one month.

Table 51: Example In-Stream Nutrient Indicators of Discharges
(Zielinski, 2003)

Parameter	Potential Problem Level*	Possible Cause of Water Quality Problem
Total Nitrogen (TN)	3.5 mg/l	High nutrients in ground water from agriculture, lawn practices, or sewage contamination from illicit connection, sanitary line break or failing septic system.
Total Phosphorus (TP)	0.4 mg/l	Contamination from lawn practices, agriculture, sewage or washwater.
Ammonia (NH_3)	0.3 mg/l	Sewage or washwater contamination from illicit connection, sanitary line break or failing septic system.

**Nutrient parameters are based on USGS NAWQA data with 85% of flow weighted samples being less than these values in urban watersheds (Note: data from Nevada were not used, due to climatic differences and for some parameters they were an order of magnitude higher). Communities can modify these benchmarks to reflect local data and experience.*

12.8 The Costs of Indicator Monitoring

This section provides general guidance on scoping and budgeting an indicator monitoring program. The required budget will ultimately be dictated by the monitoring decisions and local conditions within a community. The budgeting data presented in this section are based on the level of indicator sampling effort in two hypothetical communities, using different numbers of samples, indicator parameters, and analysis methods.

Budgets for Indicator Monitoring in a Hypothetical Community

Communities can develop annual budgets for indicator monitoring if the degree of sampling effort can be scoped. This is normally computed based on the expected number of samples to analyze and is a function of stream miles surveyed and outfall density. For example, if a community collects samples from 10 stream miles with eight outfalls per mile, it will have 80 samples to analyze. This number can be used to generate start-up and annual monitoring cost estimates that represent the expected level of sampling effort. Table 52 summarizes how indicator monitoring budgets were developed for two hypothetical communities, each with 80 outfalls to sample. Budgets are shown using both in-house and contract lab set-ups, and are split between initial start-up costs and annual costs.

Community A: Primarily Residential Land Use, Flow Chart Method

In this scenario, six indicator parameters were analyzed, several of which were used to support the Flow Chart Method. The community took no additional samples to create a chemical library, and instead relied on default values to identify illicit discharges. The community analyzed the samples in-house at a rate of one sample (includes analysis of all six parameters) per staff hour.

Community B: Mixed Land Use - Multiple Potential Sources, Complex Analysis

In the second scenario, the community analyzed 11 indicator parameters, including a bacteria indicator, and took samples of eight distinct flow types to create a chemical library, for a total of 88 samples. The community analyzed the samples in-house at a rate of one sample per 1.5 staff hours.

Some general rules of thumb that were used for this budget planning example include the following:

- $500 in initial sampling equipment (e.g., sample bottles, latex gloves, dipper, cooler, etc).
- Outfall samples are collected in batches of 10. Each batch of samples can be collected and transported to the lab in two staff days (two-person crew required to collect samples for safety purposes).
- Staff rate is $25/hr.
- Overall effort to collect samples for the chemical library and statistically analyze the data is approximately one staff day per source type.
- The staff time needed to prepare for field work and interpret lab results is roughly two times that required for conducting the field work (i.e., eight days of collecting samples requires 16 days of pre- and post-preparation).

Costs for Intermittent Discharge Analyses

Equipment costs for most specialized intermittent discharge techniques tend to be low (<$500), and are dwarfed by staff effort. As a rule of thumb, assume about four hours of staff time to deploy, retrieve and analyze samples collected from a single outfall using these techniques.

Table 52: Indicator Monitoring Costs: Two Scenarios

	Community A: In-House	Community A: Contract Lab	Community B: In-House	Community B: Contract Lab
Initial Costs				
Initial Sampling Supplies and Lab Equipment [1]	$1,700	$500	$7,500	$500
Staff Cost: Library Development [2]	$0	$0	$4,600[3]	$2,000
Analysis Costs: Library Development (Reagents or Contract Lab Cost)	$0	$0	$1,400	$13,000[4]
Total Initial Costs	**$1,700**	**$500**	**$13,500**	**$15,500**
Annual Costs in Subsequent Years				
Staff Field Cost (Sample Collection) [2, 5, 6]	$3,200	$3,200	$3,200	$3,200
Staff Costs: Chemical Analysis [2]	$2,000	$200[7]	$3,000	$200
Staff Time to Enter/ Interpret Data [2, 6]	$3,200	$3,200	$4,800	$4,800
Analysis Costs: Annual Outfall Sampling (Reagents or Contract Lab Cost)	$600	$8,400[4]	$1,400	$13,000[4]
Total Annual Cost	**$9,000**	**$15,000**	**$12,400**	**$21,200**

Notes:
[1] $500 in initial sampling equipment.
[2] Samples can be shipped to a contract lab using one staff hour.
[3] Overall effort to collect samples for the library and statistically analyze the data is approximately one staff day per source type.
[4] For contract lab analysis, assume a cost that is an average between the two extremes of the range in Table 43.
[5] Outfall samples are collected in batches of 10. Each batch of samples can be collected and transported to the lab in two staff days (two-person crew required to collect samples for safety purposes).
[6] Assume that the staff time needed to interpret lab results and prepare for field work is roughly 16 staff days. An additional eight days are required for the flow type pre- and post-preparation for Community 2.
[7] Staff rate is $25/hr.

Chapter 13: Tracking Discharges To A Source

Once an illicit discharge is found, a combination of methods is used to isolate its specific source. This chapter describes the four investigation options that are introduced below.

Storm Drain Network Investigation

Field crews strategically inspect manholes within the storm drain network system to measure chemical or physical indicators that can isolate discharges to a specific segment of the network. Once the pipe segment has been identified, on-site investigations are used to find the specific discharge or improper connection.

Drainage Area Investigation

This method relies on an analysis of land use or other characteristics of the drainage area that is producing the illicit discharge. The investigation can be as simple as a "windshield" survey of the drainage area or a more complex mapping analysis of the storm drain network and potential generating sites. Drainage area investigations work best when prior indicator monitoring reveals strong clues as to the likely generating site producing the discharge.

On-site Investigation

On-site methods are used to trace the source of an illicit discharge in a pipe segment, and may involve dye, video or smoke testing within isolated segments of the storm drain network.

Septic System Investigation

Low-density residential watersheds may require special investigation methods if they are not served by sanitary sewers and/or storm water is conveyed in ditches or swales. The major illicit discharges found in low-density development are failing septic systems and illegal dumping. Homeowner surveys, surface inspections and infrared photography have all been effectively used to find failing septic systems in low-density watersheds.

13.1 Storm Drain Network Investigations

This method involves progressive sampling at manholes in the storm drain network to narrow the discharge to an isolated pipe segment between two manholes. Field crews need to make two key decisions when conducting a storm drain network investigation—where to start sampling in the network and what indicators will be used to determine whether a manhole is considered clean or dirty.

Where to Sample in the Storm Drain Network

The field crew should decide how to attack the pipe network that contributes to a problem outfall. Three options can be used:

- Crews can work progressively up the trunk from the outfall and test manholes along the way.
- Crews can split the trunk into equal segments and test manholes at strategic junctions in the storm drain system.
- Crews can work progressively down from the upper parts of the storm drain network toward the problem outfall.

The decision to move up, split, or move down the trunk depends on the nature and land use of the contributing drainage area. Some guidance for making this decision is provided in Table 53. Each option requires different levels of advance preparation. Moving up the trunk can begin immediately when an illicit discharge is detected at the outfall, and only requires a map of the storm drain system. Splitting the trunk and moving down the system require a little more preparation to analyze the storm drain map to find the critical branches to strategically sample manholes. Accurate storm drain maps are needed for all three options. If good mapping is not available, dye tracing can help identify manholes, pipes and junctions, and establish a new map of the storm drain network.

Option 1: Move up the Trunk

Moving up the trunk of the storm drain network is effective for illicit discharge problems in relatively small drainage areas. Field crews start with the manhole closest to the outfall, and progressively move up the network, inspecting manholes until indicators reveal that the discharge is no longer present (Figure 50). The goal is to isolate the discharge between two storm drain manholes.

Table 53: Methods to Attack the Storm Drain Network

Method	Nature of Investigation	Drainage System	Advance Prep Required
Follow the discharge up	Narrow source of an individual discharge	Small diameter outfall (< 36”) Simple drainage network	No
Split into segments	Narrow source of a discharge identified at outfall	Large diameter outfall (> 36”), Complex drainage Logistical or traffic issues may make sampling difficult.	Yes
Move down the storm drain	Multiple types of pollution, many suspected problems—possibly due to old plumbing practices or number of NPDES permits	Very large drainage area (> one square mile).	Yes

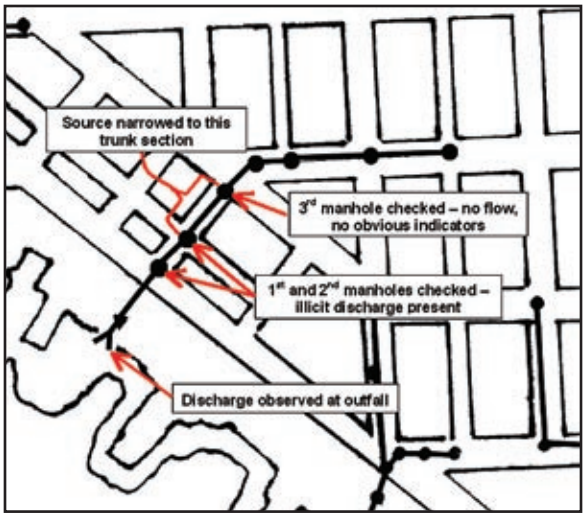


Figure 50: Example investigation following the source up the storm drain system

Option 2: Split the storm drain network

When splitting the storm drain network, field crews select strategic manholes at junctions in the storm drain network to isolate discharges. This option is particularly suited in larger and more complex drainage areas since it can limit the total number of manholes to inspect, and it can avoid locations where access and traffic are problematic.

The method for splitting the trunk is as follows:

1. Review a map of the storm drain network leading to the suspect outfall.
2. Identify major contributing branches to the trunk. The trunk is defined as the largest diameter pipe in the storm drain network that leads directly to the outfall. The "branches" are networks of smaller pipes that contribute to the trunk.
3. Identify manholes to inspect at the farthest downstream node of each contributing branch and one immediately upstream (Figure 51).
4. Working up the network, investigate manholes on each contributing branch and trunk, until the source is narrowed to a specific section of the trunk or contributing branch.
5. Once the discharge is narrowed to a specific section of trunk, select the appropriate on-site investigation method to trace the exact source.
6. If narrowed to a contributing branch, move up or split the branch until a specific pipe segment is isolated, and commence the appropriate on-site investigation to determine the source.

Option 3: Move down the storm drain network

In this option, crews start by inspecting manholes at the "headwaters" of the storm drain network, and progressively move down pipe. This approach works best in very large drainage areas that have many potential continuous and/or intermittent discharges. The Boston Water and Sewer Commission has employed the headwater option to investigate intermittent discharges in complex drainage areas up to three square miles (Jewell, 2001). Field crews certify that each upstream branch of the storm drain network has no contributing discharges before moving down pipe to a "junction manhole" (Figure 52). If discharges are found, the crew performs dye testing to pinpoint the discharge. The crew then confirms that the discharge is removed before moving farther down the pipe network. Figure 53 presents a detailed flow chart that describes this option for analyzing the storm drain network.

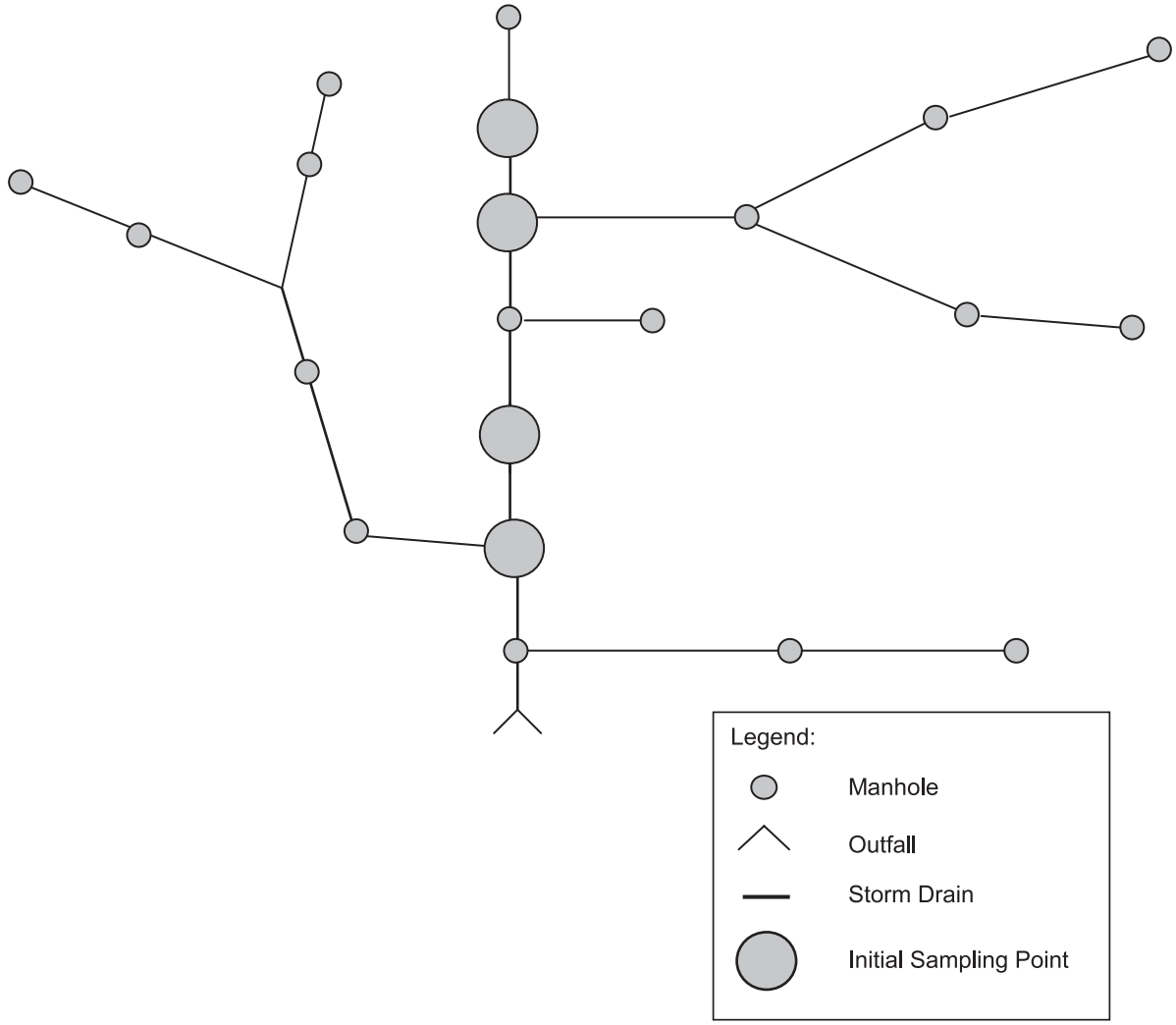


Figure 51: Key initial sampling points along the trunk of the storm drain

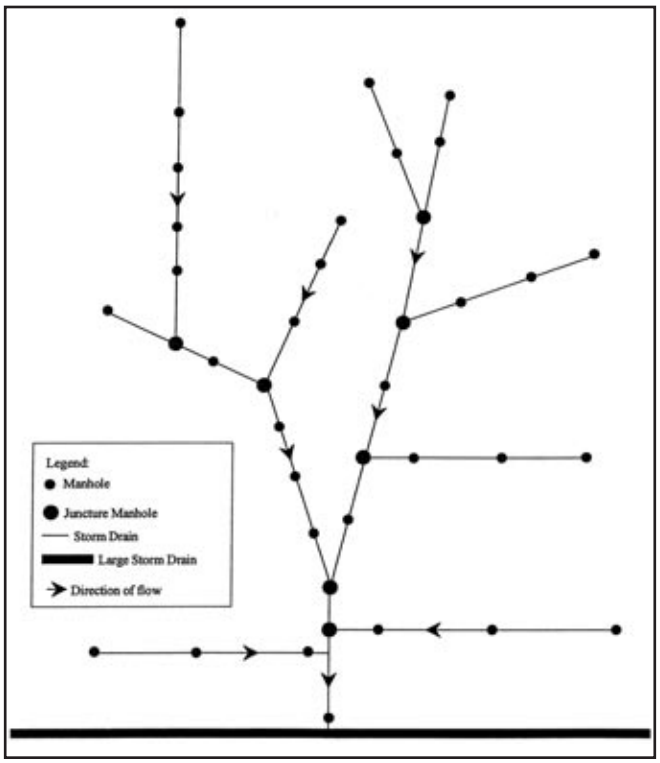


Figure 52: Storm Drain Schematic Identifying "Juncture Manholes" (Source: Jewell, 2001)

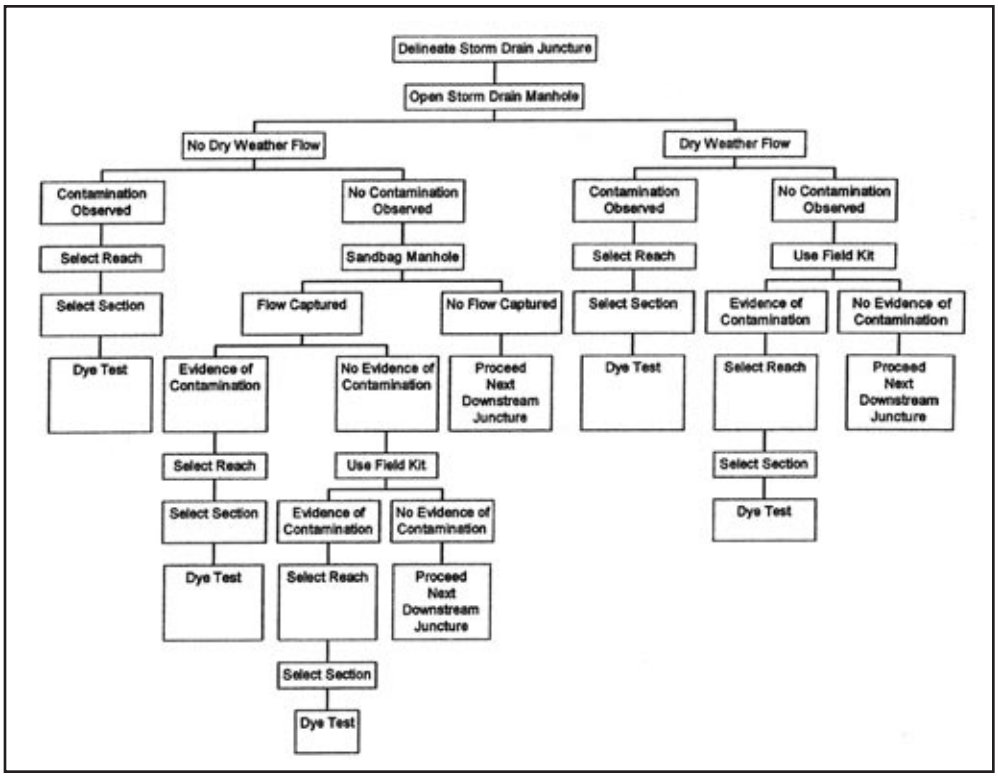


Figure 53: A Process for Following Discharges Down the Pipe (Source: Jewell, 2001)

Dye Testing to Create a Storm Drain Map

As noted earlier, storm drain network investigations are extremely difficult to perform if accurate storm drain maps are not available. In these situations, field crews may need to resort to dye testing to determine the flowpath within the storm drain network. Fluorescent dye is introduced into the storm drain network and suspected manholes are then inspected to trace the path of flow through the network (U.S. EPA, 1990). Two or three member crews are needed for dye testing. One person drops the dye into the trunk while the other(s) looks for evidence of the dye down pipe.

To conduct the investigation, a point of interest or down pipe "stopping point" is identified. Dye is then introduced into manholes upstream of the stopping point to determine if they are connected. The process continues in a systematic manner until an upstream manhole can no longer be determined, whereby a branch or trunk of the system can be defined, updated or corrected. More information on dye testing methods is provided in Section 13.3.

Manhole Inspection: Visual Observations and Indicator Sampling

Two primary methods are used to characterize discharges observed during manhole inspections—visual observations and indicator sampling. In both methods, field crews must first open the manhole to determine whether an illicit discharge is present. Manhole inspections require a crew of two and should be conducted during dry weather conditions.

Basic field equipment and safety procedures required for manhole inspections are outlined in Table 54. In particular, field crews need to be careful about how they will safely divert traffic (Figure 54). Other safety considerations include proper lifting of manhole covers to reduce the potential for back injuries, and testing whether any toxic or flammable fumes exist within the manhole before the cover is removed. Wayne County, MI has developed some useful operational procedures for inspecting manholes, which are summarized in Table 55.

Table 54: Basic Field Equipment Checklist

- Camera and film or digital camera
- Clipboards
- Field sheets
- Field vehicle
- First aid kit
- Flashlight or spotlight
- Gas monitor and probe
- Manhole hook/crow bar
- Mirror
- Storm drain, stream, and street maps
- Reflective safety vests
- Rubber / latex gloves
- Sledgehammer
- Spray paint
- Tape measures
- Traffic cones
- Two-way radios
- Waterproof marker/ pen
- Hand held global positioning satellite (GPS) system receiver (best resolution available within budget, at least 6' accuracy)



Figure 54: Traffic cones divert traffic from manhole inspection area

Table 55: Field Procedure for Removal of Manhole Covers
(Adapted from: Pomeroy et al., 1996)

Field Procedures:

1. Locate the manhole cover to be removed.
2. Divert road and foot traffic away from the manhole using traffic cones.
3. Use the tip of a crowbar to lift the manhole cover up high enough to insert the gas monitor probe. Take care to avoid creating a spark that could ignite explosive gases that may have accumulated under the lid. Follow procedures outlined for the gas monitor to test for accumulated gases.
4. If the gas monitor alarm sounds, close the manhole immediately. Do not attempt to open the manhole until some time is allowed for gases to dissipate.
5. If the gas monitor indicates the area is clear of hazards, remove the monitor probe and position the manhole hook under the flange. Remove the crowbar. Pull the lid off with the hook.
6. When testing is completed and the manhole is no longer needed, use the manhole hook to pull the cover back in place. Make sure the lid is settled in the flange securely.
7. Check the area to ensure that all equipment is removed from the area prior to leaving.

Safety Considerations:

1. Do not lift the manhole cover with your back muscles.
2. Wear steel-toed boots or safety shoes to protect feet from possible crushing injuries that could occur while handling manhole covers.
3. Do not move manhole covers with hands or fingers.
4. Wear safety vests or reflective clothing so that the field crew will be visible to traffic.
5. Manholes may only be entered by properly trained and equipped personnel and when all OSHA and local rules a.

Visual Observations During Manhole Inspection

Visual observations are used to observe conditions in the manhole and look for any signs of sewage or dry weather flow. Visual observations work best for obvious illicit discharges that are not masked by groundwater or other "clean" discharges, as shown in Figure 55. Typically, crews progressively inspect manholes in the storm drain network to look for contaminated flows. Key visual observations that are made during manhole inspections include:

- Presence of flow
- Colors
- Odors
- Floatable materials
- Deposits or stains (intermittent flows)



Figure 55: Manhole observation (left) indicates a sewage discharge. Source is identified at an adjacent sewer manhole that overflowed into the storm drain system (right).

Indicator Sampling

If dry weather flow is observed in the manhole, the field crew can collect a sample by attaching a bucket or bottle to a tape measure/rope and lowering it into the manhole (Figure 56). The sample is then immediately analyzed in the field using probes or other tests to get fast results as to whether the flow is clean or dirty. The most common indicator parameter is ammonia, although other potential indicators are described in Chapter 12.

Manhole indicator data is analyzed by looking for "hits," which are individual samples that exceed a benchmark concentration. In addition, trends in indicator concentrations are also examined throughout the storm drain network.



Figure 56: Techniques to sample from the storm drain

Figure 57 profiles a storm drain network investigation that used ammonia as the indicator parameter and a benchmark concentration of 1.0 mg/L. At both the outfall and the first manhole up the trunk, field crews recorded finding "hits" for ammonia of 2.2 mg/L and 2.3 mg/L, respectively. Subsequent manhole inspections further up the network revealed one manhole with no flow, and a second with a hit for ammonia (2.4 mg/L). The crew then tracked the discharge upstream of the second manhole, and found a third manhole with a low ammonia reading (0.05 mg/L) and a fourth with a much higher reading (4.3 mg/L). The crew then redirected its effort to sample above the fourth manhole with the 4.3 mg/L concentration, only to find another low reading. Based on this pattern, the crew concluded the discharge source was located between these two manholes, as nothing else could explain this sudden increase in concentration over this length of pipe.

The results of storm drain network investigations should be systematically documented to guide future discharge investigations, and describe any infrastructure maintenance problems encountered. An example of a sample manhole inspection field log is displayed in Figure 58.

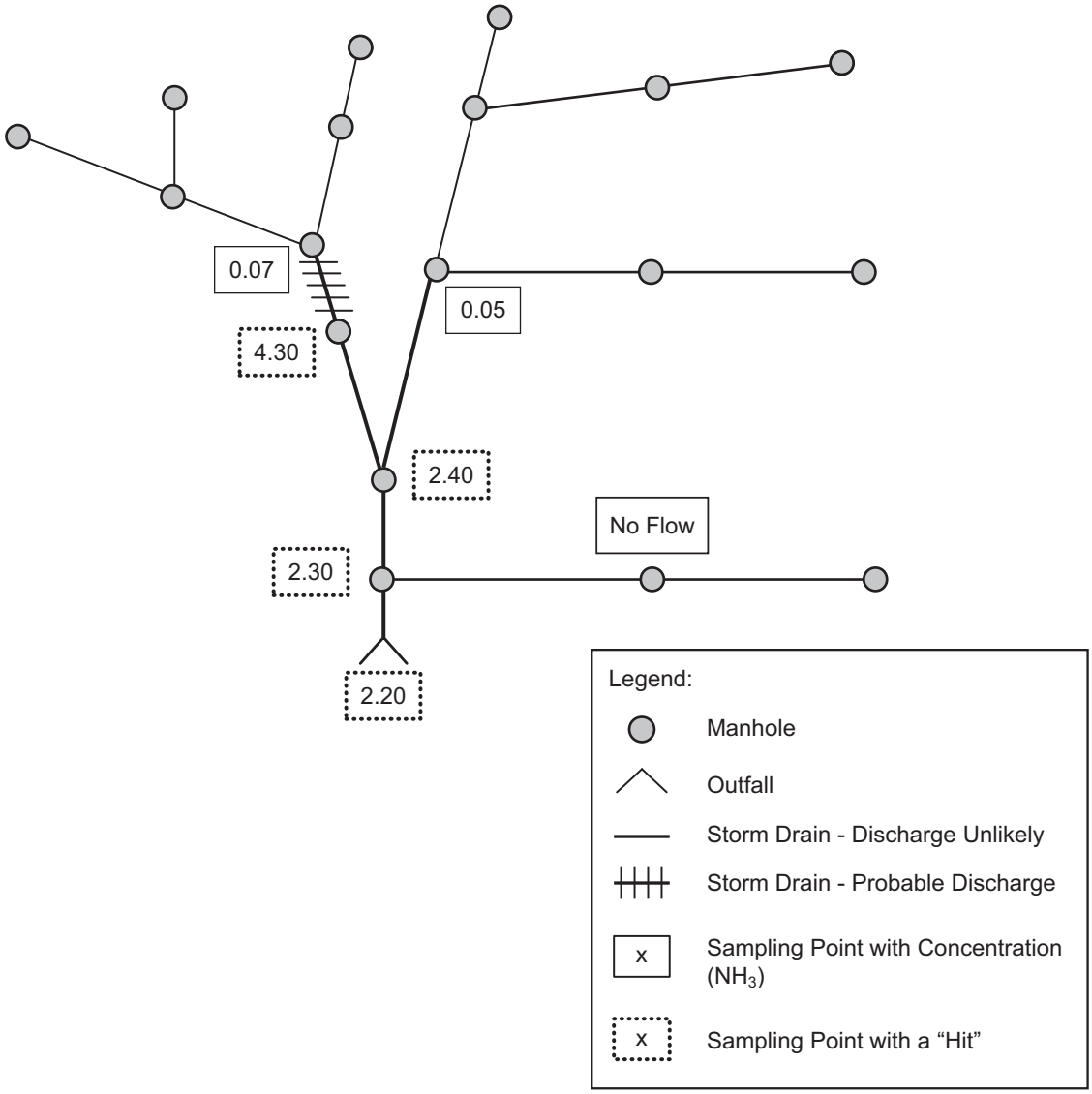
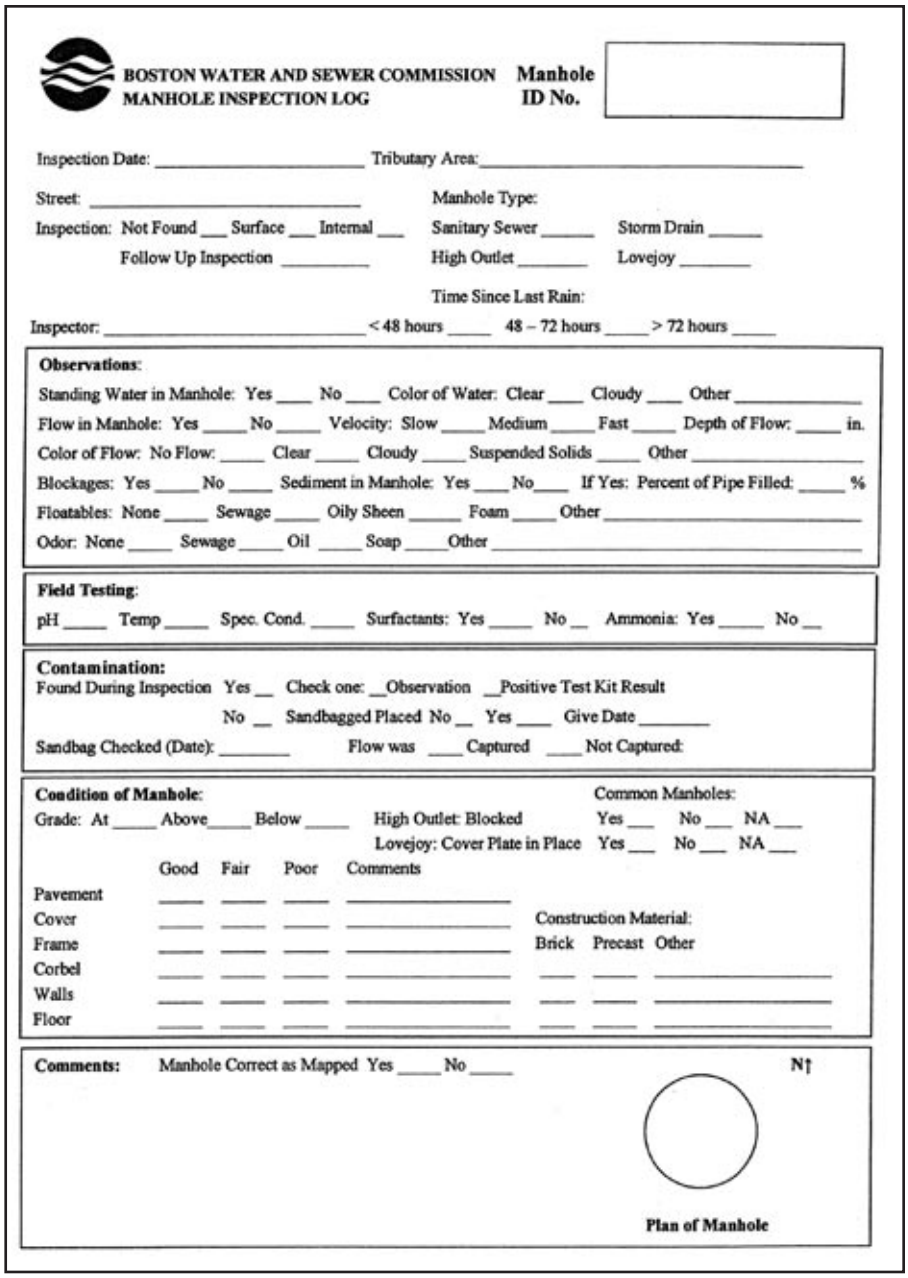


Figure 57: Use of ammonia as a trace parameter to identify illicit discharges



BOSTON WATER AND SEWER COMMISSION
MANHOLE INSPECTION LOG

Manhole ID No. _____

Inspection Date: _____ Tributary Area: _____

Street: _____ Manhole Type:

Inspection: Not Found ___ Surface ___ Internal ___ Sanitary Sewer _____ Storm Drain _____

Follow Up Inspection _____ High Outlet _____ Lovejoy _____

Time Since Last Rain:

Inspector: _____ < 48 hours _____ 48 – 72 hours _____ > 72 hours _____

Observations:

Standing Water in Manhole: Yes ____ No ____ Color of Water: Clear ____ Cloudy ____ Other _____

Flow in Manhole: Yes _____ No _____ Velocity: Slow _____ Medium _____ Fast _____ Depth of Flow: _____ in.

Color of Flow: No Flow: _____ Clear _____ Cloudy _____ Suspended Solids _____ Other _____

Blockages: Yes _____ No _____ Sediment in Manhole: Yes ____ No____ If Yes: Percent of Pipe Filled: _____ %

Floatables: None _____ Sewage _____ Oily Sheen _____ Foam _____ Other _____

Odor: None _____ Sewage _____ Oil _____ Soap _____ Other _____

Field Testing:

pH _____ Temp _____ Spec. Cond. _____ Surfactants: Yes _____ No __ Ammonia: Yes _____ No __

Contamination:

Found During Inspection Yes __ Check one: __Observation __Positive Test Kit Result

No __ Sandbagged Placed No __ Yes ____ Give Date _____

Sandbag Checked (Date): _____ Flow was ____ Captured ____ Not Captured:

Condition of Manhole:

Grade: At _____ Above _____ Below _____ High Outlet: Blocked Yes ___ No ___ NA ___

Lovejoy: Cover Plate in Place Yes ___ No ___ NA ___

Common Manholes:

	Good	Fair	Poor	Comments	Construction Material: Brick	Precast	Other
Pavement	____	____	____	_____			
Cover	____	____	____	_____			
Frame	____	____	____	_____			
Corbel	____	____	____	_____	___	___	_____
Walls	____	____	____	_____	___	___	_____
Floor	____	____	____	_____	___	___	_____

Comments: Manhole Correct as Mapped Yes _____ No _____

N↑

Plan of Manhole

Figure 58: Boston Water and Sewer Commission Manhole Inspection Log (Source: Jewell, 2001)

Methods to isolate intermittent discharges in the storm drain network

Intermittent discharges are often challenging to trace in the storm drain network, although four techniques have been used with some success.

Sandbags

This technique involves placement of sandbags or similar barriers within strategic manholes in the storm drain network to form a temporary dam that collects any intermittent flows that may occur. Any flow collected behind the sandbag is then assessed using visual observations or by indicator sampling. Sandbags are lowered on a rope through the manhole to form a dam along the bottom of the storm drain, taking care not to fully block the pipe (in case it rains before the sandbag is retrieved). Sandbags are typically installed at junctions in the network to eliminate contributing branches from further consideration (Figure 59). If no flow collects behind the sandbag, the upstream pipe network can be ruled out as a source of the intermittent discharge.

Sandbags are typically left in place for no more than 48 hours, and should only be installed when dry weather is forecast. Sandbags should not be left in place during a heavy rainstorm. They may cause a blockage in the storm drain, or, they may be washed downstream and lost. The biggest downside to sandbagging is that it requires at least two trips to each manhole.

Optical Brightener Monitoring (OBM) Traps

Optical brightener monitoring (OBM) traps, profiled in Chapter 12, can also be used to detect intermittent flows at manhole junctions. When these absorbent pads are anchored in the pipe to capture dry weather flows, they can be used to determine the presence of flow and/or detergents. These OBM traps are frequently installed by lowering them into an open-grate drop inlet or storm drain inlet, as shown in Figure 60. The pads are then retrieved after 48 hours and are observed under a fluorescent light (this method is most reliable for undiluted washwaters).

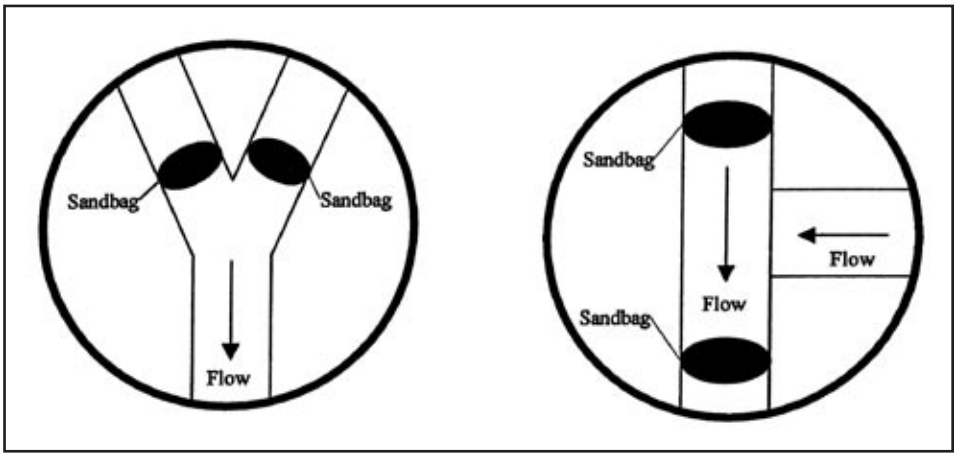


Figure 59: Example sandbag placement (Source: Jewell, 2001)



Figure 60: Optical Brightener Placement in the Storm Drain
(Source: Sargent and Castonguay, 1998)

Automatic Samplers

A few communities have installed automated samplers at strategic points within the storm drain network system that are triggered by small dry weather flows and collect water quality samples of intermittent discharges. Automated sampling can be extremely expensive, and is primarily used in very complex drainage areas that have severe intermittent discharge problems. Automated samplers can pinpoint the specific date and hours when discharges occur, and characterize its chemical composition, which can help crews fingerprint the generating source.

Observation of Deposits or Stains

Intermittent discharges often leave deposits or stains within the storm drain pipe or manhole after they have passed. Thus, crews should note whether any deposits or stains are present in the manhole, even if no dry weather flow is observed. In some cases, the origin of the discharge can be surmised by collecting indicator samples in the water ponded within the manhole sump. Stains and deposits, however, are not always a conclusive way to trace intermittent discharges in the storm drain network.

13.2 Drainage Area Investigations

The source of some illicit discharges can be determined through a survey or analysis of the drainage area of the problem outfall. The simplest approach is a rapid windshield survey of the drainage area to find the potential discharger or generating sites. A more sophisticated approach relies on an analysis of available GIS data and permit databases to identify industrial or other generating sites. In both cases, drainage area investigations are only effective if the discharge observed at an outfall has distinct or unique characteristics that allow crews to quickly ascertain the probable operation or business that is generating it. Often, discharges with a unique color, smell, or off-the-chart indicator sample reading may point to a specific industrial or commercial source. Drainage area investigations are not helpful in tracing sewage discharges, since they are often not always related to specific land uses or generating sites.

Rapid Windshield Survey

A rapid drive-by survey works well in small drainage areas, particularly if field crews are already familiar with its business operations. Field crews try to match the characteristics of the discharge to the most likely type of generating site, and then inspect all of the sites of the same type within the drainage area until the culprit is found. For example, if fuel is observed at an outfall, crews might quickly check every business operation in the catchment that stores or dispenses fuel. Another example is illustrated in Figure 61 where extremely dense algal growth was observed in a small stream during the winter. Field crews were aware of a fertilizer storage site in the drainage area, and a quick inspection identified it as the culprit.



Figure 61: Symptom (left): Discoloration of stream; Diagnosis: Extra hydroseed leftover from an upstream application (middle) was dumped into a storm drain by municipal officials (right).

A third example of the windshield survey approach is shown in Figure 62, where a very thick, sudsy and fragrant discharge was noted at a small outfall. The discharge appeared to consist of wash water, and the only commercial laundromat found upstream was confirmed to be the source. On-site testing may still be needed to identify the specific plumbing or connection generating the discharge.

Detailed Drainage Area Investigations

In larger or more complex drainage areas, GIS data can be analyzed to pinpoint the source of a discharge. If only general land use data exist, maps can at least highlight suspected industrial areas. If more detailed SIC code data are available digitally, the GIS can be used to pull up specific hotspot operations or generating sites that could be potential dischargers. Some of the key discharge indicators that are associated with hotspots and specific industries are reviewed in Appendix K.

13.3 On-site Investigations

On-site investigations are used to pinpoint the exact source or connection producing a discharge within the storm drain network. The three basic approaches are dye, video and smoke testing. While each approach can determine the actual source of a discharge, each needs to be applied under the right conditions and test limitations (see Table 56). It should be noted that on-site investigations are not particularly effective in finding *indirect* discharges to the storm drain network.



Figure 62: The sudsy, fragrant discharge (left) indicates that the laundromat is the more likely culprit than the florist (right).

Table 56: Techniques to Locate the Discharge		
Technique	**Best Applications**	**Limitations**
Dye Testing	• Discharge limited to a very small drainage area (<10 properties is ideal) • Discharge probably caused by a connection from an individual property • Commercial or industrial land use	• May be difficult to gain access to some properties
Video Testing	• Continuous discharges • Discharge limited to a single pipe segment • Communities who own equipment for other investigations	• Relatively expensive equipment • Cannot capture non-flowing discharges • Often cannot capture discharges from pipes submerged in the storm drain
Smoke Testing	• Cross-connection with the sanitary sewer • Identifying other underground sources (e.g., leaking storage techniques) caused by damage to the storm drain	• Poor notification to public can cause alarm • Cannot detect all illicit discharges

TIP

The Wayne County Department of the Environment provides excellent training materials on on-site investigations, as well as other illicit discharge techniques. More information about this training can be accessed from their website: http://www.wcdoe.org/Watershed/Programs___Srvcs_/IDEP/idep.htm.



Figure 63: Dye Testing Plumbing (NEIWPCC, 2003)

Dye Testing

Dye testing is an excellent indicator of illicit connections and is conducted by introducing non-toxic dye into toilets, sinks, shop drains and other plumbing fixtures (see Figure 63). The discovery of dye in the storm drain, rather than the sanitary sewer, conclusively determines that the illicit connection exists.

Before commencing dye tests, crews should review storm drain and sewer maps to identify lateral sewer connections and how they can be accessed. In addition, property owners must be notified to obtain entry permission. For industrial or commercial properties, crews should carry a letter to document their legal authority to gain access to the property. If time permits, the letter can be sent in advance of the dye testing. For residential properties, communication can be more challenging. Unlike commercial properties, crews are not guaranteed access to homes, and should call ahead to ensure that the owner will be home on the day of testing.

Communication with other local agencies is also important since any dye released to the storm drain could be mistaken for a spill or pollution episode. To avoid a costly and embarrassing response to a false alarm,

crews should contact key spill response agencies using a "quick fax" that describes when and where dye testing is occurring (Tuomari and Thomson, 2002). In addition, crews should carry a list of phone numbers to call spill response agencies in the event dye is released to a stream.

At least two staff are needed to conduct dye tests – one to flush dye down the plumbing fixtures and one to look for dye in the downstream manhole(s). In some cases, three staff may be preferred, with two staff entering the private residence or building for both safety and liability purposes.

The basic equipment to conduct dye tests is listed in Table 57 and is not highly specialized. Often, the key choice is the type of dye to use for testing. Several options are profiled in Table 58. In most cases, liquid dye is used, although solid dye tablets can also be placed in a mesh bag and lowered into the manhole on a rope (Figure 64). If a

Table 57: Key Field Equipment for Dye Testing
(Source: Wayne County, MI, 2000)

Maps, Documents
- Sewer and storm drain maps (sufficient detail to locate manholes)
- Site plan and building diagram
- Letter describing the investigation
- Identification (e.g., badge or ID card)
- Educational materials (to supplement pollution prevention efforts)
- List of agencies to contact if the dye discharges to a stream.
- Name of contact at the facility

Equipment to Find and Lift the Manhole Safely (small manhole often in a lawn)
- Probe
- Metal detector
- Crow bar
- Safety equipment (hard hats, eye protection, gloves, safety vests, steel-toed boots, traffic control equipment, protective clothing, gas monitor)

Equipment for Actual Dye Testing and Communications
- 2-way radio
- Dye (liquid or "test strips")
- High powered lamps or flashlights
- Water hoses
- Camera



Figure 64: Dye in a mesh bag is placed into an upstream manhole (left); Dye observed at a downstream manhole traces the path of the storm drain (right)

longer pipe network is being tested, and dye is not expected to appear for several hours, charcoal packets can be used to detect the dye (GCHD, 2002). Charcoal packets can be secured and left in place for a week or two, and then analyzed for the presence of dye. Instructions for using charcoal packets in dye testing can be accessed at the following website: http://bayinfo.tamug.tamu.edu/gbeppubs/ms4.pdf.

The basic drill for dye tests consists of three simple steps. First, flush or wash dye down the drain, fixture or manhole. Second, pop open downgradient sanitary sewer manholes and check to see if any dye appears. If none is detected in the sewer manhole after an hour or so, check downgradient storm drain manholes or outfalls for the presence of dye. Although dye testing is fairly straightforward, some tips to make testing go more smoothly are offered in Table 59.

Table 58: Dye Testing Options

Product	Applications
Dye Tablets	• Compressed powder, useful for releasing dye over time • Less messy than powder form • Easy to handle, no mess, quick dissolve • Flow mapping and tracing in storm and sewer drains • Plumbing system tracing • Septic system analysis • Leak detection
Liquid Concentrate	• Very concentrated, disperses quickly • Works well in all volumes of flow • Recommended when metering of input is required • Flow mapping and tracing in storm and sewer drains • Plumbing system tracing • Septic system analysis • Leak detection
Dye Strips	• Similar to liquid but less messy
Powder	• Can be very messy and must dissolve in liquid to reach full potential • Recommended for very small applications or for very large applications where liquid is undesirable • Leak detection
Dye Wax Cakes	• Recommended for moderate-sized bodies of water • Flow mapping and tracing in storm and sewer drains
Dye Wax Donuts	• Recommended for large sized bodies of water (lakes, rivers, ponds) • Flow mapping and tracing in storm and sewer drains • Leak detection

Table 59: Tips for Successful Dye Testing
(Adapted from Tuomari and Thompson, 2002)

Dye Selection
- Green and liquid dyes are the easiest to see.
- Dye test strips can be a good alternative for residential or some commercial applications. (Liquid can leave a permanent stain).
- Check the sanitary sewer before using dyes to get a "base color." In some cases, (e.g., a print shop with a permitted discharge to the sanitary sewer), the sewage may have an existing color that would mask a dye.
- Choose two dye colors, and alternate between them when testing multiple fixtures.

Selecting Fixtures to Test
- Check the plumbing plan for the site to isolate fixtures that are separately connected.
- For industrial facilities, check most floor drains (these are often misdirected).
- For plumbing fixtures, test a representative fixture (e.g., a bathroom sink).
- Test some locations separately (e.g., washing machines and floor drains), which may be misdirected.
- If conducting dye investigations on multiple floors, start from the basement and work your way up.
- At all fixtures, make sure to flush with plenty of water to ensure that the dye moves through the system.

Selecting a Sewer Manhole for Observations
- Pick the closest manhole possible to make observations (typically a sewer lateral).
- If this is not possible, choose the nearest downstream manhole.

Communications Between Crew Members
- The individual conducting the dye testing calls in to the field person to report the color dye used, and when it is dropped into the system.
- The field person then calls back when dye is observed in the manhole.
- If dye is not observed (e.g., after two separate flushes have occurred), dye testing is halted until the dye appears.

Locating Missing Dye
- The investigation is not complete until the dye is found. Some reasons for dye not appearing include:
- The building is actually hooked up to a septic system.
- The sewer line is clogged.
- There is a leak in the sewer line or lateral pipe.

Video Testing

Video testing works by guiding a mobile video camera through the storm drain pipe to locate the actual connection producing an illicit discharge. Video testing shows flows and leaks within the pipe that may indicate an illicit discharge, and can show cracks and other pipe damage that enable sewage or contaminated water to flow into the storm drain pipe.

Video testing is useful when access to properties is constrained, such as residential neighborhoods. Video testing can also be expensive, unless the community already owns and uses the equipment for sewer inspections. This technique will not detect all types of discharges, particularly when the illicit connection is not flowing at the time of the video survey.

Different types of video camera equipment are used, depending on the diameter and condition of the storm sewer being tested.

Field crews should review storm drain maps, and preferably visit the site before selecting the video equipment for the test. A field visit helps determine the camera size needed to fit into the pipe, and if the storm drain has standing water.

In addition to standard safety equipment required for all manhole inspections, video testing requires a Closed-Circuit Television (CCTV) and supporting items. Many commercially available camera systems are specifically adapted to televise storm sewers, ranging from large truck or van-mounted systems to much smaller portable cameras. Cameras can be self-propelled or towed. Some specifications to look for include:

- The camera should be capable of radial view for inspection of the top, bottom, and sides of the pipe and for looking up lateral connections.
- The camera should be color.
- Lighting should be supplied by a lamp on the camera that can light the entire periphery of the pipe.

When inspecting the storm sewer, the CCTV is oriented to keep the lens as close as possible to the center of the pipe. The camera can be self-propelled through the pipe using a tractor or crawler unit or it may be towed through on a skid unit (see Figures 65 and 66). If the storm drain has ponded water, the camera should be attached to a raft, which floats through the storm sewer from one manhole to the next. To see details of the sewer, the camera and lights should be able to swivel both horizontally and vertically. A video record of the inspection should be made for future reference and repairs (see Figure 67).

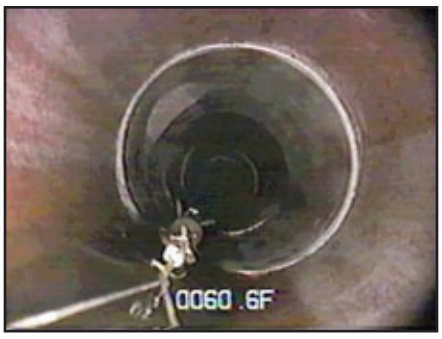


Figure 65: Camera being towed

Smoke Testing

Smoke testing is another "bottom up" approach to isolate illicit discharges. It works by introducing smoke into the storm drain system and observing where the smoke surfaces. The use of smoke testing to detect illicit discharges is a relatively new application, although many communities have used it to check for infiltration and inflow into their sanitary sewer network. Smoke testing can find improper



Figure 66: Tractor-mounted camera



Figure 67: Review of an inspection video

connections, or damage to the storm drain system (Figure 68). This technique works best when the discharge is confined to the upper reaches of the storm drain network, where pipe diameters are to small for video testing and gaining access to multiple properties renders dye testing infeasible.

Notifying the public about the date and purpose of smoke testing before starting is critical. The smoke used is non-toxic, but can cause respiratory irritation, which can be a problem for some residents. Residents should be notified at least two weeks prior to testing, and should be provided the following information (Hurco Technologies, Inc., 2003):

- Date testing will occur
- Reason for smoke testing
- Precautions they can take to prevent smoke from entering their homes or businesses
- What they need to do if smoke enters their home or business, and any health concerns associated with the smoke
- A number residents can call to relay any particular health concerns (e.g., chronic respiratory problems)

Program managers should also notify local media to get the word out if extensive smoke testing is planned (e.g., television, newspaper, and radio). On the actual day of testing, local fire, police departments and 911 call centers should be notified to handle any calls from the public (Hurco Technologies, Inc., 2003).

The basic equipment needed for smoke testing includes manhole safety equipment, a smoke source, smoke blower, and sewer plugs. Two smoke sources can be used for smoke testing. The first is a smoke "bomb," or "candle" that burns at a controlled rate and releases very white smoke visible at relatively low concentrations (Figure 69). Smoke bombs are suspended beneath a blower in a manhole. Candles are available in 30 second to three minute sizes. Once opened, smoke bombs should be kept in a dry location and should be used within one year.

The second smoke source is liquid smoke, which is a petroleum-based product that is injected into the hot exhaust of a blower where it is heated and vaporized (Figure 70). The length of smoke production can vary depending on the length of the pipe being

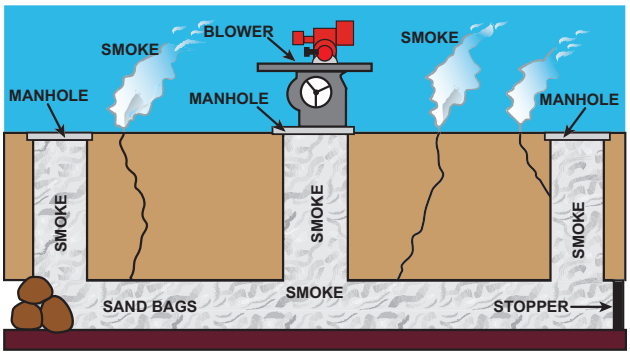


Figure 68: Smoke Testing System Schematic



Figure 69: Smoke Candles



Figure 70: Smoke blower

tested. In general, liquid smoke is not as consistently visible and does not travel as far as smoke from bombs (USA Blue Book).

Smoke blowers provide a high volume of air that forces smoke through the storm drain pipe. Two types of blowers are commonly used: "squirrel cage" blowers and direct-drive propeller blowers. Squirrel cage blowers are large and may weigh more than 100 pounds, but allow the operator to generate more controlled smoke output. Direct-drive propeller blowers are considerably lighter and more compact, which allows for easier transport and positioning.

Three basic steps are involved in smoke testing. First, the storm drain is sealed off by plugging storm drain inlets. Next, the smoke is released and forced by the blower through the storm drain system. Lastly, the crew looks for any escape of smoke above-ground to find potential leaks.

One of three methods can be used to seal off the storm drain. Sandbags can be lowered into place with a rope from the street surface. Alternatively, beach balls that have a diameter slightly larger than the drain can be inserted into the pipe. The beach ball is then placed in a mesh bag with a rope attached to it so it can be secured and retrieved. If the beach ball gets stuck in the pipe, it can simply be punctured, deflated and removed. Finally, expandable plugs are available, and may be inserted from the ground surface.

Blowers should be set up next to the open manhole after the smoke is started. Only one manhole is tested at a time. If smoke candles are used, crews simply light the candle, place it in a bucket, and lower it in the manhole. The crew then watches to see where smoke escapes from the pipe. The two most common situations that indicate an illicit discharge are when smoke is seen rising from internal plumbing fixtures (typically reported by residents) or from sewer vents. Sewer vents extend upward from the sewer lateral to release gas buildup, and are not supposed to be connected to the storm drain system.

13.4 Septic System Investigations

The techniques for tracing illicit discharges are different in rural or low-density residential watersheds. Often, these watersheds lack sanitary sewer service and storm water is conveyed through ditches or swales, rather than enclosed pipes. Consequently, many illicit discharges enter the stream as indirect discharges, through surface breakouts of septic fields or through straight pipe discharges from bypassed septic systems.

The two broad techniques used to find individual septic systems—on-site investigations and infrared imagery—are described in this section.

On-Site Septic Investigations

Three kinds of on-site investigations can be performed at individual properties to determine if the septic system is failing, including homeowner survey, surface condition analysis and a detailed system inspection. The first two investigations are rapid and relatively simple assessments typically conducted in targeted watershed areas. Detailed system inspections are a much more thorough investigation of the functioning of the septic system that is conducted by a certified professional. Detailed system inspections may occur at time of sale of a property, or be triggered by poor scores on the rapid homeowner survey or surface condition analysis.

Homeowner Survey

The homeowner survey consists of a brief interview with the property owner to determine the potential for current or future failure of the septic system, and is often done in conjunction with a surface condition analysis.

Table 60 highlights some common questions to ask in the survey, which inquire about resident behaviors, system performance and maintenance activity.

Surface Condition Analysis

The surface condition analysis is a rapid site assessment where field crews look for obvious indicators that point to current or potential production of illicit discharges by the septic system (Figure 71). Some of the key surface conditions to analyze have been described by Andrews *et al*., (1997) and are described below:

- Foul odors in the yard
- Wet, spongy ground; lush plant growth; or burnt grass near the drain field
- Algal blooms or excessive weed growth in adjacent ditches, ponds and streams
- Shrubs or trees with root damage within 10 feet of the system
- Cars, boats, or other heavy objects located over the field that could crush lateral pipes
- Storm water flowing over the drain field
- Cave-ins or exposed system components
- Visible liquid on the surface of the drain field (e.g., surface breakouts)
- Obvious system bypasses (e.g., straight pipe discharges)

Table 60: Septic System Homeowner Survey Questions
(Adapted from Andrews et al., 1997 and Holmes Inspection Services)

- How many people live in the house?[1]
- What is the septic tank capacity?[2]
- Do drains in the house empty slowly or not at all?
- When was the last time the system was inspected or maintained?
- Does sewage back up into the house through drain lines?
- Are there any wet, smelly spots in the yard?
- Is the septic tank effluent piped so it drains to a road ditch, a storm sewer, a stream, or is it connected to a farm drain tile?

[1] Water usage ranges from 50 to 100 gallons per day per person. This information can be used to estimate the wastewater load from the house (Andrews et. al, 1997).
[2] The septic tank should be large enough to hold two days' worth of wastewater (Andrews et. al, 1997).

a.  b. 

Figure 71: (a) Straight pipe discharge to nearby stream. (b) Algal bloom in a nearby pond.
(Sources: a- Snohomish County, WA, b- King County, WA)

Detailed System Inspection

The detailed system inspection is a much more thorough inspection of the performance and function of the septic system, and must be completed by a certified professional. The inspector certifies the structural integrity of all components of the system, and checks the depth of solids in the septic tank to determine if the system needs to be pumped out. The inspector also sketches the system, and estimates distance to groundwater, surface water, and drinking water sources. An example septic system inspection form from Massachusetts can be found at http://www.state.ma.us/dep/brp/wwm/soilsys.htm.

Although not always incorporated into the inspection, dye testing can sometimes point to leaks from broken pipes, or direct discharges through straight pipes that might be missed during routine inspection. Dye can be introduced into plumbing fixtures in the home, and flushed with sufficient running water. The inspector then watches the septic field, nearby ditches, watercourses and manholes for any signs of the dye. The dye may take several hours to appear, so crews may want to place charcoal packets in adjacent waters to capture dye until they can return later to retrieve them.

Infrared Imagery

Infrared imagery is a special type of photography with gray or color scales that represent differences in temperature and emissivity of objects in the image (www.stocktoninfrared.com), and can be used to locate sewage discharges. Several different infrared imagery techniques can be used to identify illicit discharges. The following discussion highlights two of these: aerial infrared thermography[13] and color infrared aerial photography.

Infrared Thermography

Infrared thermography is increasingly being used to detect illicit discharges and failing septic systems. The technique uses the temperature difference of sewage as a marker to locate these illicit discharges. Figure 72 illustrates the thermal difference

[13] Infrared thermography is also being used by communities such as Mecklenburg County and the City of Charlotte in NC to detect illicit discharges at outfalls.

between an outfall discharge (with a higher temperature) and a stream.

The equipment needed to conduct aerial infrared thermography includes an aircraft (plane or helicopter); a high-resolution, large format, infrared camera with appropriate mount; a GPS unit; and digital recording equipment. If a plane is used, a higher resolution camera is required since it must operate at higher altitudes. Pilots should be experienced since flights take place at night, slowly, and at a low altitude. The camera may be handheld, but a mounted camera will provide significantly clearer results for a larger area. The GPS can be combined with a mobile mapping program and a video encoder-decoder that encodes and displays the coordinates, date, and time (Stockton, 2000). The infrared data are analyzed after the flight by trained analysts to locate suspected discharges, and field crews then inspect the ground-truthed sites to confirm the presence of a failing septic system.

Late fall, winter, and early spring are typically the best times of year to conduct these investigations in most regions of the country. This allows for a bigger difference between receiving water and discharge temperatures, and interference from vegetation is minimized (Stockton, 2004b). In addition, flights should take place at night to minimize reflected and direct daylight solar radiation that may adversely affect the imagery (Stockton, 2004b).



Figure 72: Aerial thermography showing sewage leak

Color Infrared Aerial Photography

Color infrared aerial photography looks for changes in plant growth, differences in soil moisture content, and the presence of standing water on the ground to primarily identify failing septic systems (Figure 73).

The Tennessee Valley Authority (TVA) uses color infrared aerial photography to detect failing septic systems in reservoir watersheds. Local health departments conduct follow-up ground-truthing surveys to determine if a system is actually failing (Sagona, 1986). Similar to thermography, it is recommended that flights take place at night, during leaf-off conditions, or when the water table is at a seasonal high (which is when most failures typically occur (U.S. EPA, 1999).

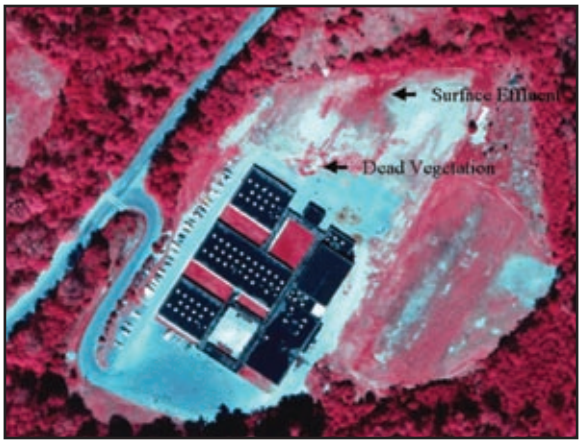


Figure 73: Dead vegetation and surface effluent are evidence of a septic system surface failure.
(Source: U.S. EPA, 1999)

13.5 The Cost to Trace Illicit Discharge Sources

Tracing illicit discharges to their source can be an elusive and complex process, and precise staffing and budget data are difficult to estimate. Experience of Phase I NPDES communities that have done these investigations in the past can shed some light on cost estimates. Some details on unit costs for common illicit discharge investigations are provided below.

Costs for Dye, Video, and Smoke Testing

The cost of smoke, dye, and video testing can be substantial and staff intensive, and often depend on investigation specific factors, such as the complexity of the drainage network, density and age of buildings, and complexity of land use. Wayne County, MI, has estimated the cost of dye testing at $900 per facility. Video testing costs range from $1.50 to $2.00 per foot, although this increases by $1.00 per foot if pipe cleaning is needed prior to testing.

Table 61 summarizes the costs of start-up equipment for basic manhole entry and inspection, which is needed regardless of which type of test is performed. Tables 62 through 64 provide specific equipment costs for dye, video and smoke testing, respectively.

Table 61: Common Field Equipment Needed for Dye, Video, and Smoke Testing

Item	Cost
1 Digital Camera	$200
Clipboards, Pens, Batteries	$25
1 Field vehicle	$15,000 - $35,000
1 First aid kit	$30
1 Spotlight	$40
1 Gas monitor and probe	$900 - $2,100
1 Hand-held GPS Unit	$150
2 Two-way radios	$250 - $750
1 Manhole hook	$80 - $130
1 Mirror	$70 - $130
2 Reflective safety vests	$40
Rubber/latex gloves (box of 100)	$25
1 Can of Spray Paint	$5
4 Traffic Cones	$50

Table 62: Equipment Costs for Dye Testing		
Product	**Water Volume**	**Cost**
Dye Strips	1 strip/500 gallons	$75 – $94 per 100 strips
Dye Tablets	0 – 50,000 gallons	$40 per 200 tablets
Liquid Concentrate (Rhodamine WT)	0 – 50,000 gallons	$80 – $90 per gallon $15 – $20 per pint
Powder	50,000 + gallons	$77 per lb
Dye Wax Cakes	20,000 – 50,000 gallons	$12 per one 1.25 ounce cake
Dye Wax Donuts	50,000 + gallons	$104 – $132 per 42 oz. donut
Price Sources: *Aquatic Eco-Systems http://www.aquaticeco.com/* *Cole Parmer http:/www.coleparmer.com* *USA Blue Book http:/www.usabluebook.com*		

Table 63: Equipment Costs for Video Testing	
Equipment	**Cost**
GEN-EYE 2™ B&W Sewer Camera with VCR & 200' Push Cable	$5,800
100' Push Rod and Reel Camera for 2" – 10" Pipes	$5,300
200' Push Rod and Reel Camera for 8" – 24" Pipes	$5,800
Custom Saturn III Inspection System 500' cable for 6-16" Lines	$32,000 ($33,000 with 1000 foot cable)
OUTPOST • Box with build-out • Generator • Washdown system	 $6,000 $2,000 $1,000
Video Inspection Trailer • 7'x10' trailer & build-out • Hardware and software package • Incidentals	 $18,500 $15,000 $5,000
Sprinter Chassis Inspection Vehicle • Van (with build-out for inspecting 6" – 24" pipes) • Crawler (needed to inspect pipes >24") • Software upgrade (optional but helpful for extensive pipe systems)	 $130,000 $18,000 $8,000
Sources: USA Blue Book and Envirotech	

Table 64: Equipment Costs for Smoke Testing	
Equipment	**Cost**
Smoke Blower	$1,000 to $2,000 each
Liquid Smoke	$38 to $45 per gallon
Smoke Candles, 30 second (4,000 cubic feet)	$27.50 per dozen
Smoke Candles, 60 Second (8,000 cubic feet)	$30.50 per dozen
Smoke Candles, 3 Minute (40,000 cubic feet)	$60.00 per dozen
Sources: Hurco Tech, 2003 and Cherne Industries, 2003	

Costs for Septic System Investigations

Most septic system investigations are relatively low cost, but factors such as private property access, notification, and the total number of sites investigated can increase costs. Unit costs for the three major septic system investigations are described below.

Homeowner Survey and Surface Condition Analysis

Both the homeowner survey and the surface condition analysis are relatively low cost investigation techniques. Assuming that a staff person can investigate one home per hour, the average cost per inspection is approximately $25. A substantial cost savings can be realized by using interns or volunteers to conduct these simple investigations.

Detailed System Inspection

Septic system inspections are more expensive, but a typical unit cost is about $250, and may also include an additional cost of pumping the system, at roughly $150, if pumping is required to complete the inspection (Wayne County, 2003). This cost is typically charged to the homeowner as part of a home inspection.

Aerial Infrared Thermography

The equipment needed to conduct aerial infrared thermography is expensive; cameras alone may range from $250,000 to $500,000 (Stockton, 2004a). However, private contractors provide this service. In general, the cost to contract an aerial infrared thermography investigation depends on the length of the flight (flights typically follow streams or rivers); how difficult it will be to fly the route; the number of heat anomalies expected to be encountered; the expected post-flight processing time (typically, four to five hours of analysis for every hour flown); and the distance of the site from the plane's "home" (Stockton, 2004a). The cost range is typically $150 to $400 per mile of stream or river flown, which includes the flight and post-flight analyses (Stockton, 2004a).

As an alternative, local police departments may already own an infrared imaging system that may be used. For instance, the Arkansas Department of Health used a state police helicopter with a Forward Looking Infrared (FLIR) imaging system, GPS, video equipment, and maps (Eddy, 2000). The disadvantage to this is that the equipment may not be available at optimal times to conduct the investigation. In addition, infrared imaging equipment used by police departments may not be sensitive enough to detect the narrow range of temperature difference (only a few degrees) often expected for sewage flows (Stockton, 2004a).

Chapter 14: Techniques to Fix Discharges

Quick and efficient correction of illicit discharges begins with having well defined legal authority and responsibilities coupled with strong enforcement and follow-up measures. Chapter 4 discussed important considerations with respect to legal authority and responsibility and Appendix B contains a model illicit discharge ordinance that provides language on violations, enforcement and penalties.

Most illicit discharge corrective actions involve some form of infrastructure modification or repair. These structural repairs are used to eliminate a wide variety of **direct discharges** such as sewage cross-connections, straight pipes, industrial cross-connections, and commercial cross-connections. Fixes range from simple plumbing projects to excavation and replacement of sewer lines. In some cases, structural repairs are necessary when **indirect** discharges, such as sewage from a sewer break or pump station failure enter the MS4 through an inlet, or flows directly into receiving waters. Most **transitory** discharges are corrected simply with spill containment and clean-up procedures. Section 8.3 previously discussed an overview of the correction process. The following section discusses more specific correction considerations.

14.1 Implementation Considerations

Once the source of an illicit discharge has been identified, steps should be taken to fix or eliminate the discharge. The following four questions should be answered for each individual illicit discharge to determine how to proceed:

- Who is responsible?
- What methods will be used to fix it?
- How long will it take?
- How will removal be confirmed?

The answer to each of these questions depends on the source of the discharge. Illicit discharges generally originate from one of the following sources:

- *An internal plumbing connection* (e.g., the discharge from a washing machine is directed to the building's storm lateral; the floor drain in a garage is connected to the building's storm lateral)
- *A service lateral cross-connection* (e.g., the sanitary lateral from a building is connected to the MS4)
- *An infrastructure failure within the sanitary sewer or MS4* (e.g., a collapsed sanitary line is discharging into the MS4)
- *An indirect transitory discharge resulting from leaks, spills, or overflows.*

Financial responsibility for source removal will typically fall on property owners, MS4 operators, or some combination of the two.

Who's responsible for fixing the problem?

Ultimate responsibility for removing the source of a discharge is generally that of either the property owner or the municipality/utility (e.g., primary owner/operator of the MS4).

Internal Plumbing Connection

The responsibility for correcting an internal plumbing connection is generally the responsibility of the building owner. Communities may wish to develop a list of certified contractors that property owners can hire for corrections.

Service Lateral

As with internal plumbing connections, the responsibility for correcting a problem within a service lateral is typically that of the property owner being served by the lateral. However, the cost of correcting a service lateral problem can be significantly higher than that of fixing an internal plumbing problem, so communities may want to consider alternative remedial approaches than those for internal plumbing corrections. For example, communities can have on-call contractors fix lateral connections allowing the problem to be fixed as soon as it is discovered. The community can then: 1) pay for correction costs through the capital budget, or state or federal funding options, or 2) share the cost with the owner, or 3) pass on the full cost to the property owner.

Infrastructure Failure Within the Sanitary Sewer or MS4

Illicit discharges related to some sort of infrastructure failure within the sanitary sewer or MS4 should be corrected by the jurisdiction, utility, or agency responsible for maintenance of the sewers and drains.

Transitory Discharge

Repair of transitory discharge sources will usually be the responsibility of the property owner where the discharge originates. Ordinances should clearly stipulate the time frame in which these discharges should be repaired.

What methods will be used to fix the problem?

The methods used to eliminate discharges will vary depending on the type of problem and the location of the problem. Internal plumbing corrections can often be performed using standard plumbing supplies for relatively little cost. For correction locations that occur outside of the building, such as service laterals or infrastructure in the right of way, costs tend to be significantly more due to specialized equipment needs. Certified contractors are recommended for these types of repairs. Table 65 provides a summary of a range of methods for fixing these more significant problems along with estimated costs. The last six techniques described in Table 68 are used for sanitary sewer line repair and rehabilitation. These activities are typically used when there is evidence of significant seepage from the sanitary system to the storm drain system.

How long should it take?

The timeframe for eliminating a connection or discharge should depend on the type of connection or discharge and how difficult elimination will be. A discharge that poses a significant threat to human or environmental health should be discontinued and eliminated immediately. Clear guidance should be provided in the local ordinance on the timeframe for removing discharges and connections. Typically, discharges should be stopped within seven days of notification by the municipality, and illicit connections should be repaired within 30 days of notification.

How is the removal or correction confirmed?

Removal and correction of a discharge or connection should be confirmed both at the

source, to ensure that the correction has been made, and downstream, to ensure that it is the only local discharge present.

For discharges resulting from internal plumbing and lateral connections, dye testing can confirm the correction. Also, sandbagging should be done in the first accessible storm drain manhole downstream of the correction to verify that this was the only discharge present.

The correction of discharges resulting from some sort of infrastructure failure in the sanitary sewer or MS4 can be verified by dye testing or televising the line in conjunction with sandbagging and sampling at an accessible downstream manhole.

Table 65: Methods to Eliminate Discharges

Technique	Application	Description	Estimated Cost
1. Service Lateral Disconnection, Reconnection	Lateral is connected to the wrong line	Lateral is disconnected and reconnected to appropriate line	$2,500[1]
2. Cleaning	Line is blocked or capacity diminished	Flushing (sending a high pressure water jet through the line); pigging (dragging a large rubber plug through the lines); or rodding	$1/linear foot[2]
3. Excavation and Replacement	Line is collapsed, severely blocked, significantly misaligned, or undersized	Existing pipe is removed, new pipe placed in same alignment; Existing pipe abandoned in place, replaced by new pipe in parallel alignment	For 14” line, $50-$100/linear foot (higher number is associated with repaving or deeper excavations, if necessary)[2]
4. Manhole Repair	Decrease ponding; prevent flow of surface water into manhole; prevent groundwater infiltration	Raise frame and lid above grade; install lid inserts; grout, mortar or apply shortcrete inside the walls; install new precast manhole.	Vary widely, from $250 to raise a frame and cover to ~ $2,000 to replace manhole[2]
5. Corrosion Control Coating	Improve resistance to corrosion	Spray- or brush-on coating applied to interior of pipe.	< $10/linear foot[2]
6. Grouting	Seal leaking joints and small cracks	Seals leaking joints and small cracks.	For a 12” line, ~ $36-$54/linear foot[2]
7. Pipe Bursting	Line is collapsed, severely blocked, or undersized	Existing pipe used as guide for inserting expansion head; expansion head increases area available for new pipe by pushing existing pipe out radially until it cracks; bursting device pulls new pipeline behind it	For 8” pipe, $40-$80/linear foot[4]
8. Slip Lining	Pipe has numerous cracks, leaking joints, but is continuous and not misaligned	Pulling of a new pipe through the old one.	For 12” pipe, $50-$75 /linear foot[2]
9. Fold and Formed Pipe	Pipe has numerous cracks, leaking joints	Similar to sliplining but is easier to install, uses existing manholes for insertion; a folded thermoplastic pipe is pulled into place and rounded to conform to internal diameter of existing pipe	For 8-12” pipe, $60-$78/linear foot[3]

Table 65: Methods to Eliminate Discharges			
Technique	**Application**	**Description**	**Estimated Cost**
10. Inversion Lining	Pipe has numerous cracks, leaking joints; can be used where there are misalignments	Similar to sliplining but is easier to install, uses existing manholes for insertion; a soft resin impregnated felt tube is inserted into the pipe, inverted by filling it with air or water at one end, and cured in place.	$75-$125/linear foot[2]
1 CWP (2002) *2 1991 costs from Brown (1995)* *3 U.S. EPA (1991)* *4 U.S. EPA (1999b)*			

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Illicit Discharge Detection and Elimination

TECHNICAL APPENDICES

by the
Center for
Watershed Protection

and
Robert Pitt
University of Alabama

October 2004

TECHNICAL APPENDICES

ILLICIT DISCHARGE DETECTION AND ELIMINATION: A GUIDANCE MANUAL FOR PROGRAM DEVELOPMENT AND TECHNICAL ASSESSMENTS

by

Edward Brown and Deb Caraco
Center for Watershed Protection
Ellicott City, Maryland 21043

and

Robert Pitt
University of Alabama
Tuscaloosa, Alabama 35487

EPA Cooperative Agreement
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Project Officer

Bryan Rittenhouse
Water Permits Division
Office of Water and Wastewater
U.S. Environmental Protection Agency
Washington, D.C.

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APPENDIX A

GENERATING SITES, STORM WATER REGULATORY STATUS, AND DISCHARGE POTENTIAL

The information presented in this Appendix refers to the Standard Industrial Classification (SIC) system. This system has historically been used to classify industries and other businesses for census, tax, permit and other purposes. It should be noted that, more recently, federal agencies, including EPA, have adopted the North American Industry Classification System (NAICS, pronounced "Nakes") as the industry classification system. For more information on the NAICS and how it correlates with SIC, visit http://www.census.gov/epcd/www/naics.html.

Overview

Identification of land uses that may impact water quality in local streams can be a difficult and time-consuming task. Research suggests that program managers might wish to preferentially investigate certain land uses when looking for the sources of possible pollutant loads. These land uses are all considered to be generating sites where routine operations can produce higher levels of storm water pollutants, and/or present a higher potential risk for spills, leaks or illicit discharges. There are two basic types of generating sites: *regulated hotspots* that are known sources of pollution and are subject to federal or state regulations, and *unregulated hotspots* which are operations suspected to be potential pollution sources, but which are not currently regulated.

Identifying Potential Generating Sites

The number and type of generating sites present in a subwatershed may vary greatly, and currently there is no public database available to identify all the regulated sites in a subwatershed. Instead, multiple databases need to be queried to identify generating sites that may be targets for source control or illicit discharge investigations. A three-phase approach is useful for gathering as much information as possible on generating sites within a subwatershed that may qualify for more intensive scrutiny.

Phase 1. Consult publicly available databases

The federal government has a number of databases that may help identify locations for investigation. The Environmental Protection Agency (EPA) operates two such databases. The first is the Enforcement and Compliance History Online (ECHO) database. With this system, facility compliance history can be queried and facilities can be found based on geographic location (county level), or zip code (http://www.epa.gov/echo/index.html). The other database is Envirofacts (http://www.epa.gov/enviro/). This website provides access to multiple EPA databases to provide information about environmental activities (including Resource Conservation and Recovery Act [RCRA] and Toxic Release Inventory [TRI] facilities) that may affect air, water, and land anywhere in the United States. The website also provides access to Enviromapper, which will display the location of regulated facilities.
There are also commercial databases that can provide information on regulated industries based on manufacturing or industrial SIC codes. These databases are not free, and have limitations since they are designed primarily for marketing.

Phase 2. Consult State and Local Agencies

Most states have NPDES permit programs, and track permit application to some extent. You can consult state or local regulatory agencies to obtain lists of industries that have filed NOIs (Notices of Intent) to obtain storm water permits, as well as those that have filed under TRI requirements. Other agencies that may have information on local generating sites include fire departments (for

hazardous waste), and sanitation or wastewater treatment agencies.

Phase 3. Permit Review

The final source for information is through a review of local permits. Most permit databases have SIC codes as one of the fields. These codes can be matched against the SIC codes in Table A.1 that list common generating sites under major land use headings. If a local permit database does not exist, it may be worthwhile to simply get the local phone book and do a quick look for businesses that are similar to those listed in Table A.1.

Compiling the findings from the various databases will provide an initial list of potential generating sites for future investigation. However, research has found that most of these databases can miss many of the industries that are subject to regulation (Duke *et al.*, 1999; Duke and Shaver, 1999), and further identification may be necessary. Field investigations using techniques such as the Unified Subwatershed and Site Reconnaissance (Wright *et al.*, 2004) can assist in identifying many of these generating sites that should likely be regulated by communities.

Reference Tables

This appendix is designed to assist in identifying the land uses and associated generating sites in a subwatershed where routine activities may result in pollution being discharged to the storm drain system. There are two tables provided, each of which is described below.

Table A.1 presents a listing of potential generating sites under common land uses where illicit discharges can occur based on regular activities or practices. Column one describes the general industry type. Column two lists their associated SIC codes, if known. Column three identifies whether an industry type is subject to NPDES industrial storm water permit requirements (designated by "X"). Facilities where only certain activities or facilities at the site are subject to regulation are noted (this pertains mostly to the transport-related industries). In addition, for many "light" industrial facilities, storm water permits are required only if material handling equipment or activities, raw materials, immediate products, final products, waste materials, by-products, or industrial machinery are exposed to storm water. Industries where this applies are noted with an "**". If only specific SIC codes within a major group qualify for this exception they are noted in parentheses. Municipal facilities that are subject to NPDES MS4 permit requirements are designated by "MS4." Column four identifies those businesses that can be considered an unregulated storm water hotspot (also designated by "X"). Column five looks at the illicit discharge potential of each of the businesses listed. The potential for a business to produce an illicit discharge is rated as either high (H) medium (M) or Low (L) based on the likelihood that it has a direct connection to the storm drain system (direct) or that it can produce a transitory discharge (indirect).

Table A.2 is a list of the SIC Codes that are regulated by the Industrial Multi Sector General Permit (MSGP). The list includes the four-digit SIC code level along with the official description. This table is provided for those who wish to know the full description of each SIC code that is regulated by NPDES industrial storm water permits.

Table A.1: Common Generating Sites and their Pollution Potential

Land Use Generating Site Description	Associated SIC Code(s)	Regulated Storm Water Hotspot	Unregulated Storm Water Hotspot	Illicit Discharge Potential*	
				Direct	Indirect
Commercial					
Animal Care Services	0742, 0752		X	L	L
Auto Repair	7532-7539, 7549		X	M	M
Automobile Parking	7521			L	M
Building Materials	5211-5251		X	L	L
Campgrounds/RV parks	7033		X	L	M
Car Dealers	5511-5599,		X	M	M
Car Washes	7542		X	L	L
Commercial Laundry/Dry Cleaning	7211-7219		X	L	L
Convenience Stores	5399		X	L	L
Food Stores and Wholesale Food and Beverage	5141-5149 5411-5499		X	L	M
Equipment Repair	7622-7699		X	L	L
Gasoline Stations	5541		X	M	M
Heavy Construction Equipment Rental and Leasing	7353		X	L	H
Building and Heavy Construction (For land disturbing activities)	1521-1542 1611-1629	X		L	H
Marinas	4493	X		L	M
Nurseries and garden centers	5261		X	L	M
Oil Change Shops	7549		X		M
Restaurants	5812,5813,7011		X	M	L
Swimming Pools	7997, 7999		X	L	L
Warehouses	4221-4226	X** (4221-4225)		L	L
Wholesalers of Chemical and Petroleum	5162-5169,5172		X	L	L
Industrial					
Apparel and Other Fabrics	2311–2399 3131–3199	X**		2300 L 3100 H	L M
Auto Recyclers and Scrap Yards	5015, 5093	X		L	H
Beverages and Brewing	2082-2087	X**		L	L
Boat Building and Repair	3731,3732	X		L	H
Chemical Products	2812-2899	X** (2830, 2850)		2810 H 2820 H 2840 H 2860 M 2830 L 2850 L 2870 L 2890 L	2810 L 2820 L 2840 L 2860 L 2830 L 2850 L 2870 L 2890 L

Table A.1: Common Generating Sites and their Pollution Potential					
Land Use Generating Site Description	**Associated SIC Code(s)**	**Regulated Storm Water Hotspot**	**Unregulated Storm Water Hotspot**	**Illicit Discharge Potential***	
				Direct	**Indirect**
Industrial (continued)					
Food Processing	2011–2141	X**		2010 H 2020 H 2030 H 2040 H 2050 L. 2060 L 2070 M 2090 L 2110 M	2010 L 2020 L 2030 L 2040 L 2050 L. 2060 L 2070 L 2090 L 2110 L
Garbage Truck Washout Activities	4212		X	L	H
Industrial or Commercial Machinery, Electronic Equipment	3511–3599 3612–3699	X**		L	L
Instruments; Photographic and Optical Goods, Watches and Clocks and other Miscellaneous Manufacturing	3812–3873 3933-3999	X**		L	L
Leather Tanners	3411	X		H	M
Metal Production, Plating and Engraving Operations	2514, 2522, 2542, 3312-3399, 3411-3499, 3590	X** (2514,2522, 2542, 3411-3433, 3442-3499, 3590)		H	L
Paper and Wood Products	2411-2499, 2511, 2512, 2517, 2519, 2521, 2541, 2611–2679	X** (2434, 2652–2657, 2671–2679)		2400 L 2500 L 2600 H	2400 H 2500 L 2600 H
Petroleum Storage and Refining	2911	X		2911 H	H
Printing	2711–2796	X**		L	L
Rubber and Plastics	3011-3089	X**		M	L
Stone, Glass, Clay, Cement, Concrete, and Gypsum Product	3211-3299	X** (3233)		L	L
Textile Mills	2211–2299	X**		H	L
Transportation Equipment	3711–3728, 3743-3799	X**		H	M
Institutional					
Cemeteries	6553		X	L	L
Churches	8661		X	L	L
Colleges and Universities	8221-8222		X	L	M
Corporate Office Parks			X	L	L
Hospitals	8062-8069 8071-8072		X	L	L
Private Golf Courses	7997		X	L	L
Private Schools	8211		X	L	L

Table A.1: Common Generating Sites and their Pollution Potential					
Land Use Generating Site Description	**Associated SIC Code(s)**	**Regulated Storm Water Hotspot**	**Unregulated Storm Water Hotspot**	**Illicit Discharge Potential***	
				Direct	**Indirect**
Municipal					
Composting Facilities	2875	X		L	L
Public Golf Courses	7992		X	L	L
Landfills and Hazardous Waste Material Disposal	4953, HZ, LF	X		L	H
Local Streets		MS4	X	L	H
Maintenance Depots	4173	MS4		M	H
Municipal Fleet Washing	4100	MS4		L	M
Public Works Yards		MS4		M	H
Steam Electric Plants	SE	X		L	L
Treatment Works	TW	X		L	L
Transport Related (NPDES regulation is for the portion of the facility dedicated to vehicle maintenance shops, equipment-cleaning operations, and airport deicing operations).					
Airports	4581	X		L	M
Streets and Highways Construction	1611, 1622	X		L	H
Ports	4449, 4499	X		L	H
Railroads	4011, 4013	X		L	H
Rental Car Lots	7513-7519	X		L	M
US Postal Service	4311	X		L	M
Trucking Companies and Distribution Centers	4212-4215, 4231	X		L	M
Petroleum Bulk Stations or Terminals	5171	X		L	H

*Adapted from Pitt (2001)
** Generating sites where storm water permits are required only if material handling equipment or activities, raw materials, immediate products, final products, waste materials, by-products, or industrial machinery are exposed to storm water.

Table A.2: SIC and Activity Codes for EPA's Multi-Sector General Permit for Industrial Activity	
Sector A. Timber Products	
2411	Log Storage and Handling
2421	General Sawmills and Planning Mills
2426	Hardwood Dimension and Flooring Mills
2429	Special Product Sawmills, Not Elsewhere Classified
2431–2439	Millwork, Veneer, Plywood, and Structural Wood (except 2434)
2448, 2449	Wood Containers
2451, 2452	Wood Buildings and Mobile Homes
2491	Wood Preserving
2493	Reconstituted Wood Products
2499	Wood Products, Not Elsewhere Classified
Sector B. Paper and Allied Products Manufacturing	
2611	Pulp Mills
2621	Paper Mills
2631	Paperboard Mills
2652–2657	Paperboard Containers and Boxes
2671–2679	Converted Paper and Paperboard Products, Except Containers and Boxes
Sector C. Chemical and Allied Products Manufacturing	
2812–2819	Industrial Inorganic Chemicals
2821–2824	Plastics Materials and Synthetic Resins, Synthetic Rubber, Cellulosic and Other Manmade Fibers Except Glass
2833–2836	Medicinal chemicals and botanical products; pharmaceutical preparations; invitro and invivo diagnostic substances; biological products, except diagnostic substances
2841–2844	Soaps, Detergents, Cleaning Preparations; Perfumes, Cosmetics, Other Toilet
2851	Preparations
2861–2869	Paints, Varnishes, Lacquers, Enamels, and Allied Products
2873–2879	Industrial Organic Chemicals
2891–2899	Agricultural Chemicals, Including Facilities that Make Fertilizer Solely from Leather Scraps and Leather Dust
3952 (limited to list)	Miscellaneous Chemical Products Inks and Paints, Including China Painting Enamels, India Ink, Drawing Ink, Platinum Paints for Burnt Wood or Leather Work, Paints for China Painting, Artist's Paints and Watercolors
Sector D. Asphalt Paving and Roofing Materials Manufacturers and Lubricant Manufacturers	
2951, 2952	Asphalt Paving and Roofing Materials
2992, 2999	Miscellaneous Products of Petroleum and Coal
Sector E. Glass, Clay, Cement, Concrete, and Gypsum Product Manufacturing	
3211	Flat Glass
3221, 3229	Glass and Glassware, Pressed or Blown
3231	Glass Products Made of Purchased Glass
3241	Hydraulic Cement
3251-3259	Structural Clay Products
3261-3269	Pottery and Related Products
3271-3275	Concrete, Gypsum and Plaster Products
3281	Cut Stone and Stone Products
3291–3292	Abrasive and Asbestos Products
3295	Minerals and Earth's, Ground, or Otherwise Treated
3296	Mineral Wool
3297	Non-Clay Refractories
3299	Nonmetallic Mineral Products, Not Elsewhere Classified

Table A.2: SIC and Activity Codes for EPA's Multi-Sector General Permit for Industrial Activity	
Sector F. Primary Metals	
3312–3317	Steel Works, Blast Furnaces, and Rolling and Finishing Mills
3321–3325	Iron and Steel Foundries
3331–3339	Primary Smelting and Refining of Nonferrous Metals
3341	Secondary Smelting and Refining of Nonferrous Metals
3351–3357	Rolling, Drawing, and Extruding of Nonferrous Metals
3363–3369	Nonferrous Foundries (Castings)
3398, 3399	Miscellaneous Primary Metal Products
Sector G. Metal Mining (Ore Mining and Dressing)	
1011	Iron Ores
1021	Copper Ores
1031	Lead and Zinc Ores
1041, 1044	Gold and Silver Ores
1061	Ferroalloy Ores, Except Vanadium
1081	Metal Mining Services
1094, 1099	Miscellaneous Metal Ores
Sector H. Coal Mines and Coal Mining-Related Facilities	
1221–1241	Coal Mines and Coal Mining-Related Facilities Sector
Sector I. Oil and Gas Extraction and Refining	
1311	Crude Petroleum and Natural Gas
1321	Natural Gas Liquids
1381–1389	Oil and Gas Field Services
2911	Petroleum refining
Sector J. Mineral Mining and Dressing	
1411	Dimension Stone
1422–1429	Crushed and Broken Stone, Including Rip Rap
1481	Nonmetallic Minerals, Except Fuels
1442, 1446	Sand and Gravel
1455, 1459	Clay, Ceramic, and Refractory Materials
1474–1479	Chemical and Fertilizer Mineral Mining
1499	Miscellaneous Nonmetallic Minerals, Except Fuels
Sector K. Hazardous Waste Treatment Storage or Disposal Facilities	
HZ	Hazardous Waste Treatment, Storage or Disposal
Sector L. Landfills and Land Application Sites	
LF	Landfills, Land Application Sites and Open Dumps
Sector M. Automobile Salvage Yards	
5015	Automobile Salvage Yards
Sector N. Scrap Recycling Facilities	
5093	Scrap Recycling Facilities
Sector O. Steam Electric Generating Facilities	
SE	Steam Electric Generating Facilities
Sector P. Land Transportation	
4011, 4013	Railroad Transportation
4111–4173	Local and Highway Passenger Transportation
4212–4231	Motor Freight Transportation and Warehousing
4311	United States Postal Service
5171	Petroleum Bulk Stations and Terminals
Sector Q. Water Transportation	
4412–4499	Water Transportation
Sector R. Ship and Boat Building or Repairing Yards	
3731, 3732	Ship and Boat Building or Repairing Yards
Sector S. Air Transportation Facilities	
4512–4581	Air Transportation Facilities

Table A.2: SIC and Activity Codes for EPA's Multi-Sector General Permit for Industrial Activity	
Sector T. Treatment Works	
TW	Treatment Works
Sector U. Food and Kindred Products	
2011–2015	Meat Products
2021–2026	Dairy Products
2032	Canned, Frozen and Preserved Fruits, Vegetables and Food Specialties
2041–2048	Grain Mill Products
2051–2053	Bakery Products
2061–2068	Sugar and Confectionery Products
2074–2079	Fats and Oils
2082–2087	Beverages
2091–2099	Miscellaneous Food Preparations and Kindred Products
2111–2141	Tobacco Products
Sector V. Textile Mills, Apparel, and Other Fabric Product Manufacturing	
2211–2299	Textile Mill Products
2311–2399	Apparel and Other Finished Products Made From Fabrics and Similar Materials
3131–3199	Leather Products (except 3111)
Sector W. Furniture and Fixtures	
2511–2599	Furniture and Fixtures
2434	Wood Kitchen Cabinets
Sector X. Printing and Publishing	
2711–2796	Printing, Publishing and Allied Industries
Sector Y. Rubber, Miscellaneous Plastic Products, and Miscellaneous Manufacturing Industries	
3011	Tires and Inner Tubes
3021	Rubber and Plastics Footwear
3052, 3053	Gaskets, Packing, and Sealing Devices and Rubber and Plastics Hose and Belting
3061, 3069	Fabricated Rubber Products, Not Elsewhere Classified
3081–3089	Miscellaneous Plastics Products
3931	Musical Instruments
3942–3949	Dolls, Toys, Games and Sporting and Athletic Goods
3951–3955	Pens, Pencils, and Other Artists' Materials (except 3952)
3961, 3965	Costume Jewelry and Novelties, Buttons, and Miscellaneous Notions, Except Precious Metal
3991–3999	Miscellaneous Manufacturing Industries
Sector Z. Leather Tanning and Finishing	
3111	Leather Tanning and Finishing
Sector AA. Fabricated Metal Products	
3411–3499	Fabricated Metal Products, Except Machinery and Transportation Equipment and Cutting, Engraving and Allied Services
3911–3915	Jewelry, Silverware, and Plated Ware
3479	Coating, Engraving, and Allied Services
Sector AB. Transportation Equipment, Industrial or Commercial Machinery	
3511–3599	Industrial and Commercial Machinery (except 3571–3579)
3711–3799	Transportation Equipment (except 3731, 3732)
Sector AC. Electronic, Electrical, Photographic and Optical Goods	
3612–3699	Electronic, Electrical Equipment and Components, Except Computer Equipment
3812–3873	Measuring, Analyzing and Controlling Instrument, Photographic/Optical Goods,
3571–3579	Watches/Clocks
	Computer and Office Equipment
Miscellaneous	
1521-1542	Building Construction General Contractors And Operative Builders
1611-1629	Heavy Construction Other Than Building Construction Contractors

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APPENDIX B

MODEL ILLICIT DISCHARGE AND CONNECTION ORDINANCE

Introduction to the Model Illicit Discharge and Connection Ordinance

The model ordinance provided in this Appendix is intended to be a tool for communities who are responsible for meeting the illicit discharge detection and correction requirements of the National Pollutant Discharge Elimination System (NPDES) regulations. This model ordinance is provided to assist communities in creating their own illicit discharge ordinances. In designing this model, an attempt was made to avoid creating too complex an ordinance, and instead to provide standard language and concepts that a good illicit discharge ordinance might contain. The language was borrowed from a number of ordinances.

Feel free to use and alter any and all portions of this document to meet the needs of the local community. Throughout the ordinance, there are sections in which the name of the agency to which regulatory power over illicit discharges has been given should be filled in to customize it. These sections are denoted by text placed in brackets – [authorized enforcement agency].

Italicized text with this symbol should be interpreted as comments, instructions, or information to assist local governments in tailoring the ordinance. This text would not appear in a final adopted ordinance.
This ordinance should not be construed as an exhaustive listing of all the language needed for a local ordinance, but represents a good base that communities can build upon and customize to be consistent with the staff resources available in their locality. It is recommended that this document be used in conjunction with other sources, such as existing ordinances created by other IDDE programs in the same geographic region and with similar objectives. In addition, several state agencies, councils of governments, and other regional groups have developed model ordinances. Two very comprehensive yet different examples of ordinances are:

- Model Storm Water Ordinance
  Source: North Central Texas Council of Governments
  (www.dfwstormwater.com/illicits)

- Model Illicit Discharge and Illegal Connection Ordinance
  Source: Metropolitan North Georgia Water Planning District
  (www.northgeorgiawater.com)

For those areas where septic systems are commonly used for wastewater treatment, language requiring inspection of these systems should also be added. The Washtenaw County (MI) *Regulation for the Inspection of Residential On-site Water and Sewage Disposal Systems at Time of Property Transfer* is an example of an ordinance that specifies requirements for inspection and maintenance of septic systems.

MODEL ILLICIT DISCHARGE AND CONNECTION ORDINANCE

ORDINANCE NO. _____

SECTION 1. PURPOSE/INTENT.

The purpose of this ordinance is to provide for the health, safety, and general welfare of the citizens of **[jurisdiction]** through the regulation of non-storm water discharges to the storm drainage system to the maximum extent practicable as required by federal and state law. This ordinance establishes methods for controlling the introduction of pollutants into the municipal separate storm sewer system (MS4) in order to comply with requirements of the National Pollutant Discharge Elimination System (NPDES) permit process. The objectives of this ordinance are:

(1) To regulate the contribution of pollutants to the MS4 by storm water discharges by any user.

(2) To prohibit illicit connections and discharges to the MS4.

(3) To establish legal authority to carry out all inspection, surveillance, monitoring, and enforcement procedures necessary to ensure compliance with this ordinance.

SECTION 2. DEFINITIONS.

For the purposes of this ordinance, the following shall mean:

Authorized Enforcement Agency. Employees or designees of the director of the municipal agency designated to enforce this ordinance.

Best Management Practices (BMPs). Schedules of activities, prohibitions of practices, general good house keeping practices, pollution prevention and educational practices, maintenance procedures, and other management practices to prevent or reduce the discharge of pollutants directly or indirectly to storm water, receiving waters, or storm water conveyance systems. BMPs also include treatment practices, operating procedures, and practices to control site runoff, spillage or leaks, sludge or water disposal, or drainage from raw materials storage.

Clean Water Act. The federal Water Pollution Control Act (33 U.S.C. § 1251 et seq.), and any subsequent amendments thereto.

Construction Activity. Activities subject to NPDES Construction Permits. These include construction projects resulting in land disturbance of one acre or more. Such activities include but are not limited to clearing and grubbing, grading, excavating, and demolition.

Hazardous Materials. Any material, including any substance, waste, or combination thereof, which because of its quantity, concentration, or physical, chemical, or infectious characteristics may cause, or significantly contribute to, a substantial present or potential hazard to human health, safety, property, or the environment when improperly treated, stored, transported, disposed of, or otherwise managed.

Illegal Discharge. Any direct or indirect non-storm water discharge to the storm drain system, except as exempted in Section 8 of this ordinance.

Illicit Connections. An illicit connection is defined as either of the following:

- Any drain or conveyance, whether on the surface or subsurface that allows an illegal discharge to enter the storm drain system including but not limited to any conveyances that allow any non-storm water discharge including sewage, process wastewater, and wash water to enter the storm drain system and any connections to the storm drain system from indoor drains and sinks, regardless of whether said drain or connection had been previously allowed, permitted, or approved by an authorized enforcement agency or,
- Any drain or conveyance connected from a commercial or industrial land use to the storm drain system that has not been documented in plans, maps, or equivalent records and approved by an authorized enforcement agency.

Industrial Activity. Activities subject to NPDES Industrial Storm Water Permits as defined in 40 CFR, Section 122.26 (b)(14).

Municipal Separate Storm Sewer System (MS4). The system of conveyances (including sidewalks, roads with drainage systems, municipal streets, catch basins, curbs, gutters, ditches, man-made channels, or storm drains) owned and operated by the **[jurisdiction]** and designed or used for collecting or conveying storm water, and that is not used for collecting or conveying sewage.

National Pollutant Discharge Elimination System (NPDES) Storm Water Discharge Permit. means a permit issued by EPA (or by a State under authority delegated pursuant to 33 USC § 1342(b)) that authorizes the discharge of pollutants to waters of the United States, whether the permit is applicable on an individual, group, or general area-wide basis.

Non-Storm Water Discharge. Any discharge to the storm drain system that is not composed entirely of storm water.

Person. Any individual, association, organization, partnership, firm, corporation or other entity recognized by law and acting as either the owner or as the owner's agent.

Pollutant. Anything which causes or contributes to pollution. Pollutants may include, but are not limited to: paints, varnishes, and solvents; oil and other automotive fluids; non-hazardous liquid and solid wastes and yard wastes; refuse, rubbish, garbage, litter, or other discarded or abandoned objects, ordinances, and accumulations, so that same may cause or contribute to pollution; floatables; pesticides, herbicides, and fertilizers; hazardous substances and wastes; sewage, fecal coliform and pathogens; dissolved and particulate metals; animal wastes; wastes and residues that result from constructing a building or structure; and noxious or offensive matter of any kind.

Premises. Any building, lot, parcel of land, or portion of land whether improved or unimproved including adjacent sidewalks and parking strips.

Storm Drainage System. Publicly-owned facilities by which storm water is collected and/or conveyed, including but not limited to any roads with drainage systems, municipal streets, gutters, curbs, inlets, piped storm drains, pumping facilities, retention and detention basins, natural and human-made or altered drainage channels, reservoirs, and other drainage structures.

Storm Water. Any surface flow, runoff, and drainage consisting entirely of water from any form of natural precipitation, and resulting from such precipitation.

Storm Water Management Plan. A document which describes the Best Management Practices and activities to be implemented by a person or business to identify sources of pollution or contamination at a site and the actions to eliminate or reduce pollutant discharges to Storm Water, Storm Water Conveyance Systems, and/or Receiving Waters to the Maximum Extent Practicable.

Wastewater. Any water or other liquid, other than uncontaminated storm water, discharged from a facility.

SECTION 3. APPLICABILITY.

This ordinance shall apply to all water entering the storm drain system generated on any developed and undeveloped lands unless explicitly exempted by the **[authorized enforcement agency]**.

SECTION 4. RESPONSIBILITY FOR ADMINISTRATION.

The **[authorized enforcement agency]** shall administer, implement, and enforce the provisions of this ordinance. Any powers granted or duties imposed upon the **[authorized enforcement agency]** may be delegated in writing by the Director of the **[authorized enforcement agency]** to persons or entities acting in the beneficial interest of or in the employ of the agency.

SECTION 5. COMPATIBILITY WITH OTHER REGULATIONS.

This ordinance is not intended to modify or repeal any other ordinance, rule, regulation, or other provision of law. The requirements of this ordinance are in addition to the requirements of any other ordinance, rule, regulation, or other provision of law, and where any provision of this ordinance imposes restrictions different from those imposed by any other ordinance, rule, regulation, or other provision of law, whichever provision is more restrictive or imposes higher protective standards for human health or the environment shall control.

SECTION 6. SEVERABILITY.

The provisions of this ordinance are hereby declared to be severable. If any provision, clause, sentence, or paragraph of this ordinance or the application thereof to any person, establishment, or circumstances shall be held invalid, such invalidity shall not affect the other provisions or application of this ordinance.

SECTION 7. ULTIMATE RESPONSIBILITY.

The standards set forth herein and promulgated pursuant to this ordinance are minimum standards; therefore this ordinance does not intend or imply that compliance by any person will ensure that there will be no contamination, pollution, or unauthorized discharge of pollutants.

SECTION 8. DISCHARGE PROHIBITIONS.

8.1. Prohibition of Illegal Discharges.

No person shall throw, drain, or otherwise discharge, cause, or allow others under its control to throw, drain, or otherwise discharge into the MS4 any pollutants or waters containing any pollutants, other than storm water.

The commencement, conduct or continuance of any illegal discharge to the storm drain system is prohibited except as described as follows:

(1) The following discharges are exempt from discharge prohibitions established by this ordinance: water line flushing, landscape irrigation, diverted stream flows, rising ground waters, uncontaminated ground water infiltration, uncontaminated pumped ground water, discharges from potable water sources, foundation drains, air conditioning condensation, irrigation water, springs, water from crawl space pumps, footing drains, lawn watering, individual residential car washing, flows from riparian habitats and wetlands, dechlorinated swimming pool discharges, and street wash water.

(2) Discharges or flow from firefighting, and other discharges specified in writing by the **[authorized enforcement agency]** as being necessary to protect public health and safety.

(3) Discharges associated with dye testing, however this activity requires a verbal notification to the **[authorized enforcement agency]** prior to the time of the test.

(4) The prohibition shall not apply to any non-storm water discharge permitted under an NPDES permit, waiver, or waste discharge order issued to the discharger and administered under the authority of the United States Environmental Protection Agency (EPA), provided that the discharger is in full compliance with all requirements of the permit, waiver, or order and other applicable laws and regulations, and provided that written approval has been granted for any discharge to the storm drain system.

The local government may evaluate and remove any of the above exemptions if it is determined that they are causing an adverse impact.

8.2. Prohibition of Illicit Connections.

(1) The construction, use, maintenance or continued existence of illicit connections to the storm drain system is prohibited.

(2) This prohibition expressly includes, without limitation, illicit connections made in the past, regardless of whether the connection was permissible under law or practices applicable or prevailing at the time of connection.

(3) A person is considered to be in violation of this ordinance if the person connects a line conveying sewage to the MS4, or allows such a connection to continue.

(4) Improper connections in violation of this ordinance must be disconnected and redirected, if necessary, to an approved onsite wastewater management system or the sanitary sewer system upon approval of the **[authorized enforcement agency]**.

(5) Any drain or conveyance that has not been documented in plans, maps or equivalent, and which may be connected to the storm sewer system, shall be located by the owner or occupant of that property upon receipt of written notice of violation from the **[authorized**

enforcement agency] requiring that such locating be completed. Such notice will specify a reasonable time period within which the location of the drain or conveyance is to be determined, that the drain or conveyance be identified as storm sewer, sanitary sewer or other, and that the outfall location or point of connection to the storm sewer system, sanitary sewer system or other discharge point be identified. Results of these investigations are to be documented and provided to the **[authorized enforcement agency]**.

SECTION 9. WATERCOURSE PROTECTION.

Every person owning property through which a watercourse passes, or such person's lessee, shall keep and maintain that part of the watercourse within the property free of trash, debris, excessive vegetation, and other obstacles that would pollute, contaminate, or significantly retard the flow of water through the watercourse. In addition, the owner or lessee shall maintain existing privately owned structures within or adjacent to a watercourse, so that such structures will not become a hazard to the use, function, or physical integrity of the watercourse.

SECTION 10. INDUSTRIAL OR CONSTRUCTION ACTIVITY DISCHARGES.

10.1. Submission of NOI to [jurisdiction].

(1) Any person subject to an industrial or construction activity NPDES storm water discharge permit shall comply with all provisions of such permit. Proof of compliance with said permit may be required in a form acceptable to the **[authorized enforcement agency]** prior to the allowing of discharges to the MS4.

(2) The operator of a facility, including construction sites, required to have an NPDES permit to discharge storm water associated with industrial activity shall submit a copy of the Notice of Intent (NOI) to the **[authorized enforcement agency]** at the same time the operator submits the original Notice of Intent to the EPA as applicable.

(3) The copy of the Notice of Intent may be delivered to the **[authorized enforcement agency]** either in person or by mailing it to:

Notice of Intent to Discharge Storm Water

[authorized enforcement agency]

[street address]

[city, state, zip code]

(4) A person commits an offense if the person operates a facility that is discharging storm water associated with industrial activity without having submitted a copy of the Notice of Intent to do so to the **[authorized enforcement agency]**.

SECTION 11. COMPLIANCE MONITORING

11.1. Right of Entry: Inspection and Sampling.

The **[authorized enforcement agency]** shall be permitted to enter and inspect facilities subject to regulation under this ordinance as often as may be necessary to determine compliance with this ordinance.

(1) If a discharger has security measures in force which require proper identification and clearance before entry into its premises, the discharger shall make the necessary arrangements to allow access to representatives of the **[authorized enforcement agency]**.

(2) Facility operators shall allow the **[authorized enforcement agency]** ready access to all parts of the premises for the purposes of inspection, sampling, examination and copying of records that must be kept under the conditions of an NPDES permit to discharge storm water, and the performance of any additional duties as defined by state and federal law.

(3) The **[authorized enforcement agency]** shall have the right to set up on any permitted facility such devices as are necessary in the opinion of the **[authorized enforcement agency]** to conduct monitoring and/or sampling of the facility's storm water discharge.

(4) The **[authorized enforcement agency]** has the right to require the discharger to install monitoring equipment as necessary. The facility's sampling and monitoring equipment shall be maintained at all times in a safe and proper operating condition by the discharger at its own expense. All devices used to measure storm water flow and quality shall be calibrated to ensure their accuracy.

(5) Any temporary or permanent obstruction to safe and easy access to the facility to be inspected and/or sampled shall be promptly removed by the operator at the written or oral request of the **[authorized enforcement agency]** and shall not be replaced. The costs of clearing such access shall be borne by the operator.

(6) Unreasonable delays in allowing the **[authorized enforcement agency]** access to a permitted facility is a violation of a storm water discharge permit and of this ordinance. A person who is the operator of a facility with an NPDES permit to discharge storm water associated with industrial activity commits an offense if the person denies the **[authorized enforcement agency]** reasonable access to the permitted facility for the purpose of conducting any activity authorized or required by this ordinance.

11.2. Search Warrants.

If the **[authorized enforcement agency]** has been refused access to any part of the premises from which storm water is discharged, and he/she is able to demonstrate probable cause to believe that there may be a violation of this ordinance, or that there is a need to inspect and/or sample as part of a routine inspection and sampling program designed to verify compliance with this ordinance or any order issued hereunder, or to protect the overall public health, safety, and welfare of the community, then the **[authorized enforcement agency]** may seek issuance of a search warrant from any court of competent jurisdiction.

SECTION 12. REQUIREMENT TO PREVENT, CONTROL, AND REDUCE STORM WATER POLLUTANTS BY THE USE OF BEST MANAGEMENT PRACTICES.

[Authorized enforcement agency] will adopt requirements identifying Best Management Practices for any activity, operation, or facility which may cause or contribute to pollution or contamination of storm water, the storm drain system, or waters of the United States. The owner or operator of such activity, operation, or facility shall provide, at their own expense, reasonable protection from accidental discharge of prohibited materials or other wastes into the municipal storm drain system or watercourses through the use of these structural and non-structural BMPs. Further, any person responsible for a property or premise that is, or may be, the source of an illicit discharge, may be required to implement, at said person's expense, additional structural and non-structural BMPs to prevent the further discharge of pollutants to the MS4. Compliance with all terms and conditions of a valid NPDES permit authorizing the discharge of storm water associated with industrial activity, to the extent practicable, shall be deemed compliance with the provisions of this section. These BMPs shall be part of a storm water management plan (SWMP) as necessary for compliance with requirements of the NPDES permit.

SECTION 13. NOTIFICATION OF SPILLS.

Notwithstanding other requirements of law, as soon as any person responsible for a facility or operation, or responsible for emergency response for a facility or operation has information of any known or suspected release of materials which are resulting or may result in illegal discharges or pollutants discharging into storm water, the storm drain system, or waters of the United States, said person shall take all necessary steps to ensure the discovery, containment, and cleanup of such release. In the event of such a release of hazardous materials said person shall immediately notify emergency response agencies of the occurrence via emergency dispatch services. In the event of a release of non-hazardous materials, said person shall notify the **[authorized enforcement agency]** in person or by phone or facsimile no later than the next business day. Notifications in person or by phone shall be confirmed by written notice addressed and mailed to the **[authorized enforcement agency]** within **[___]** business days of the phone notice. If the discharge of prohibited materials emanates from a commercial or industrial establishment, the owner or operator of such establishment shall also retain an on-site written record of the discharge and the actions taken to prevent its recurrence. Such records shall be retained for at least **[___]** years.

Failure to provide notification of a release as provided above is a violation of this ordinance.

SECTION 14. VIOLATIONS, ENFORCEMENT, AND PENALTIES.

14.1. Violations.

It shall be unlawful for any person to violate any provision or fail to comply with any of the requirements of this ordinance. Any person who has violated or continues to violate the provisions of this ordinance, may be subject to the enforcement actions outlined in this section or may be restrained by injunction or otherwise abated in a manner provided by law.

In the event the violation constitutes an immediate danger to public health or public safety, the **[authorized enforcement agency]** is authorized to enter upon the subject private property,

without giving prior notice, to take any and all measures necessary to abate the violation and/or restore the property. The **[authorized enforcement agency]** is authorized to seek costs of the abatement as outlined in Section 17.

14.2. Warning Notice.

When the **[authorized enforcement agency]** finds that any person has violated, or continues to violate, any provision of this ordinance, or any order issued hereunder, the **[authorized enforcement agency]** may serve upon that person a written Warning Notice, specifying the particular violation believed to have occurred and requesting the discharger to immediately investigate the matter and to seek a resolution whereby any offending discharge will cease. Investigation and/or resolution of the matter in response to the Warning Notice in no way relieves the alleged violator of liability for any violations occurring before or after receipt of the Warning Notice. Nothing in this subsection shall limit the authority of the **[authorized enforcement agency]** to take any action, including emergency action or any other enforcement action, without first issuing a Warning Notice.

14.3. Notice of Violation.

Whenever the **[authorized enforcement agency]** finds that a person has violated a prohibition or failed to meet a requirement of this ordinance, the **[authorized enforcement agency]** may order compliance by written notice of violation to the responsible person.

The Notice of Violation shall contain:

(1) The name and address of the alleged violator;

(2) The address when available or a description of the building, structure or land upon which the violation is occurring, or has occurred;

(3) A statement specifying the nature of the violation;

(4) A description of the remedial measures necessary to restore compliance with this ordinance and a time schedule for the completion of such remedial action;

(5) A statement of the penalty or penalties that shall or may be assessed against the person to whom the notice of violation is directed;

(6) A statement that the determination of violation may be appealed to the **[authorized enforcement agency]** by filing a written notice of appeal within **[___]** days of service of notice of violation; and

(7) A statement specifying that, should the violator fail to restore compliance within the established time schedule, the work will be done by a designated governmental agency or a contractor and the expense thereof shall be charged to the violator.

Such notice may require without limitation:

(1) The performance of monitoring, analyses, and reporting;

(2) The elimination of illicit connections or discharges;

(3) That violating discharges, practices, or operations shall cease and desist;

(4) The abatement or remediation of storm water pollution or contamination hazards and the

restoration of any affected property

(5) Payment of a fine to cover administrative and remediation costs; and

(6) The implementation of source control or treatment BMPs.

14.5. Compensatory Action.

In lieu of enforcement proceedings, penalties, and remedies authorized by this ordinance, the **[authorized enforcement agency]** may impose upon a violator alternative compensatory actions, such as storm drain stenciling, attendance at compliance workshops, creek cleanup, etc.

14.6. Suspension Of MS4 Access.

14.6.1. Emergency Cease and Desist Orders

When the **[authorized enforcement agency]** finds that any person has violated, or continues to violate, any provision of this ordinance, or any order issued hereunder, or that the person's past violations are likely to recur, and that the person's violation(s) has (have) caused or contributed to an actual or threatened discharge to the MS4 or waters of the United States which reasonably appears to present an imminent or substantial endangerment to the health or welfare of persons or to the environment, the **[authorized enforcement agency]** may issue an order to the violator directing it immediately to cease and desist all such violations and directing the violator to:

(1) Immediately comply with all ordinance requirements; and

(2) Take such appropriate preventive action as may be needed to properly address a continuing or threatened violation, including immediately halting operations and/or terminating the discharge.

Any person notified of an emergency order directed to it under this Subsection shall immediately comply and stop or eliminate its endangering discharge. In the event of a discharger's failure to immediately comply voluntarily with the emergency order, the **[authorized enforcement agency]** may take such steps as deemed necessary to prevent or minimize harm to the MS4 or waters of the United States, and/or endangerment to persons or to the environment, including immediate termination of a facility's water supply, sewer connection, or other municipal utility services. The **[authorized enforcement agency]** may allow the person to recommence its discharge when it has demonstrated to the satisfaction of the **[authorized enforcement agency]** that the period of endangerment has passed, unless further termination proceedings are initiated against the discharger under this ordinance. A person that is responsible, in whole or in part, for any discharge presenting imminent endangerment shall submit a detailed written statement, describing the causes of the harmful discharge and the measures taken to prevent any future occurrence, to the **[authorized enforcement agency]** within **[___]** days of receipt of the emergency order. Issuance of an emergency cease and desist order shall not be a bar against, or a prerequisite for, taking any other action against the violator.

14.6.2. Suspension due to Illicit Discharges in Emergency Situations

The **[authorized enforcement agency]** may, without prior notice, suspend MS4 discharge access to a person when such suspension is necessary to stop an actual or threatened discharge which presents or may present imminent and substantial danger to the environment, or to the health or welfare of persons, or to the MS4 or waters of the United States. If the violator fails to

comply with a suspension order issued in an emergency, the **[authorized enforcement agency]** may take such steps as deemed necessary to prevent or minimize damage to the MS4 or waters of the United States, or to minimize danger to persons.

14.6.3. Suspension due to the Detection of Illicit Discharge

Any person discharging to the MS4 in violation of this ordinance may have their MS4 access terminated if such termination would abate or reduce an illicit discharge. The **[authorized enforcement agency]** will notify a violator of the proposed termination of its MS4 access. The violator may petition the **[authorized enforcement agency]** for a reconsideration and hearing.

A person commits an offense if the person reinstates MS4 access to premises terminated pursuant to this Section, without the prior approval of the **[authorized enforcement agency]**.

14.7. Civil Penalties.

In the event the alleged violator fails to take the remedial measures set forth in the notice of violation or otherwise fails to cure the violations described therein within **[___]** days, or such greater period as the **[authorized enforcement agency]** shall deem appropriate, after the **[authorized enforcement agency]** has taken one or more of the actions described above, the **[authorized enforcement agency]** may impose a penalty not to exceed $**[___]** (depending on the severity of the violation) for each day the violation remains unremedied after receipt of the notice of violation.

14.8. Criminal Prosecution.

Any person that has violated or continues to violate this ordinance shall be liable to criminal prosecution to the fullest extent of the law, and shall be subject to a criminal penalty of $**[___]** per violation per day and/or imprisonment for a period of time not to exceed **[___]** days. Each act of violation and each day upon which any violation shall occur shall constitute a separate offense.

SECTION 15. APPEAL OF NOTICE OF VIOLATION.

Any person receiving a Notice of Violation may appeal the determination of the **[authorized enforcement agency]**. The notice of appeal must be received within **[___]** days from the date of the Notice of Violation. Hearing on the appeal before the appropriate authority or his/her designee shall take place within **[___]** days from the date of receipt of the notice of appeal. The decision of the municipal authority or their designee shall be final.

SECTION 16. ENFORCEMENT MEASURES AFTER APPEAL.

If the violation has not been corrected pursuant to the requirements set forth in the Notice of Violation, or, in the event of an appeal, within **[___]** days of the decision of the municipal authority upholding the decision of the **[authorized enforcement agency]**, then representatives of the **[authorized enforcement agency]** shall enter upon the subject private property and are authorized to take any and all measures necessary to abate the violation and/or restore the property. It shall be unlawful for any person, owner, agent or person in possession of any

premises to refuse to allow the government agency or designated contractor to enter upon the premises for the purposes set forth above.

SECTION 17. COST OF ABATEMENT OF THE VIOLATION.

Within **[___]** days after abatement of the violation, the owner of the property will be notified of the cost of abatement, including administrative costs. The property owner may file a written protest objecting to the amount of the assessment within **[___]** days. If the amount due is not paid within a timely manner as determined by the decision of the municipal authority or by the expiration of the time in which to file an appeal, the charges shall become a special assessment against the property and shall constitute a lien on the property for the amount of the assessment.

Any person violating any of the provisions of this article shall become liable to the **[jurisdiction]** by reason of such violation. The liability shall be paid in not more than **[___]** equal payments. Interest at the rate of **[___]** percent per annum shall be assessed on the balance beginning on the **[___]** day following discovery of the violation.

SECTION 18. VIOLATIONS DEEMED A PUBLIC NUISANCE.

In addition to the enforcement processes and penalties provided, any condition caused or permitted to exist in violation of any of the provisions of this ordinance is a threat to public health, safety, and welfare, and is declared and deemed a nuisance, and may be summarily abated or restored at the violator's expense, and/or a civil action to abate, enjoin, or otherwise compel the cessation of such nuisance may be taken.

SECTION 19. REMEDIES NOT EXCLUSIVE.

The remedies listed in this ordinance are not exclusive of any other remedies available under any applicable federal, state or local law and it is within the discretion of the **[authorized enforcement agency]** to seek cumulative remedies.

The **[authorized enforcement agency]** may recover all attorney's fees court costs and other expenses associated with enforcement of this ordinance, including sampling and monitoring expenses.

SECTION 20. ADOPTION OF ORDINANCE.

This ordinance shall be in full force and effect **[___]** days after its final passage and adoption. All prior ordinances and parts of ordinances in conflict with this ordinance are hereby repealed.

PASSED AND ADOPTED this ____ day of _____, 20__, by the following vote:

APPENDIX C

SIX STEPS TO ESTABLISHING A HOTLINE AND REPORTING AND TRACKING SYSTEM

Introduction

A complaint hotline is a dedicated phone number or website where citizens can easily report illicit discharge and pollution concerns. A prompt investigation of each complaint by trained inspectors should always follow a reported incident, usually within 24 hours. Many Phase I communities utilize hotlines to track down intermittent and transitory discharges, and regard them as one of their most effective tools to isolate illicit discharges (CWP, 2002).

This appendix describes the six steps needed to establish a hotline to report and track illicit discharges.

Step 1. Define the scope

The community must first determine its need for an IDDE complaint hotline and should not establish one simply because it does not currently exist. An IDDE hotline may be appropriate for a community for the following reasons:

- The municipality already receives a high volume of complaint calls associated with illicit discharges. Without a designated number, complaints may be received by several different departments, which can lead to inconsistent handling of concerns. If a community is unsure of the number of complaints received across the municipality, it may want to quickly survey departments likely to receive calls. A hotline can help promote stakeholder reporting of incidents and make the reporting process more efficient rather than relying on calls making it to the correct office.
- A community hotline exists that cannot be altered to accommodate the needs of the IDDE program. Situations that would make two hotlines incompatible include: significantly different concerns (e.g., IDDE vs. emergency services); varying jurisdictional limits (e.g., regional vs. city only); and funding restrictions (e.g., hotline is developed with a grant that prevents it from overlapping with other programs).
- Related municipal programs exist that would benefit from the establishment of a hotline, such as erosion and sediment control or storm water management programs. Combining similar services can lead to a significant savings in cost and time.

Communities that have no pressing need for a hotline may still choose to institute a department phone number or email address to field complaints and incident reports during normal business hours, or a website that provides guidance on how to report potential illicit discharges.

Once a community has decided to implement a hotline, the scope of the IDDE hotline should be defined, including the intent and extent of the program. The intent of the hotline may be to process the incident/complaint, and investigate and enforce violations, or to take a more educational approach that also provides information and guidance. It is recommended that communities initiating a hotline for the first time limit the scope to the former intent.

The extent of the hotline refers to the geographic area of coverage as well as the types of incidents that fall under the responsibility of the responding agency or department. Often hotlines are restricted to

one specific jurisdiction to minimize complications with investigating and enforcing violations across jurisdictional lines. Significant coordination and planning are required if the hotline is intended to serve a region or watershed with several jurisdictions. Similar coordination efforts are necessary if a wide range of incidents is handled by the hotline that require multiple agencies or departments to respond. It is important for communities to predetermine what agency or department is best suited and trained to respond to specific incident reports, and for all hotline operators to be well trained and knowledgeable about these distinctions.

Step 2. Create a tracking and reporting system

The next step to establishing an IDDE hotline is to create a tracking and reporting system. The two key features that should be considered are the methods of reporting and methods of responding.

At a minimum, the reporting method should include a telephone call-in system and may also include a website. The phone number and/or internet address should be easy to remember and toll-free if any areas under the jurisdiction of the IDDE program are long-distance from the reporting office. The reporting method should be available 24 hours a day, seven days a week. This around the clock process encourages stakeholders to call as soon as a problem is identified.

Providing an option for anonymous reporting also encourages calls because it can be done without fear of retribution from neighbors, employers, or others. In most cases this is achieved by providing an "Incident ID" that may also be used to allow the caller to track the investigation and know that their concerns are being addressed, as well as build in accountability within the department to respond to hotline callers.

The level of detail collected during an incident report will vary depending on system design and complaint responder training. Many hotlines collect only basic information, however, more detailed information will help prioritize investigations and take advantage of a database system to expand reporting options. A sample Illicit Discharge Incident Tracking Sheet is provided at the end of this Appendix to help facilitate this process. The sheet is intended for use with a phone reporting system, and is designed so that the responder can prompt the caller through each section. This sheet may be modified into a simple, multiple-choice questionnaire if reporting is done through a website or email. The basic information collected during an incident report is described below.

- *Incident ID* - Each incident should receive a unique identification code to ensure accurate tracking and public feedback.

- *Reporter Information* - Reporter contact information may be recorded, however, anonymous reporting is often preferred because it frees the reporter from potential backlash. The date and time of incident must be noted, as it may be different than the time it was called in.

- *Responder Information* - The name of the responder and the time and date of the call should be recorded. The amount of precipitation in the past 24-48 hours is also recorded for reporting purposes.

- *Incident Location* - The location of the potential illicit discharge is one of the most important yet difficult pieces of information to accurately collect. Unique

and visible outfall numbering allows reports to be precisely located. In the absence of outfall IDs, callers should be encouraged to provide the nearest street/intersection information and any general descriptions that tie the site to a nearby landmark or major land use (e.g., shopping center, school, etc.), as well as indicate whether the incident site is located in the stream corridor or in an upland area. Other options are to include blank space for narrative descriptions or for the response team to meet the caller at a nearby known location if the caller cannot provide sufficient locational information.

- *Problem Type* - Providing a list of likely problems and problem descriptions can help to readily identify the potential source. The problem types will likely fall into the following five categories: unnatural stream conditions, sewage, wash water, oil/solvents, and industrial wastes. "Other" should also be included, as exceptions will occur. By identifying a suspected origin, the field team may have a head start on the investigation and suspected repeat offenders can be screened through trend analysis.

- *Problem Indicator Description* - A description of the discharge odor and color, and type of floatables present permits investigators to know what they are looking for and start preparing for how to handle the situation.

- *Investigation Notes* - To properly track and report suspected illicit discharges, the investigation needs to be documented. Key information to record for the initial and follow-up investigation (if applicable) include: date, time, step taken to respond to incident report (not all require follow up), investigators, length of time spent for investigation, corrective actions taken, date case closed, and any other pertinent information.

Due to the intermittent nature of illicit discharges, a 24-hour investigation response can increase the likelihood of identifying and eliminating problems. While some problems require more immediate attention than others, investigators should always respond as soon as appropriate. Calls should be screened by a "live" person so only the most urgent calls are passed through a pager system in order to minimize the pressure that 24-hour response places on investigators at odd hours. The complaint questions should be detailed enough to help support this basic prioritization.

Some communities may determine that 24-hour response is cost prohibitive, and that non-emergency response will only occur during normal working hours (e.g., 8AM - 5PM). In these situations, it is essential that explicit instructions be provided to the caller in case of a true emergency.

Another aspect of responding to complaints is determining when another department or agency should handle the problem. An incident may need to be passed on because the reported problem falls under the responsibility of another department, such as the fire or health department. Having specific guidelines for the call responder and investigators is imperative to handling these incidents appropriately.

Step 3. Train personnel

Training of complaint respondents should include how to provide good customer service, the basics of illicit discharge identification and details of the tracking and reporting process. The responder should be

trained so that he/she understands the significance of the information being collected and can go beyond the "check boxes" when necessary to answer the reporter questions, as well as guide the caller through the data collection process. This ensures that the incident is handled correctly, and that the caller feels that the concern is in good hands.

An initial screening of the potential illicit source by the responder can be useful. Table C1 provides a list of descriptions of common illicit discharges called in and the likely source or situation.

Inter- and intra-department training should focus on the importance of IDDE, the complaint hotline investigation and tracking process, and the expected responsibilities of each involved entity. Such training can greatly increase watershed wide awareness of illicit discharge problems and is essential to developing good working relationships with other departments.

Step 4. Advertise

Public relations are an important aspect of a pollution hotline. Many municipalities have noted that there is always a peak in incident reporting following an advertising campaign. Advertising the hotline phone number or web address several times a year keeps the message fresh in public minds. Effective methods include magnets, stickers, phone book advertisements, flyers, bill inserts, displays, fair booths and newspaper articles.

Advertising, including publicizing success stories about the hotline serves several purposes. First it highlights the responsiveness of the program to the general public. Second, it serves as a means to further promote the hotline. Third, it builds public support for the program and fosters public stewardship. Success stories can be published through newspaper articles, TV broadcasts or other highly visible means of advertising. The stories will build general awareness of illicit discharge issues and promote greater public stewardship and accountability by both those reporting the problems and potential violators.

Table C1: Types of Potential IDDE Hotline Complaints

Typical Call-in Indicators	Likely Source
Sewage smell, or floatables from storm drain outfall during dry weather flow	Storm and sanitary sewer cross-connection
Small (<6" diameter) pipe directly discharging to receiving water	Straight pipe discharge from home or business
Greatly discolored or unnatural smelling liquid (often hydrocarbons) flowing from or pooling on property or from outfall below property	Dumping
Sewage smell; extra green vegetation; saturated ground	Failing septic system
Muddy water; sediment deposits, up stream construction site	Poor erosion and sediment control

Step 5. Respond to complaints

Hotline customer service staff should provide friendly and knowledgeable service to callers that might include an overview of the investigation process, how long a response should take, and an incident tracking ID so the caller can follow-up on the complaint. Hotline staff should arrange to send an investigator out to the incident site as soon as possible.

Investigators should respond to complaints in a timely manner, and provide the necessary feedback to the database system. The type of complaint will dictate the necessary response, as well as the timing of the response (e.g., a failing septic system may not be as high a priority as a sanitary sewer overflow). Information submitted to the reporting database might include: time from initial call to investigation, steps taken to investigate, and actions taken to solve the problem.

Step 6. Track incidents

Illicit discharge complaints and incidents should be reported and tracked through a database system in order to meet the following program goals:

- Identify recurring problems and suspected offenders
- Measure program success
- Comply with annual report requirements

Basic data to be compiled and analyzed include the following:

- Number of calls received per year
- Number of incidents investigated
- Number of actual IDDE incidents
- Average time to follow up on incident report
- Average time to remedy identified illicit problem
- Most common problems identified by public

Costs

Table C2 provides planning level costs to establish and maintain a hotline and tracking system. Certain costs can undoubtedly be reduced through sharing of services across departments and even jurisdictions.

Table C2: Cost to Create and Maintain a Successful IDDE Hotline			
Steps	**Key Elements/ Consideration**	**Initial Costs**	**Annual Costs**
1. Define the scope	Planning Costs: 60 hrs @ $25/hr to coordinate with other departments and design program basics	$1,500	$0
2. Create a tracking and reporting system	Initial web design: 80hrs @ $25/hr Annual web hosting @ 200/yr[1]	$2,000	$200
	800 toll free number set-up: free Monthly costs: $20/month ($240/yr) + $0.20 per minute (assume average call of 10 minutes and 1000 calls/yr, or $2,000/yr)[2]	$0	$2,240
	Database design: 20 hrs @ $25/hr[1]	$500	$0
3. Train personnel	*Initial*: 3 days (Approx $25/hr) including full day introductory Access training course ($400) = $1,000[3] *Annual*: approx 1/2 day refresher = $200	$1,000	$200
	Initial: presentation prep (24 hrs @ $50/hr) *Annual*: mini-refresher training (16 hrs @ $25/hr to rotate through other departments)	$1,200	$800
4. Advertise	*Initial*: Design brochure and magnets ($1,000)[4,] Design 30 second PSA video spot ($500)[5] *Annual*: 4,000 magnets ($920), 10,000 brochures printed and mailed ($1,500) + 20 hrs or coordination ($500)	$1,500	$2,920
5. Respond to complaints	Assumes 1,000 calls per year at 10 min per complaint[6] to handle including receiving the call, forwarding to appropriate place, logging into a database, and tracking investigation. This time represents approximately 15% of a full time position.	$0	$5,000
6. Track incidents			
TOTAL		**$7,700**	**$11,360**

Ways to reduce cost: Use in-house or donated database, brochure and web design services; combine with other pollution prevention hotlines (e.g., storm water); combine with other local, regional or state IDDE hotline programs; use existing web page hosting services; hire staff with database experience

Notes:

[1] Personal communication with Center for Watershed Protection staff performing similar duties

[2] Sprint Small Business website

[3] ExecuTrain - computer training business

[4] CWP, 1998

[5] CSG, 1998

[6] adapted from TCEQ, 2003

References

Center for Watershed Protection (CWP). 1998. *Rapid Watershed Planning Handbook – A Comprehensive Guide for Managing Urbanizing Watersheds*. Ellicott City, MD.

Center for Watershed Protection. 2002. Unpublished Task I Technical Memorandum in Support of *Illicit Discharge Detection and Elimination Guidance Manual*. Ellicott City, MD.

Council of State Governments (CSG). 1998. *Getting in Step: A Guide to Effective Outreach in Your Watershed*.

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Texas Commission of Environmental Quality (TCEQ) Personal Communication. May 9, 2003. Email Jim Reed.

Illicit Discharge Hotline Incident Tracking Sheet

Incident ID:

Responder Information	
Call taken by:	Call date:
Call time:	Precipitation (inches) in past 24-48 hrs:
Reporter Information	
Incident time:	Incident date:

Caller contact information (*optional*):

Incident Location *(complete one or more below)*

Latitude and longitude:

Stream address or outfall #:

Closest street address:

Nearby landmark:

Primary Location Description	**Secondary Location Description:**		
☐ Stream corridor *(In or adjacent to stream)*	☐ Outfall	☐ In-stream flow	☐ Along banks
☐ Upland area *(Land not adjacent to stream)*	☐ Near storm drain	☐ Near other water source (storm water pond, wetland, etc.):	

Narrative description of location:

Upland Problem Indicator Description

☐ Dumping	☐ Oil/solvents/chemicals	☐ Sewage
☐ Wash water, suds, etc.	☐ Other: _____	

Stream Corridor Problem Indicator Description

Odor	☐ None	☐ Sewage	☐ Rancid/Sour	☐ Petroleum (gas)
	☐ Sulfide (rotten eggs); natural gas	☐ Other: Describe in "Narrative" section		
Appearance	☐ "Normal"	☐ Oil sheen	☐ Cloudy	☐ Suds
	☐ Other: Describe in "Narrative" section			
Floatables	☐ None:	☐ Sewage (toilet paper, etc)	☐ Algae	☐ Dead fish
	☐ Other: Describe in "Narrative" section			

Narrative description of problem indicators:

Suspected Violator (name, personal or vehicle description, license plate #, etc.):

Investigation Notes	
Initial investigation date:	Investigators:
☐ No investigation made	Reason:
☐ Referred to different department/agency:	Department/Agency:
☐ Investigated: No action necessary	
☐ Investigated: Requires action	Description of actions:
Hours between call and investigation:	Hours to close incident:
Date case closed:	
Notes:	

APPENDIX D

OUTFALL RECONNAISSANCE INVENTORY FIELD SHEET

OUTFALL RECONNAISSANCE INVENTORY/ SAMPLE COLLECTION FIELD SHEET

Section 1: Background Data

Subwatershed:		Outfall ID:	
Today's date:		Time (Military):	
Investigators:		Form completed by:	
Temperature (°F):	Rainfall (in.): Last 24 hours:	Last 48 hours:	
Latitude:	Longitude:	GPS Unit:	GPS LMK #:
Camera:		Photo #s:	

Land Use in Drainage Area (Check all that apply):

☐ Industrial
☐ Ultra-Urban Residential
☐ Suburban Residential
☐ Commercial
☐ Open Space
☐ Institutional
Other: _____
Known Industries: _____

Notes (e.g., origin of outfall, if known):

Section 2: Outfall Description

LOCATION	MATERIAL	SHAPE		DIMENSIONS (IN.)	SUBMERGED
☐ **Closed Pipe**	☐ RCP ☐ CMP ☐ PVC ☐ HDPE ☐ Steel ☐ Other: _____	☐ Circular ☐ Eliptical ☐ Box ☐ Other: _____	☐ Single ☐ Double ☐ Triple ☐ Other: _____	Diameter/Dimensions: _____	In Water: ☐ No ☐ Partially ☐ Fully With Sediment: ☐ No ☐ Partially ☐ Fully
☐ **Open drainage**	☐ Concrete ☐ Earthen ☐ rip-rap ☐ Other: _____	☐ Trapezoid ☐ Parabolic ☐ Other: _____		Depth: _____ Top Width: _____ Bottom Width: _____	
☐ **In-Stream**	**(applicable when collecting samples)**				
Flow Present?	☐ Yes ☐ No	***If No, Skip to Section 5***			
Flow Description (If present)	☐ Trickle ☐ Moderate ☐ Substantial				

Section 3: Quantitative Characterization

FIELD DATA FOR FLOWING OUTFALLS				
PARAMETER		**RESULT**	**UNIT**	**EQUIPMENT**
☐Flow #1	Volume		Liter	Bottle
	Time to fill		Sec	
☐Flow #2	Flow depth		In	Tape measure
	Flow width	_____' _____"	Ft, In	Tape measure
	Measured length	_____' _____"	Ft, In	Tape measure
	Time of travel		S	Stop watch
Temperature			°F	Thermometer
pH			pH Units	Test strip/Probe
Ammonia			mg/L	Test strip

Outfall Reconnaissance Inventory Field Sheet

Section 4: Physical Indicators for Flowing Outfalls Only

Are Any Physical Indicators Present in the flow? ☐ Yes ☐ No (*If No, Skip to Section 5)*

INDICATOR	CHECK if Present	DESCRIPTION	RELATIVE SEVERITY INDEX (1-3)		
Odor	☐	☐ Sewage ☐ Rancid/sour ☐ Petroleum/gas ☐ Sulfide ☐ Other:	☐ 1 – Faint	☐ 2 – Easily detected	☐ 3 – Noticeable from a distance
Color	☐	☐ Clear ☐ Brown ☐ Gray ☐ Yellow ☐ Green ☐ Orange ☐ Red ☐ Other:	☐ 1 – Faint colors in sample bottle	☐ 2 – Clearly visible in sample bottle	☐ 3 – Clearly visible in outfall flow
Turbidity	☐	See severity	☐ 1 – Slight cloudiness	☐ 2 – Cloudy	☐ 3 – Opaque
Floatables -Does Not Include Trash!!	☐	☐ Sewage (Toilet Paper, etc.) ☐ Suds ☐ Petroleum (oil sheen) ☐ Other:	☐ 1 – Few/slight; origin not obvious	☐ 2 – Some; indications of origin (e.g., possible suds or oil sheen)	☐ 3 - Some; origin clear (e.g., obvious oil sheen, suds, or floating sanitary materials)

Section 5: Physical Indicators for Both Flowing and Non-Flowing Outfalls

Are physical indicators that are not related to flow present? ☐ Yes ☐ No (*If No, Skip to Section 6)*

INDICATOR	CHECK if Present	DESCRIPTION	COMMENTS
Outfall Damage	☐	☐ Spalling, Cracking or Chipping ☐ Peeling Paint ☐ Corrosion	
Deposits/Stains	☐	☐ Oily ☐ Flow Line ☐ Paint ☐ Other:	
Abnormal Vegetation	☐	☐ Excessive ☐ Inhibited	
Poor pool quality	☐	☐ Odors ☐ Colors ☐ Floatables ☐ Oil Sheen ☐ Suds ☐ Excessive Algae ☐ Other:	
Pipe benthic growth	☐	☐ Brown ☐ Orange ☐ Green ☐ Other:	

Section 6: Overall Outfall Characterization

☐ Unlikely ☐ Potential (presence of two or more indicators) ☐ Suspect (one or more indicators with a severity of 3) ☐ Obvious

Section 7: Data Collection

1. Sample for the lab?	☐ Yes	☐ No	
2. If yes, collected from:	☐ Flow	☐ Pool	
3. Intermittent flow trap set?	☐ Yes	☐ No	If Yes, type: ☐ OBM ☐ Caulk dam

Section 8: Any Non-Illicit Discharge Concerns (e.g., trash or needed infrastructure repairs)?

APPENDIX E

FLOW TYPE DATA FROM TUSCALOOSA AND BIRMINGHAM, AL

Appendix E1: Data Tables for Tuscaloosa

Table E1.1: Tap Water Reference ("Library") Samples

Sample number	Sampling Location	Date	pH	Spec. cond. (µS/cm)	Temp. (°F)	Turb. (NTU)	Color (APHA Platinum Cobalt Units)	F (mg/L)	Hard. (mg/L $CaCO_3$)	Detergent (mg/L as MBAS)	Fluorescence (raw signal strength)	Fluorescence (mg/L as "Tide")
1	B.B.Commer Hall	5/17/2002	8.19	132	N/A	N/A	0	0.97	63.6	0	N/A	N/A
2	Rose Towers	5/17/2002	7.92	145	N/A	N/A	0	0.97	68.4	0	N/A	N/A
3	H.C.Commer Hall	5/17/2002	8.46	125	N/A	N/A	0	0.96	60.8	0	N/A	N/A
4	Rec Centre	5/17/2002	8.11	130	N/A	N/A	0	0.92	64.8	0	N/A	N/A
5	Coleman Coliseum	5/17/2002	8.28	130	N/A	N/A	0	0.94	72.8	0	N/A	N/A
6	Mib (UA)	5/29/2003	7.81	146	N/A	1.15	0	1.04	28	0	2115	4.88
7	Alex Appt.	5/30/2003	7.38	156	N/A	0.761	0	0.82	44	0	92	0.21
8	Georgas Library (UA)	6/3/2003	8.13	152	N/A	0.811	0		42	0	1255	2.9
9	Rodgers Library	6/8/2003	7.5	141	N/A	0.566	0	0.84	40	0	165	0.38
10	Alexander Property Appt.	6/8/2003	7.5	138	N/A	0.61	0	0.89	46	0	637	1.47
11	Pslidea Court Appt.	6/8/2003	7.68	139	N/A	0.433	0	1.00	44	0	566	1.3
12	University Plaza Appt.	6/8/2003	7.5	140	N/A	0.856	0	0.94	46	0	1003	2.31
Mean			7.87	140	-	0.74	0	0.94	52	0	833	1.92
Standard Deviation			0.36	9.3	-	0.23	0	0.065	14	0	702	1.62
COV			0.05	0.07	-	0.32	-	0.07	0.27	-	0.84	0.84
Anderson Darling Probability Test Value (Normal)			**1.138**	**1.004**	-	**1.57**	-	**1.144**	**1.331**	-	-	**1.601**
Anderson Darling Probability Test Value (Log-normal)			-	0.998	-	1.543	-	1.185	1.307	-	-	1.639

Data provided by Robert Pitt, University of Alabama

Table E1.1: Tap Water Reference ("Library") Samples, CONT.									
Sample number	**Sampling Location**	**Date**	**K (mg/L)**	**NH_3 (mg/L as N)**	**NH_3/K (ratio)**	**B (mg/L)**	**Total Coliforms (MPN/100 mL)**	***E. coli* (MPN/100 mL)**	**Enterococci (MPN/100 mL)**
1	B.B.Commer Hall	5/17/2002	1	<LD	N/A	N/A	N/A	N/A	N/A
2	Rose Towers	5/17/2002	1	<LD	N/A	N/A	N/A	N/A	N/A
3	H.C.Commer Hall	5/17/2002	1	<LD	N/A	N/A	N/A	N/A	N/A
4	Rec Centre	5/17/2002	1	<LD	N/A	N/A	N/A	N/A	N/A
5	Coleman Coliseum	5/17/2002	1	<LD	N/A	N/A	N/A	N/A	N/A
6	Mib (UA)	5/29/2003	2	0.01	0.005	0.19	1	<1	<1
7	Alex Appt.	5/30/2003	2	<LD	N/A	0.1	<1	<1	<1
8	Georgas Library (UA)	6/3/2003	1	<LD	N/A	0.12	<1	<1	<1
9	Rodgers Library	6/8/2003	1	<LD	N/A	0.04	21.6	<1	<1
10	Alexander Property Appt.	6/8/2003	1	0.07	0.07	0.14	<1	<1	<1
11	Pslidea Court Appt.	6/8/2003	2	0.07	0.035	0.27	<1	<1	<1
12	University Plaza Appt.	6/8/2003	2	0.07	0.035	0.11	<1	<1	<1
Mean			1.3	<0.055	0.036	0.14	<11	<1	<1
Standard Deviation			0.49	0.03	0.026	0.07	15	-	-
COV			0.37	0.55	0.73	0.53	1.3	-	-
Anderson Darling Probability Test Value (Normal)			**3.809**	**3.199**	**2.539**	**1.663**	4.103	-	-
Anderson Darling Probability Test Value (Log-normal)			3.809	3.199	2.703	1.685	4.103	-	-

Data provided by Robert Pitt, University of Alabama

Table E1.2: Spring Water Reference ("Library") Samples

Sample number	Sampling Location	Date	pH	Spec. cond. (µS/cm)	Temp. (°F)	Turb. (NTU)	Color (APHA Platinum Cobalt Units)	F (mg/L)	Hard. (mg/L $CaCO_3$)	Detergent (mg/L as MBAS)	Fluorescence (raw signal strength)	Fluorescence (mg/L as "Tide")
1	Marrs Spring	9/30/2002	5.77	128	30	56	0	0.01	24.6	0	N/A	0.94
2	Jack Warner Pkwy	10/11/2002	6.46	124	30	67	0	0.01	34.4	0	N/A	0.56
3	Marrs Spring	11/3/2002	6.21	166	N/A	0.85	0	0.01	40.2	0	N/A	4.84
4	Jack Warner Pkwy	11/3/2002	6.36	112	N/A	42	0	0.01	28.6	0	N/A	6.64
5	Marrs Spring	3/11/2003	6.64	230	N/A	0.591	0	0.08	38	0	N/A	0.46
6	Jack Warner Pkwy	5/16/2003	6.45	126	N/A	19.3	0	0.21	32	0	20754	47.97
7	Jack Warner Pkwy	5/17/2003	6.16	128	N/A	19.6	0	0.17	44	0	2296	5.30
8	Marrs Spring	5/18/2003	6.82	182	N/A	1.78	0	0.39	42	0	1542	3.56
9	Marrs Spring	5/30/2003	6.43	143	N/A	1.12	5	0.31	40	0	1130	2.61
10	Marrs Spring	6/3/2003	6.81	200	N/A	21.2	27	0.07	42	0	6537	15.11
11	Jack Warner Pkwy	6/3/2003	5.63	125	72	4.08	0	0.14	48	0	7855	18.15
12	Jack Warner Pkwy	6/5/2003	6.04	130	68	4.89	0	0.24	48	0	5343	12.35
Mean			**6.3**	**149**	**50**	**19.8**	**2.6**	**0.13**	**38**	**0**	**6493**	**9.8**
Standard Deviation			**0.37**	**36**	**23**	**23**	**7.7**	**0.12**	**7.3**	**0**	**6800**	**13.3**
COV			**0.05**	**0.24**	**0.46**	**1.16**	**2.92**	**0.93**	**0.19**	**-**	**-**	**1.3**
Anderson Darling Probability Test (Normal)			**1.046**	**1.046**	**1.795**	**-**	**1.726**	**5.451**	**1.215**	**1.08**	**-**	**-**
Anderson Darling Probability Test (Log-normal)			**-**	**-**	**1.633**	**-**	**1.192**	**4.201**	**1.664**	**1.213**	**-**	**-**

Data provided by Robert Pitt, University of Alabama

Table E1.2: Spring Water Reference ("Library") Samples, CONT.

Sample number	Sampling Location	Date	K (mg/L)	NH_3 (mg/L as N)	NH_3/K (ratio)	B (mg/L)	Total Coliforms (MPN/100 mL)	*E. coli* (MPN/100 mL)	Enterococci (MPN/100 mL)
1	Marrs Spring	9/30/2002	8	0.01	0.001	N/A	1203.3	4.1	4.1
2	Jack Warner Pkwy	10/11/2002	1	0.02	0.02	N/A	275.5	1	36.4
3	Marrs Spring	11/3/2002	3	0.04	0.013	N/A	N/A	N/A	N/A
4	Jack Warner Pkwy	11/3/2002	2	0.02	0.01	N/A	N/A	N/A	N/A
5	Marrs Spring	3/11/2003	3	0.08	0.026	N/A	N/A	N/A	N/A
6	Jack Warner Pkwy	5/16/2003	3	0.01	0.0033	0.15	116.2	<1	<1
7	Jack Warner Pkwy	5/17/2003	2	0.29	0.14	0.15	>2419.2	290.9	412
8	Marrs Spring	5/18/2003	4	0.01	0.0025	0.14	>2419.2	172.3	140.8
9	Marrs Spring	5/30/2003	3	0.05	0.016	0.09	111.2	<1	3.1
10	Marrs Spring	6/3/2003	2	0.05	0.025	0.16	>2419.2	9.7	65.7
11	Jack Warner Pkwy	6/3/2003	4	0.05	0.012	0.09	4.1	1	<1
12	Jack Warner Pkwy	6/5/2003	3	0.05	0.016	0.04	7.2	<1	<1
Mean			3.1	0.057	0.024	0.117	>286	<80	<110
Standard Deviation			1.7	0.077	0.039	0.045	460	123	156
COV			0.55	1.35	1.592	0.381	1.60	1.54	1.41
Anderson Darling Probability Test Value (Normal)			1.9	3.01	3.498	**1.864**	2.06	3.27	2.66
Anderson Darling Probability Test Value (Log-normal)			**1.4**	**1.2**	**1.3**	2.04	1.55	2.14	1.47

Data provided by Robert Pitt, University of Alabama

Table E1.3: Car Wash Reference ("Library") Samples

Sample number	Sampling Location	Date	pH	Spec. cond. (µS/cm)	Temp. (°F)	Turb. (NTU)	Color (APHA Platinum Cobalt Units)	F (mg/L)	Hard. (mg/L $CaCO_3$)	Detergent (mg/L as MBAS)	Fluorescence (raw signal strength)
1	Gee's Car Wash-Self Service	10/31/2002	6.62	320	26	263	100	<LD	56		N/A
2	Texaco Gas Station - Automatic Carwash	10/31/2002	6.90	300	28	232	>100	0.04	15	150	N/A
3	Chevey Gas Station - Automatic Carwash	5/16/2003	7.00	260	N/A	383	80.00	6.45	68	120	46162
4	Self service carwash-University Blvd.	5/17/2003	9.04	380	N/A	81	>100	1.70	76	150	19192
5	Self service carwash-University Blvd.	5/17/2003	7.37	390	N/A	239	>100	0.56	78	140	294014
6	Chevey Gas Station - Automatic Carwash	5/17/2003	9.34	570	N/A	264	>100	<LD	82	80	39262
7	Chevey Gas Station-McFarland - Automatic Carwash	5/29/2003	7.79	210	N/A	62	77.00	1.47	83	200	41341
8	Parade gas station (McFarland) - Automatic Carwash	6/3/2003	8.57	200	N/A	207	>100	0.05	84	150	54268
9	Stop and go self service carwash-Skyland Blvd.	6/3/2003	6.81	200	70	65	80.00	0.42	76	120	70180
10	Parade gas station-(Skyland Blvd.) - Automatic Carwash	6/3/2003	7.53	192	70	69	60.00	0.19	74	150	35731
11	Shell gas station (Skyland Blvd.) - Automatic Carwash	6/3/2003	7.2	120	71	1	30.00	0.50	82	150	14937
12	Parade gas station (Skyland Blvd.) - Automatic Carwash	6/8/2003	7.89	154	N/A	14	0.00	0.87	80	140	13681
Mean			7.67	274	53	156	>61	1.22	71	140	62876
Standard Deviation			0.89	126	23	122	34	1.92	19	29	83144
COV			0.11	0.45	0.44	0.77	0.56	1.56	0.27	0.20	1.32
Anderson Darling Probability Test (Normal)			**1.22**	**1.27**	-	**1.33**	**1.96**	2.66	**1.72**	**1.87**	-
Anderson Darling Probability Test (Log-normal)			-	1.02	-	1.79	2.18	**1.20**	1.81	3.12	-

Data provided by Robert Pitt, University of Alabama

Table E1.3: Car Wash Reference ("Library") Samples, CONT.

Sample number	Sampling Location	Date	Fluorescence (mg/L as "Tide")	K (mg/L)	NH_3 (mg/L as N)	NH_3/K (ratio)	B (mg/L)	Total Coliforms (MPN/100 mL)	*E. coli* (MPN/100 mL)	Enterococci (MPN/100 mL)
1	Gee's Car Wash-Self Service	10/31/2002	132	10	0.44	0.044	N/A	>2419.2	1553.1	>2419.2
2	Texaco Gas Station - Automatic Carwash	10/31/2002	130	2	0.65	0.33	N/A	>2419.2	1413.60	6.20
3	Chevey Gas Station - Automatic Carwash	5/16/2003	106	2	0.37	0.19	0.50	>2419.2	4.1	5.2
4	Self service carwash-University Blvd.	5/17/2003	44	5	0.28	0.06	0.65	>2419.2	14.6	3.1
5	Self service carwash-University Blvd.	5/17/2003	55	2	0.03	0.02	1.23	>2419.2	>2419.2	1
6	Chevey Gas Station - Automatic Carwash	5/17/2003	90	3	4.50	1.50	1.74	>2419.2	1413.6	>2419.2
7	Chevey Gas Station-McFarland - Automatic Carwash	5/29/2003	95	3	0.75	0.25	0.37	>2419.2	15.8	<1
8	Parade gas station (McFarland) - Automatic Carwash	6/3/2003	125	2	0.25	0.13	0.48	>2419.2	11.9	11.1
9	Stop and go self service carwash-Skyland Blvd.	6/3/2003	162	6	1	0.17	0.70	>2419.2	235.9	<1
10	Parade gas station-(Skyland Blvd.) - Automatic Carwash	6/3/2003	82	2	0.25	0.13	0.50	>2419.2	15.5	<1
11	shell gas station (Skyland Blvd.) - Automatic Carwash	6/3/2003	34	3	0.05	0.02	0.09	>2419.2	1553.1	2419.2
12	parade gas station (Skyland Blvd.) - Automatic Carwash	6/8/2003	31	3	2.25	0.75	0.28	<1	<1	<1
Mean			90	3.6	0.90	0.29	0.65	>2419.2	>623	>407
Standard Deviation			42	2.4	1.2	0.42	0.48	-	744	985
COV			0.46	0.667	1.4	1.4	0.74	-	1.1	2.4
Anderson Darling Probability Test (Normal)			**1.029**	2.313	2.6	2.58	1.678	-	2.158	4.467
Anderson Darling Probability Test (Log-normal)			1.254	**1.71**	**1.103**	**0.999**	**1.34**	-	1.626	2.372

Data provided by Robert Pitt, University of Alabama

Table E1.4: Laundry Reference ("Library") Samples

Sample number	Sampling Location	Date	pH	Spec. cond. (µS/cm)	Temp. (°F)	Turb. (NTU)	Color (APHA Platinum Cobalt Units)	F (mg/L)	Hard. (mg/L $CaCO_3$)	Detergent (mg/L as MBAS)	Fluorescence (raw signal strength)	Fluorescence (mg/L as "Tide")
1	Renee's House (unknown)	11/3/2002	6.52	220	26	90.40	20	1.27	13.00	1000.00	N/A	1231
2	Renee's House (unknown)	12/14/2002	6.22	180	26	66.20	30	0.98	18.00	920.00	N/A	1002
3	Renee's House (unknown)	5/11/2003	9.06	440	N/A	366.00	20	0.82	54	900	644924	1490
4	Renee's House (unknown)	5/11/2003	7.73	1690	N/A	85.70	20	0.78	60	1020	744120	1720
5	Renee's House (unknown)	5/11/2003	9.63	360	N/A	398.00	20	1.07	58	1000	131046	302
6	Yukio's apartment (Purex)	5/30/2003	7.10	590	N/A	226.00	20	0.84	42	920	886425	2049
7	Yukio's apartment (Purex)	5/31/2003	8.7	370	81	344	20	0.76	46	800	606787	1402
8	Suman (Tide)	5/30/2003	7.1	430	70	25	>100	0.05	52	620	1280468	2805
9	Yukio's apartment (Purex)	6/3/2003	8.2	470	84	128	>100	0.38	50	760	583967	1349
10	Soumya (Tide)	6/3/2003	8.03	420	110	304	>100	1.04	56	420	745300	1722
11	Veera (Gain)	6/3/2003	9.45	240	N/A	135	45	1.12	54	580	186050	430
12	Sanju (Tide)	6/8/2003	7.2	152	N/A	59.1	40	1.09	44	480	260002	601
Mean			7.91	463.5	26	185	>26	0.85	45	785	532069	1342
Standard Deviation			1.12	408	26	134	9.93	0.34	15	212	271933	709
COV			0.14	0.880	N/A	0.72	0.38	0.40	0.33	0.27	0.51	0.52
Anderson Darling Probability Test Value (Normal)			**1.013**	2.641	N/A	1.401	**2.578**	**1.42**	**1.841**	**1.28**	-	**1.035**
Anderson Darling Probability Test Value (Log-normal)			-	1.298	N/A	**1.132**	2.587	2.71	2.583	1.435	-	1.32

Data provided by Robert Pitt, University of Alabama

Table E1.4: Laundry Reference ("Library") Samples, CONT.

Sample number	Sampling Location	Date	K (mg/L)	NH_3 (mg/L as N)	NH_3/K (ratio)	B (mg/L)	Total Coliforms (MPN/100 mL)	*E. coli* (MPN/100 mL)	Enterococci (MPN/100 mL)
1	Renee's House (unknown)	11/3/2002	2	1.10	0.55	N/A	N/A	N/A	N/A
2	Renee's House (unknown)	12/14/2002	2	0.89	0.44	N/A	N/A	N/A	N/A
3	Renee's House (unknown)	5/11/2003	7	2.50	0.35	0.53	290.9	<1	<1
4	Renee's House (unknown)	5/11/2003	4	0.50	0.12	0.36	<1	<1	<1
5	Renee's House (unknown)	5/11/2003	15	0.53	0.03	0.67	<1	<1	<1
6	Yukio's apartment (Purex)	5/30/2003	15	1.50	0.1	0.75	>2419.2	>2419.2	<1
7	Yukio's apartment (Purex)	5/31/2003	9	5	0.55	0.58	>2419.2	20.1	<1
8	Suman (Tide)	5/30/2003	5	8	1.6	7.90	>2419.2	<1	<1
9	Yukio's apartment (Purex)	6/3/2003	12	3	0.25	0.97	>2419.2	19.7	<1
10	Soumya (Tide)	6/3/2003	2	5	2.5	10.80	<1	<1	<1
11	Veera (Gain)	6/3/2003	2	2	1	1.16	<1	<1	<1
12	Sanju (Tide)	6/8/2003	3	9	3	0.70	<1	<1	<1
Mean			6.5	3.2	0.87	2.4	>2419.2	-	<1
Standard Deviation			5.0	2.8	0.98	3.7	-	-	-
COV			0.78	0.89	1.12	1.59	-	-	-
Anderson Darling Probability Test Value (Normal)			1.568	1.468	1.871	3.419	-	-	-
Anderson Darling Probability Test Value (Log-normal)			**1.294**	**0.982**	**0.99**	**2.106**	-	-	-

Data provided by Robert Pitt, University of Alabama

Table E1.5: Sewage (Dry Weather) Reference ("Library") Samples												
Sample number	**Sampling Location**	**Date**	**pH**	**Spec. cond. (µS/cm)**	**Temp. (°F)**	**Turb. (NTU)**	**Color (APHA Platinum Cobalt Units)**	**F (mg/L)**	**Hard. (mg/L $CaCO_3$)**	**Detergent (mg/L as MBAS)**	**Fluorescence (raw signal strength)**	**Fluorescence (mg/L as "Tide")**
1	Tuscaloosa WWTP (Dry Season)	12/18/2002	6.44	780	N/A	192	>100	0.64	36	10	N/A	260
2	Tuscaloosa WWTP (Dry Season)	1/8/2003	6.56	2100	N/A	306	>100	0.74	42	10	N/A	156
3	Tuscaloosa WWTP (Dry Season)	1/15/2003	6.42	1500	N/A	203	>100	0.64	52	12.5	N/A	142
4	Tuscaloosa WWTP (Dry Season)	3/11/2003	6.9	1280	N/A	53.6	>100	0.68	68	10	N/A	189
5	Tuscaloosa WWTP (Dry Season)	5/18/2003	7.1	540	N/A	230	70	0.65	65	8	114406	264
6	Tuscaloosa WWTP (Dry Season)	5/29/2003	6.99	1090	N/A	128	100	0.82	42	8	115847	267
Mean			6.73	1215	-	185	>100	0.695	50	9.7	115126	213
Standard Deviation			0.29	553	-	86	-	0.072	13	1.66	1018	57
COV			0.04	0.45	-	0.46	-	0.104	0.260	0.171	0.009	0.27
Anderson Darling Probability Test Value (Normal)			**1.878**	**1.96**	-	**1.77**	**-**	**1.992**	**1.874**	**2.012**	-	**2.042**
Anderson Darling Probability Test Value (Log-normal)			-	1.913	-	1.996	-	1.96	1.846	2	-	2.025

Sample number	**Sampling Location**	**Date**	**K (mg/L)**	**NH_3 (mg/L as N)**	**NH_3/K (ratio)**	**B (mg/L)**	**Total Coliforms (MPN/100 mL)**	***E. coli* (MPN/100 mL)**	**Enterococci (MPN/100 mL)**
1	Tuscaloosa WWTP (Dry Season)	12/18/2002	11	11	1	N/A	>2419.2	>2419.2	>2419.2
2	Tuscaloosa WWTP (Dry Season)	1/8/2003	10	14	1.4	N/A	N/A	N/A	N/A
3	Tuscaloosa WWTP (Dry Season)	1/15/2003	15	18	1.2	N/A	>2419.2	>2419.2	>2419.2
4	Tuscaloosa WWTP (Dry Season)	3/11/2003	11	45	4.0	N/A	>2419.2	816.4	43.6
5	Tuscaloosa WWTP (Dry Season)	5/18/2003	15	37.5	2.5	N/A	N/A	N/A	N/A
6	Tuscaloosa WWTP (Dry Season)	5/29/2003	9	27	3	0.97	>24192000	12033000	613000
Mean			11.8	25.4	2.19	0.97	>2419.2	6000000	300000
Standard Deviation			2.5	13.6	1.21	-	-	8500000	430000
COV			0.21	0.53	0.55	-	-	1.41	1.41
Anderson Darling Probability Test Value (Normal)			**2.026**	**1.77**	**1.81**	-	-	3.066	3.065
Anderson Darling Probability Test Value (Log-normal)			1.955	1.737	1.785	-	-	2.846	2.672

Data provided by Robert Pitt, University of Alabama

Table E1.6: Sewage (Wet Weather) Reference ("Library") Samples												
Sample number	**Sampling Location**	**Date**	**pH**	**Spec. cond. (µS/cm)**	**Temp. (°F)**	**Turb. (NTU)**	**Color (APHA Platinum Cobalt Units)**	**F (mg/L)**	**Hard. (mg/L $CaCO_3$)**	**Detergent (mg/L as MBAS)**	**Fluorescence (raw signal strength)**	**Fluorescence (mg/L as "Tide")**
1	Tuscaloosa WWTP (Wet Season)	5/30/2003	6.8	1240	N/A	202	>100	0.19	52	8	115770	267
2	Tuscaloosa WWTP (Wet Season)	6/2/2003	6.81	1250	N/A	270	>100	0.22	48	7.5	126580	292
3	Tuscaloosa WWTP (Wet Season)	6/3/2003	6.99	440	N/A	255	100	0.25	44	6	108689	251
4	Tuscaloosa WWTP (Wet Season)	6/4/2003	6.92	440	N/A	231	100	0.14	52	8	129110	298
5	Tuscaloosa WWTP (Wet Season)	6/5/2003	7.00	550	N/A	113	57	0.20	54	7.5	109058	252
6	Tuscaloosa WWTP (Wet Season)	6/6/2003	7.00	850	N/A	259	60	0.17	47	7.5	105607	244
Mean			6.9	795	-	221	>79	0.19	49	7.4	115802	267
Standard Deviation			0.09	379	-	58	24	0.03	3.78	0.73	9932	22
COV			0.01	0.47	-	0.26	0.30	0.197	0.07	0.0996	0.086	0.086
Anderson Darling Probability Test Value (Normal)			**2.097**	**1.722**	-	**2.097**	**2.72**	**1.708**	**1.83**	**2.357**	-	**1.911**
Anderson Darling Probability Test Value (Log-normal)			-	1.725	-	2.3	2.706	1.734	1.838	2.43	-	1.898

Sample number	**Sampling Location**	**Date**	**K (mg/L)**	**NH_3 (mg/L as N)**	**NH_3/K (ratio)**	**B (mg/L)**	**Total Coliforms (MPN/100 mL)**	***E. coli* (MPN/100 mL)**	**Enterococci (MPN/100 mL)**
1	Tuscaloosa WWTP (Wet Season)	5/30/2003	11	30	2.72	1.38	>24192000	2851000	833000
2	Tuscaloosa WWTP (Wet Season)	6/2/2003	12	35	2.91	0.98	>24192000	3654000	598000
3	Tuscaloosa WWTP (Wet Season)	6/3/2003	12	22.5	1.87	0.93	>24192000	2187000	292000
4	Tuscaloosa WWTP (Wet Season)	6/4/2003	10	22.5	2.25	1.05	>24192000	1785000	328000
5	Tuscaloosa WWTP (Wet Season)	6/5/2003	11	36	3.27	1.01	>24192000	3255000	369000
6	Tuscaloosa WWTP (Wet Season)	6/6/2003	14	27.5	1.96	0.78	>24192000	2282000	609000
Mean			11.6	28.9	2.500	1.02	>24192000	2669000	504833
Standard Deviation			1.3	5.8	0.55	0.19	-	708561	210828
COV			0.11	0.203	0.22	0.195	-	0.265	0.418
Anderson Darling Probability Test Value (Normal)			**1.891**	**1.809**	**1.751**	**1.984**	-	1.744	1.854
Anderson Darling Probability Test Value (Log-normal)			1.858	1.825	1.761	1.906	-	1.747	1.833

Data provided by Robert Pitt, University of Alabama

Table E1.7: Industrial Reference ("Library") Samples

Sample number	Sampling Location	Date	pH	Spec. cond. (µS/cm)	Temp. (°F)	Turb. (NTU)	Color (APHA Platinum Cobalt Units)	F (mg/L)	Hard. (mg/L $CaCO_3$)	Detergent (mg/L as MBAS)	Fluores-cence (raw signal strength)	Fluores-cence (mg/L as "Tide")
1	DELPHI (Automotive manufacture)(Water supply unknown)	12/18/2002	6.72	240	N/A	91.6	20	0.04	23	7.5	N/A	722
2	PECO FOODS (Poultry Supplier) (City water supply)	12/18/2002	6.44	850	N/A	309	40	0.89	34	10	N/A	149
3	TAMKO (Roofing Products)(Water supply unknown)	12/18/2002	7	380	N/A	251	>100	0.02	32	12.5	N/A	309
4	DELPHI (Automotive manufacture)(Water supply unknown)	1/8/2003	6.88	340	N/A	225	10	LD	30	0.25	N/A	101
5	PECO FOODS (Poultry Supplier)(City water supply)	1/8/2003	6.22	960	N/A	14.8	10	0.72	32	0.5	N/A	130
6	TAMKO (Roofing Products)(Water supply unknown)	1/8/2003	6.9	310	N/A	210	>100	0.01	38	2	N/A	410
7	DELPHI (Automotive manufacture)(Water supply unknown)	1/15/2003	6.42	81	N/A	37.4	15	0.01	36	6	N/A	599
8	PECO FOODS (Poultry Supplier)(City water supply)	1/15/2003	6.36	45	N/A	10	20	0.81	28	5	N/A	150
9	TAMKO (Roofing Products)(Water supply unknown)	1/15/2003	7.3	37	N/A	226	>100	0.01	26	10	N/A	375
Mean			6.6	360	-	152	>19	0.31	31	5.9	-	327
Standard Deviation			0.35	335	-	114	11	0.41	4.7	4.4	-	221
COV			0.053	0.930	-	0.748	0.58	1.309	0.155	0.741	-	0.67
Anderson Darling Probability Test Value (Normal)			**1.321**	1.629	-	**1.538**	2.056	2.414	**1.21**	**1.276**	-	**1.451**
Anderson Darling Probability Test Value (Log-normal)			-	**1.408**	-	1.792	**1.833**	**1.982**	1.254	1.763	-	1.386

Sample number	Sampling Location	Date	K (mg/L)	NH_3 (mg/L as N)	NH_3/K (ratio)	B (mg/L)	Total Coliforms (MPN/100 mL)	*E. coli* (MPN/100 mL)	Enterococci (MPN/100 mL)
1	DELPHI (Automotive manufacture)(Water supply unknown)	12/18/2002	24	0.55	0.02	N/A	920.8	66.3	0
2	PECO FOODS (Poultry Supplier) (City water supply)	12/18/2002	37	6	0.16	N/A	>2419.2	>2419.2	>2419.2
3	TAMKO (Roofing Products)(Water supply unknown)	12/18/2002	8	10	1.25	N/A	>2419.2	3	>2419.2
4	DELPHI (Automotive manufacture)(Water supply unknown)	1/8/2003	92	0.4	0.004	N/A	N/A	N/A	N/A
5	PECO FOODS (Poultry Supplier)(City water supply)	1/8/2003	42	4.5	0.10	N/A	N/A	N/A	N/A
6	TAMKO (Roofing Products)(Water supply unknown)	1/8/2003	32	12	0.37	N/A	N/A	N/A	N/A
7	DELPHI (Automotive manufacture)(Water supply unknown)	1/15/2003	81	0.9	0.01	N/A	>2419.2	<1	<1
8	PECO FOODS (Poultry Supplier)(City water supply)	1/15/2003	45	2	0.04	N/A	>2419.2	>2419.2	866.4
9	TAMKO (Roofing Products)(Water supply unknown)	1/15/2003	37	8.5	0.22	N/A	204.6	<1	<1
Mean			44	4.9	0.24	-	>562	>34	>433.2
Standard Deviation			26.5	4.3	0.39	-	506	44	612
COV			0.60	0.88	1.6	-	0.89	1.2	1.4
Anderson Darling Probability Test Value (Normal)			**1.611**	**1.371**	2.499	-	2.575	2.668	2.172
Anderson Darling Probability Test Value (Log-normal)			1.536	1.436	1.203	-	2.603	1.963	2.467

Data provided by Robert Pitt, University of Alabama

Table E1.8: Industrial (Cintas) Reference ("Library") Samples

Sample number	Sampling Location	Date	pH	Spec. cond. (µS/cm)	Temp. (°F)	Turb. (NTU)	Color (APHA Platinum Cobalt Units)	F (mg/L)	Hard. (mg/L $CaCO_3$)	Detergent (mg/L as MBAS)	Fluorescence (raw signal strength)	Fluorescence (mg/L as "Tide")
1	CINTAS (Cooperate uniform mfg.)(City water supply)	12/18/2002	11.44	1460	N/A	3388	>100	<LD	35	5	N/A	29
2	CINTAS (Cooperate uniform mfg.)(City water supply)	1/8/2003	9.56	850	N/A	483	>100	<LD	40	10	N/A	285
3	CINTAS (Cooperate uniform mfg.)(City water supply)	1/15/2003	10.22	85	N/A	4023	>100	0.02	32	3	N/A	66
Mean			10.4	798	-	2631	>100	<0.02	35	6	-	127
Standard Deviation			0.95	688	-	1887	-	-	4.0	3.6	-	138
COV			0.091	0.86	-	0.71	-	-	0.11	0.6	-	1.08
Anderson Darling Probability Test Value (Normal)			**3.067**	**3.072**	-	**3.21**	-	-	**3.063**	**3.084**	-	**3.15**
Anderson Darling Probability Test Value (Log-normal)			-	3.201	-	3.298	-	-	3.06	3.059	-	3.067

Sample number	Sampling Location	Date	K (mg/L)	NH_3 (mg/L as N)	NH_3/K (ratio)	B (mg/L)	Total Coliforms (MPN/100 mL)	*E. coli* (MPN/100 mL)	Enterococci (MPN/100 mL)
1	CINTAS (Cooperate uniform mfg.)(City water supply)	12/18/2002	53	7.5	0.14	N/A	0	0	0
2	CINTAS (Cooperate uniform mfg.)(City water supply)	1/8/2003	56	6	0.10	N/A	N/A	N/A	N/A
3	CINTAS (Cooperate uniform mfg.)(City water supply)	1/15/2003	85	5	**0.05**	N/A	0	<1	22.2
Mean			64	6.1	0.10	-	0	-	11.1
Standard Deviation			17	1.2	0.04	-	0	-	15.6
COV			0.27	0.20	0.40	-	-	-	1.4
Anderson Darling Probability Test Value (Normal)			**3.182**	**3.06**	**3.079**	-	4.201	-	4.201
Anderson Darling Probability Test Value (Log-normal)			3.167	3.059	3.118	-	-	-	-

Data provided by Robert Pitt, University of Alabama

Table E1.9: Irrigation Reference ("Library") Samples

Sample number	Sampling Location	Date	pH	Spec. cond. (µS/cm)	Temp. (^{o}F)	Turb. (NTU)	Color (APHA Platinum Cobalt Units)	F (mg/L)	Hard. (mg/L $CaCO_3$)	Detergent (mg/L as MBAS)	Fluorescence (raw signal strength)	Fluorescence (mg/L as "Tide")
1	Ferguson Parking (UA) - Run over concrete	5/16/2003	7.91	200	N/A	16.2	0	0.69	62	0	21226	49
2	B.B. Commer (UA) - Run over concrete	5/18/2003	7.38		N/A	4.03	10	0.68	60	0	13915	32
3	Art Building (UA) - Taken at a little puddle, NO concrete	5/16/2003	7.46	200	N/A	64.6	0	0.76	55	0	40040	92
4	MIB (UA) - Run over concrete	5/19/2003	7.18	163	N/A	9.95	20	0.83	58	0	19234	44
5	MIB (UA) - Run over concrete	5/30/2003	7.1	148	89	21.8	50	0.30	40	0	26851	62
6	Art Building (UA) - Taken at a little puddle, NO concrete	5/30/2003	7.46	200	70	96.6	56	0.39	44	0	38389	88
7	Quad(UA) - Taken at a little puddle, NO concrete	5/30/2003	6.99	181	70	826	54	0.23	52	0	30820	53
8	MIB (UA) - Run over concrete	6/5/2003	7.26	183	82	14.5	50	0.64	54	0	23353	53
9	MIB (UA) - Taken at a little puddle, NO concrete	6/5/2003	7.16	182	78	16.5	30	0.91	52	0	17788	41
10	Bevil (UA) - Taken at a little puddle, NO concrete	6/5/2003	6.91	156	72	32	27	0.57	48	0	24149	55
11	MIB (UA) - Run over concrete	6/9/2003	7.4	183	78	9	40	0.84	66	0	23160	53
12	MIB (UA) - Taken at a little puddle, NO concrete	6/9/2003	7.3	194	80	16.6	50	0.57	54	0	23260	53
Mean			7.2	180	77	93	32	0.61	53	0	25182	56
Standard Deviation			0.26	18	6.5	232	20	0.21	7.3	0	7831	17
COV			0.03	0.10	0.08	2.46	0.64	0.35	0.13	-	0.31	0.31
Anderson Darling Probability Test Value (Normal)			**1.147**	**1.401**		5.099	**1.296**	**1.103**	**1.002**	-	-	1.718
Anderson Darling Probability Test Value (Log-normal)			-	1.457		**1.516**	1.677	1.457	1.006	-	-	**1.383**

Data provided by Robert Pitt, University of Alabama

Table E1.9: Irrigation Reference ("Library") Samples, CONT.									
Sample number	**Sampling Location**	**Date**	**K (mg/L)**	**NH_3 (mg/L as N)**	**NH_3/K (ratio)**	**B (mg/L)**	**Total Coliforms (MPN/100 mL)**	***E. coli* (MPN/100 mL)**	**Enterococci (MPN/100 mL)**
1	Ferguson Parking (UA) - Run over concrete	5/16/2003	2	<LD	N/A	0.14	>2419.2	27.8	>2419.2
2	B.B. Commer (UA) - Run over concrete	5/18/2003	9	1.0	0.111	0.20	>2419.2	8.3	2
3	Art Building (UA) - Taken at a little puddle, NO concrete	5/16/2003	5	0.08	0.016	0.25	>2419.2	>2419.2	>2419.2
4	MIB (UA) - Run over concrete	5/19/2003	3	0.21	0.07	0.13	>2419.2	>2419.2	>2419.2
5	MIB (UA) - Run over concrete	5/30/2003	2	3.5	1.75	0.2	>2419.2	31.8	>2419.2
6	Art Building (UA) -Taken at a little puddle, NO concrete	5/30/2003	4	0.5	0.125	0.36	>2419.2	>2419.2	287.7
7	Quad(UA) - Taken at a little puddle, NO concrete	5/30/2003	5	1	0.2	0.5	>2419.2	>2419.2	>2419.2
8	MIB (UA) - Run over concrete	6/5/2003	9	4.5	0.5	0.22	>2419.2	>2419.2	>2419.2
9	MIB (UA) - Taken at a little puddle, NO concrete	6/5/2003	8	0.5	0.06	0.14	>2419.2	>2419.2	>2419.2
10	Bevil (UA) - Taken at a little puddle, NO concrete	6/5/2003	4	1	0.25	0.23	>2419.2	1299.7	>2419.2
11	MIB (UA) - Run over concrete	6/9/2003	7	0.5	0.07	0.25	>4838.4	>4838.4	>4838.4
12	MIB (UA) - Taken at a little puddle, NO concrete	6/9/2003	10	1	0.1	0.35	>4838.4	>4838.4	>4838.4
Mean			5.6	1.25	0.29	0.24	>2419.2	>2419.2	>2419.2
Standard Deviation			2.8	1.41	0.50	0.10	-	-	-
COV			0.50	1.12	1.69	0.43	-	-	-
Anderson Darling Probability Test Value (Normal)			**1.144**	2.471	3.343	1.366	-	-	-
Anderson Darling Probability Test Value (Log-normal)			1.146	**1.325**	**1.277**	**1.094**	-	-	-
Data provided by Robert Pitt, University of Alabama									

Appendix E-2. Data Tables for Birmingham

Table E2.1: Spring Water Samples													
Sample #	**Conductivity (µS/cm)**	**Fluoride (mg/L)**	**Hardness (mg/L) (as $CaCO_3$)**	**Detergent (mg/L)**	**Fluoresc. (% scale)**	**Potassium (mg/L)**	**Ammonia (mg/L)**	**pH**	**Color (units)**	**Chlorine (mg/L)**	**Toxicity (I25) (% reduc.)**	**Copper (mg/L)**	**Phenols (mg/L)**
1	310	0.09	231	0	11	0.83	0.02	6.92	0	0.00	0	NA	NA
2	288	0.01	239	0	4	0.76	0.00	6.89	0	0.00	0	NA	NA
3	327	0.01	255	0	5	0.69	0.01	7.01	0	0.00	0	NA	NA
4	310	0.03	248	0	5	0.72	0.05	6.98	0	0.01	0	0	0
5	301	0.05	240	0	10	0.74	0.00	7.00	0	0.01	0	0	0
6	295	0.00	243	0	2	0.73	0.00	6.87	0	0.00	0	0	0
7	298	0.03	241	0	6	0.56	0.00	6.99	0	0.00	0	0	0
8	290	0.03	229	0	8	0.72	0.00	6.95	0	0.00	0	0	0
9	295	0.05	233	0	10	0.76	0.00	6.99	0	0.01	0	0	0
10	298	0.01	239	0	7	0.77	0.01	7.01	0	0.00	0	0	0
Mean	301	0.03	240	0	7	0.73	0.01	6.96	0	0.00	0	0	0
St. Dev.	11.6	0.03	7.83	0	2.9	0.07	0.02	0.05	0	0.00	0	0	0
95% conf limits (mean +/-)	6.87	0.02	4.63	0	1.7	0.04	0.01	0.03	0	0.00	0	0	0
Median	298	0.03	240	0	7	0.74	0.00	6.99	0	0.00	0	0	0
Coefficient of Variability	0.04	1.00	0.03	--	0.43	0.10	2.00	0.01	--	--	--	--	--
Distribution	normal	normal	normal	uniform	normal	normal	l-norm	normal	uniform	uniform	uniform	uniform	uniform
Data provided by Robert Pitt, University of Alabama													

NA: Data not available

Table E2.2: Shallow Ground Water Samples													
Sample #	**Conductivity (µS/cm)**	**Fluoride (mg/L)**	**Hardness (mg/L) (as $CaCO_3$)**	**Detergent (mg/L)**	**Fluoresc. (% scale)**	**Potassium (mg/L)**	**Ammonia (mg/L)**	**pH**	**Color (units)**	**Chlorine (mg/L)**	**Toxicity (I25) (% reduc.)**	**Copper (mg/L)**	**Phenols (mg/L)**
1	5	0.08	5	0	7	NA	NA	NA	5	0.04	0	0.01	0
2	5	0.03	22	0	12	NA	NA	NA	20	0.00	0	0.01	0
3	32	0.14	18	0	160	NA	NA	7.8	35	0.08	0	0.00	0
4	128	0.07	41	0	34	1.70	0.38	6.2	0	0.02	0	0.00	0
5	119	0.05	38	0	22	2.15	0.89	5.4	0	0.00	0	0.00	0
6	77	0.04	29	0	15	0.81	0.08	6.4	10	0.01	0	0.00	0
7	31	0.05	32	0	8	0.91	0.05	6.5	5	0.00	0	0.00	0
8	43	0.06	35	0	11	0.89	0.09	6.7	0	0.00	0	0.00	0
9	46	0.04	27	0	17	1.01	0.13	6.4	5	0.01	0	0.00	0
10	28	0.07	26	0	13	0.83	0.08	6.3	0	0.00	0	0.00	0
Mean	51	0.06	27	0	30	1.19	0.24	6.46	8	0.02	0	0.00	0
St. Dev.	43.3	0.03	10.5	0	46.4	0.53	0.31	0.66	11.4	0.03	0	0.00	0
95% conf limits (mean +/-)	34.6	0.03	8.48	0	37.1	0.42	0.25	0.53	9	0.02		0.00	0
Median	38	0.06	28	0	14	0.91	0.09	6.40	5	0.01	0	0.00	0
Coefficient of Variability	0.84	0.50	0.39	--	1.55	0.44	1.26	0.10	1.42	1.50	--	--	--
Distribution	normal	l-normal	normal	uniform	l-normal	normal	normal	normal	l-normal	normal	uniform	uniform	uniform

Data provided by Robert Pitt, University of Alabama

NA: Data not available

Table E2.3: Samples from Irrigation of Landscaped Areas													
Sample #	**Conductivity (µS/cm)**	**Fluoride (mg/L)**	**Hardness (mg/L) (as $CaCO_3$)**	**Detergent (mg/L)**	**Fluoresc. (% scale)**	**Potassium (mg/L)**	**Ammonia (mg/L)**	**pH**	**Color (units)**	**Chlorine (mg/L)**	**Toxicity (I25) (% reduc.)**	**Copper (mg/L)**	**Phenols (mg/L)**
1	109	0.98	42.3	0	132.1	6.46	0.28	6.88	5	0.03	0.0	0.00	0.00
2	119	0.93	39.0	0	218.6	9.42	0.24	6.90	15	0.05	0.0	0.00	0.00
3	92	1.65	41.4	0	267.6	3.21	0.55	7.09	15	0.08	0.0	0.00	0.00
4	98	1.94	40.4	0	199.9	6.32	0.40	7.04	10	0.02	0.0	0.00	0.00
5	107	0.97	39.4	0	231.6	5.44	0.41	6.90	10	0.03	0.0	0.00	0.00
6	110	0.81	38.0	0	242.0	6.71	0.37	7.02	13	0.00	0.0	0.00	0.00
7	100	0.93	39.0	0	212.4	6.49	0.31	7.01	10	0.03	0.0	0.00	0.00
8	102	0.89	41.0	0	201.2	4.98	0.48	6.89	7	0.01	0.0	0.00	0.00
9	106	0.91	42.0	0	223.6	5.79	0.35	6.91	5	0.00	0.0	0.00	0.00
10	107	0.98	39.0	0	215.0	6.01	0.32	6.98	10	0.00	0.0	0.00	0.00
Mean	105	0.90	40.2	0	214.4	6.08	0.37	6.96	10	0.03	0.0	0.00	0.00
St. Dev.	7.28	0.10	1.47	0	35.20	1.56	0.09	0.08	3.62	0.03	0.00	0.00	0.00
95% conf. limits (mean +/-)	5.83	0.08	1.18	0	28.17	1.25	0.07	0.06	2.90	0.02	0.00	0.00	0.00
Median	106	0.93	39.9	0	216.80	6.17	0.36	6.95	10	0.03	0.0	0.00	0.00
Coefficient of Variability	0.07	0.11	0.04	--	0.16	0.26	0.25	0.01	0.36	1.00	--	--	--
Distribution	normal	normal	normal	uniform	normal	normal	normal	bi-modal	normal	normal	uniform	uniform	uniform
Data provided by Robert Pitt, University of Alabama													

NA: Data not available

Table E2.4: Residential/Commercial Sanitary Sewage Samples								
Sample #	**Collection Date**	**Collection Time**	**Conductivity (µS/cm)**	**Fluoride (mg/L)**	**Hardness (mg/L) (as $CaCO_3$)**	**Detergent (mg/L)**	**Fluoresc. (% scale)**	**Potassium (mg/L)**
1	1-Aug	10 p.m.	265	0.90	149	0.96	240	5.25
2	2-Aug	12 a.m.	320	0.72	161	3.80	200	4.79
3	2-Aiug	2 a.m.	360	0.46	172	0.58	170	3.44
4	2-Aug	4 a.m.	350	0.58	181	0.54	155	3.09
5	2-Aug	6 a.m.	410	0.74	167	0.54	205	4.51
6	2-Aug	8 a.m.	435	0.87	154	0.99	265	5.88
7	2-Aug	10 a.m.	410	1.08	150	0.48	265	5.99
8	2-Aug	12 p.m.	400	0.77	145	3.60	270	5.70
9	2-Aug	2 p.m.	410	0.83	149	0.54	280	7.50
10	2-Aug	4 p.m.	460	0.93	151	0.95	265	7.20
11	2-Aug	6 p.m.	410	0.88	156	0.98	265	6.78
12	2-Aug	8 p.m.	430	0.88	158	0.96	300	7.56
13	4-Aug	6 p.m.	550	0.69	145	4.20	280	7.00
14	4-Aug	8 p.m.	460	0.64	133	4.40	280	6.73
15	4-Aug	10 p.m.	500	0.74	123	0.97	265	6.05
16	5-Aug	12 a.m.	420	0.60	142	0.99	227	4.03
17	5-Aug	2 a.m.	360	0.54	148	0.65	175	3.55
18	5-Aug	4 a.m.	365	0.43	158	0.64	120	4.94
19	5-Aug	6 a.m.	390	0.60	142	0.62	230	7.47
20	5-Aug	8 a.m.	500	1.04	126	0.65	310	7.13
21	5-Aug	10 a.m.	450	0.80	125	0.96	315	6.87
22	5-Aug	12 p.m.	430	0.97	126	0.98	310	6.88
23	5-Aug	2 p.m.	420	0.85	126	0.90	300	7.07
24	5-Aug	4 p.m.	460	0.83	122	0.94	290	7.55
25	6-Aug	6 p.m.	440	0.81	127	2.40	280	7.14
26	6-Aug	8 p.m.	435	0.66	123	1.60	290	6.75
27	6-Aug	10 p.m.	400	0.77	120	0.97	265	6.12
28	7-Aug	12 a.m.	390	0.67	133	0.96	210	5.06
29	7-Aug	2 a.m.	340	0.44	149	0.89	175	3.59
30	7-Aug	4 a.m.	400	0.43	141	0.76	170	3.57
31	7-Aug	6 a.m.	420	0.68	138	0.98	300	6.65
32	7-Aug	8 a.m.	465	1.04	136	0.95	260	5.68
33	7-Aug	10 a.m.	460	0.94	141	3.00	280	6.69
34	7-Aug	12 p.m.	460	0.89	138	3.60	285	6.93
35	7-Aug	2 p.m.	490	0.85	135	4.00	265	7.11
36	7-Aug	4 p.m.	450	0.83	155	2.00	270	6.69
Mean			420	0.76	143	1.50	251	5.97
St. Dev.			55.14	0.17	15.04	1.22	49.88	1.36
95% conf. limits (mean +/-)			18.01	0.06	4.91	0.40	16.33	0.45
Median			420	0.79	142	0.96	265	6.67
Coefficient of Variability			0.13	0.23	0.11	0.82	0.20	0.23
Distribution			normal	normal	normal	normal	normal	normal

Data provided by Robert Pitt, University of Alabama

Table E2.4 (cont.)

Sample #	Collection Date	Collection Time	Ammonia (mg/L)	pH	Color (units)	Chlorine (mg/L)	Toxicity (I25) (% reduc.)	Copper (mg/L)	Phenols (mg/L)
1	1-Aug	10 p.m.	8.59	7.35	42	0.01	23.8	0.01	0.00
2	2-Aug	12 a.m.	7.25	7.23	10	0.03	29.2	0.00	0.00
3	2-Aiug	2 a.m.	5.02	7.33	12	0.03	30.3	0.00	0.00
4	2-Aug	4 a.m.	5.22	7.24	8	0.01	26.0	0.00	0.00
5	2-Aug	6 a.m.	13.04	7.35	11	0.02	16.3	0.00	0.00
6	2-Aug	8 a.m.	14.23	7.30	12	0.00	23.8	0.00	0.00
7	2-Aug	10 a.m.	13.03	7.17	15	0.01	20.6	0.01	0.00
8	2-Aug	12 p.m.	9.67	6.97	31	0.00	21.7	0.02	0.00
9	2-Aug	2 p.m.	8.00	6.98	28	0.00	15.3	0.00	0.00
10	2-Aug	4 p.m.	8.81	7.12	22	0.00	11.0	0.00	0.00
11	2-Aug	6 p.m.	7.82	7.03	23	0.00	17.4	0.00	0.00
12	2-Aug	8 p.m.	7.32	7.09	21	0.05	19.5	0.01	0.00
13	4-Aug	6 p.m.	10.03	7.21	75	0.00	43.3	NA	NA
14	4-Aug	8 p.m.	9.18	6.94	61	0.03	47.2	NA	NA
15	4-Aug	10 p.m.	11.82	7.10	45	0.00	41.7	NA	NA
16	5-Aug	12 a.m.	11.04	6.89	49	0.00	41.1	NA	NA
17	5-Aug	2 a.m.	6.38	7.10	26	0.02	46.7	NA	NA
18	5-Aug	4 a.m.	6.00	7.05	19	0.01	49.6	NA	NA
19	5-Aug	6 a.m.	12.83	7.16	22	0.00	52.2	NA	NA
20	5-Aug	8 a.m.	19.49	7.06	50	0.01	52.8	NA	NA
21	5-Aug	10 a.m.	12.34	6.88	60	0.00	37.8	NA	NA
22	5-Aug	12 p.m.	10.67	7.00	64	0.00	48.9	NA	NA
23	5-Aug	2 p.m.	8.57	6.98	54	0.01	47.8	NA	NA
24	5-Aug	4 p.m.	9.25	7.06	48	0.00	53.3	NA	NA
25	6-Aug	6 p.m.	11.00	7.03	62	0.02	65.4	NA	NA
26	6-Aug	8 p.m.	9.99	6.98	48	0.04	99.6	NA	NA
27	6-Aug	10 p.m.	10.66	7.01	43	0.10	99.4	NA	NA
28	7-Aug	12 a.m.	8.29	7.06	15	0.03	40.5	NA	NA
29	7-Aug	2 a.m.	5.53	7.13	16	0.00	4.2	NA	NA
30	7-Aug	4 a.m.	5.84	7.13	18	0.01	3.1	NA	NA
31	7-Aug	6 a.m.	17.28	7.16	42	0.02	54.0	NA	NA
32	7-Aug	8 a.m.	15.74	7.18	68	0.00	98.3	NA	NA
33	7-Aug	10 a.m.	10.99	7.03	80	0.00	68.6	NA	NA
34	7-Aug	12 p.m.	10.03	7.08	54	0.00	71.9	NA	NA
35	7-Aug	2 p.m.	7.43	6.86	52	0.01	69.7	NA	NA
36	7-Aug	4 p.m.	8.58	7.11	58	0.03	71.9	NA	NA
Mean			9.92	7.09	38	0.01	43.4	0.00	0.00
St. Dev.			3.33	0.13	20.95	0.02	25.47	0.01	0.00
95% Conf. limits (mean +/-)			1.09	0.04	6.84	0.01	8.32	0.00	0.00
Median			9.46	7.09	42	0.01	42.5	0.00	0.00
Coefficient of Variability			0.34	0.02	0.55	2.00	0.59	--	--
Distribution			L-normal	normal	normal	L-normal	normal	uniform	uniform

Data provided by Robert Pitt, University of Alabama

NA: Data not available

Table E2.5: Residential Septic Tank Discharge Samples													
Sample #	**Conductivity (µS/cm)**	**Fluoride (mg/L)**	**Hardness (mg/L) (as $CaCO_3$)**	**Detergent (mg/L)**	**Fluoresc. (% scale)**	**Potassium (mg/L)**	**Ammonia (mg/L)**	**pH (units)**	**Color (units)**	**Chlorine (mg/L)**	**Toxicity (I25) (% reduc.)**	**Copper (mg/L)**	**Phenols (mg/L)**
1	82	0.75	252	0.03	511	30.06	117.80	7.23	38	0.03	100	NA	NA
2	108	0.70	186	0.00	547	32.06	124.60	7.38	38	0.01	100	NA	NA
3	56	0.62	186	0.00	536	27.26	114.40	7.16	18	0.00	100	NA	NA
4	397	1.19	36	10.00	266	8.16	26.07	6.61	68	0.01	100	NA	NA
5	482	0.70	29	5.00	321	8.83	135.75	6.53	87	0.03	100	NA	NA
6	362	1.12	36	12.00	351	8.16	26.77	6.67	77	0.00	100	NA	NA
7	812	0.92	80	0.50	466	20.85	89.60	6.63	54	0.00	100	NA	NA
8	812	1.55	84	0.15	431	23.25	91.60	6.59	64	0.01	100	NA	NA
9	762	1.26	82	0.57	471	22.25	86.10	6.54	91	0.03	100	NA	NA
10	432	0.61	45	2.50	455	24.51	95.90	7.39	55	0.20	100	0.00	0.00
11	297	0.42	53	1.00	253	18.66	107.80	6.19	10	0.00	100	0.00	0.00
12	236	0.56	61	0.50	463	21.73	99.30	6.59	100	0.19	100	0.40	0.00
13	327	0.87	63	0.45	339	31.81	113.20	6.72	100	0.20	100	0.35	0.00
Mean	502	0.93	57	3.27	382	18.82	87.21	6.65	70.60	0.07	100	0.19	0.00
St. Dev.	209.87	0.36	20.52	4.35	84.95	7.97	35.11	0.30	27.28	0.09	0.00	0.22	0.00
95% conf. limits (mean +/-)	114.09	0.20	11.16	2.37	46.18	4.33	19.09	0.16	14.83	0.05	0.00	0.12	0.00
Median	414	0.90	57	0.79	391	21.29	93.75	6.60	72.50	0.02	100	0.18	0.00
Coefficient of Variability	0.42	0.39	0.36	1.33	0.22	0.42	0.40	0.04	0.39	1.28	0.00	1.16	--
Distribution	normal	normal	log-normal	log-normal	normal	normal	normal	normal	normal	normal	uniform	bi-modal	uniform

Data provided by Robert Pitt, University of Alabama

NA: Data not available

Table E2.6: Commercial Carwash Samples													
Sample #	**Conductivity (µS/cm)**	**Fluoride (mg/L)**	**Hardness (mg/L) (as $CaCO_3$)**	**Detergent (mg/L)**	**Fluoresc. (% scale)**	**Potassium (mg/L)**	**Ammonia (mg/L)**	**pH**	**Color (units)**	**Chlorine (mg/L)**	**Toxicity (I25) (% reduc.)**	**Copper (mg/L)**	**Phenols (mg/L)**
1	448	16.5	145	50.4	1325	22.00	0.28	6.49	380	0.00	100	0.00	0.00
2	450	11.5	149	52.2	1350	22.00	0.32	6.46	340	0.00	100	0.00	0.00
3	550	12.5	152	52.5	1400	78.40	0.20	7.11	190	0.00	100	0.00	0.00
4	490	15.5	150	49.0	1100	40.70	0.23	6.90	190	0.01	100	0.00	0.00
5	495	12.5	158	56.7	1075	47.70	0.19	6.84	190	0.00	100	0.00	0.00
6	470	8.0	160	50.3	1095	35.40	0.14	6.77	240	0.02	100	0.00	0.00
7	480	10.2	172	38.0	1005	48.20	0.23	6.76	200	0.08	100	NA	NA
8	473	11.8	165	49.0	1155	46.20	0.25	6.67	175	0.23	100	NA	NA
9	492	12.3	159	43.5	1190	16.70	0.19	6.40	160	0.12	100	0.00	0.00
10	505	12.2	155	48.0	1205	39.60	0.36	6.80	150	0.15	100	0.00	0.00
Mean	485	12.3	157	49.0	1190	42.69	0.24	6.72	222	0.07	100	0.00	0.00
St. Dev.	9.41	2.40	8.07	5.14	130.79	15.92	0.07	0.22	77.46	0.08	0.00	0.00	0.00
95% conf. limits (mean +/-)	8.23	1.49	5.00	3.19	81.06	9.87	0.04	0.14	48.01	0.05	0.00	0.00	0.00
Median	485	12.3	157	49.7	1173	43.45	0.23	6.77	190	0.05	100	0.00	0.00
Coefficient of Variability	0.06	0.19	0.05	0.10	0.11	0.37	0.28	0.03	0.35	1.14	0.00	--	--
Distribution	normal	normal	normal	normal	normal	normal	normal	normal	normal	bi-modal	uniform	uniform	uniform
Data provided by Robert Pitt, University of Alabama													

NA: Data not available

Table E2.7: Commercial Laundry Samples													
Sample #	**Conductivity (µS/cm)**	**Fluoride (mg/L)**	**Hardness (mg/L) (as $CaCO_3$)**	**Detergent (mg/L)**	**Fluoresc. (% scale)**	**Potassium (mg/L)**	**Ammonia (mg/L)**	**pH**	**Color (units)**	**Chlorine (mg/L)**	**Toxicity (I25) (% reduc.)**	**Copper (mg/L)**	**Phenols (mg/L)**
1	752	15.89	32	37.0	1169.6	3.47	0.94	9.37	25	0.57	100	NA	NA
2	462	23.98	40	21.5	1144.6	3.97	0.96	9.40	59	0.51	100	NA	NA
3	422	54.48	38	17.0	844.6	3.37	0.62	8.37	61	0.44	100	NA	NA
4	589	42.48	36	32.5	819.6	3.67	0.70	8.60	43	0.38	100	NA	NA
5	657	48.98	34	35.0	1169.6	3.57	0.84	9.10	49	0.21	100	NA	NA
6	565	31.48	37	31.0	1094.6	3.27	0.91	9.20	30	0.33	100	NA	NA
7	485	22.48	38	20.0	994.6	3.77	0.78	9.41	55	0.42	100	NA	NA
8	715	26.98	33	25.0	1019.6	2.57	0.88	9.05	38	0.47	100	0.00	0.00
9	545	35.98	32	24.0	1019.6	3.67	0.69	9.36	57	0.33	100	0.00	0.00
10	437	25.48	37	26.0	969.9	3.47	0.84	9.12	50	0.35	100	0.00	0.00
Mean	563	32.82	36	26.9	1024.6	3.48	0.82	9.10	47	0.40	100	0.00	0.00
St. Dev.	115.81	12.45	2.78	6.69	124.61	0.38	0.12	0.35	12.41	0.10	0.00	0.00	0.00
95% conf. limits (mean +/-)	68.44	7.36	1.64	3.96	73.64	0.22	0.07	0.21	7.33	0.06	0.00	0.00	0.00
Median	555	29.23	37	25.5	1019.6	3.52	0.84	9.16	50	0.40	100	0.00	0.00
Coefficient of Variability	0.21	0.38	0.08	0.25	0.12	0.11	0.14	0.04	0.27	0.26	0.00	--	--
Distribution	normal	normal	normal	normal	normal	normal	normal	normal	normal	normal	uniform	uniform	uniform
Data provided by Robert Pitt, University of Alabama													

NA: Data not available

Table E2.8: Radiator Waste Samples

Sample #	Conductivity (µS/cm)	Fluoride (mg/L)	Hardness (mg/L) (as $CaCO_3$)	Detergent (mg/L)	Fluoresc. (% scale)	Potassium (mg/L)	Ammonia (mg/L)	pH	Color (units)	Chlorine (mg/L)	Toxicity (I25) (% reduc.)	Copper (mg/L)	Phenols (mg/L)
1	4250	136.5	0	17.4	20850	3230	16.9	6.95	2933	0.04	100	NA	NA
2	3350	177.0	0	13.8	24000	2446	32.4	6.99	3000	0.02	100	NA	NA
3	4200	172.5	32	14.7	20500	3473	21.0	6.25	3066	0.06	100	NA	NA
4	3321	133.3	12	14.2	21940	2694	18.1	7.01	3000	0.03	100	NA	NA
5	3289	129.8	0	15.1	22210	2902	22.3	6.85	3000	0.04	100	NA	NA
6	3510	121.5	12	18.3	22240	2907	12.2	6.50	3000	0.00	100	NA	NA
7	1900	183.0	0	13.5	22650	2282	8.9	7.61	2933	0.03	100	NA	NA
8	2510	124.5	0	13.5	22250	2364	90.1	7.38	3000	0.03	100	NA	NA
9	2987	170.1	0	14.6	21920	2899	23.8	6.98	3066	0.02	100	NA	NA
10	3466	145.0	0	15.3	21900	2821	17.5	7.11	3000	0.03	100	NA	NA
Mean	3278	149.3	5.6	15.04	22046	2801	26.3	6.96	3000	0.03	100	NA	NA
St. Dev.	704.32	23.76	10.53	1.62	952.08	374.89	23.32	0.39	44.33	0.02	0.00	NA	NA
95% conf. limits (mean +/-)	436.54	14.73	6.53	1.00	590.10	323.36	14.45	0.24	27.48	0.01	0.00	NA	NA
Median	3335	140.8	0	14.65	22075	2864	24.5	6.99	3000	0.03	100	NA	NA
Coefficient of Variability	0.21	0.16	1.88	0.11	0.04	0.13	0.89	0.06	0.01	0.52	0.00	NA	NA
Distribution	normal	normal	normal	normal	normal	normal	normal	normal	normal	normal	uniform	NA	NA

Data provided by Robert Pitt, University of Alabama

NA: Data not available

Table E2.9: Plating Bath Waste Samples													
Sample #	**Conductivity (µS/cm)**	**Fluoride (mg/L)**	**Hardness (mg/L) (as $CaCO_3$)**	**Detergent (mg/L)**	**Fluoresc. (% scale)**	**Potassium (mg/L)**	**Ammonia (mg/L)**	**pH**	**Color (units)**	**Chlorine (mg/L)**	**Toxicity (I25) (% reduc.)**	**Copper (mg/L)**	**Phenols (mg/L)**
1	16200	9.00	1408	15.0	640.0	774	105.00	1.78	60	0.12	100	0.27	0
2	3620	1.68	950	1.8	505.0	552	74.20	4.82	90	0.27	100	0.00	0
3	8500	1.86	775	10.0	77.5	1730	3.05	5.20	368	0.01	89.4	0.00	0
4	9700	6.00	1452	9.0	225.0	186	139.37	6.15	70	0.08	100	0.21	0
5	10200	5.52	1476	11.4	390.0	220	29.33	3.36	90	0.00	100	0.32	0
6	7000	5.85	1818	1.5	88.0	490	76.00	8.60	50	0.04	68.4	0.07	0
7	8000	6.00	2433	1.6	75.0	356	58.60	7.60	50	0.03	90.5	0.05	0
8	12500	7.95	1484	6.9	510.5	380	60.90	3.10	75	0.02	100	0.35	0
9	8100	4.20	1398	3.9	147.5	1100	101.00	2.50	110	0.00	100	0.48	0
10	19700	3.20	1091	7.0	275.0	4300	9.05	6.20	75	0.19	100	0.00	0
Mean	10352	5.13	1429	6.8	293.4	1009	65.65	4.93	104	0.08	94.8	0.18	0.00
St. Dev.	4681.35	2.41	464.03	4.63	206.61	1247.85	43.37	2.25	94.71	0.09	10.15	0.17	0.00
95% conf. limits (mean +/-)	2901.53	1.49	287.61	2.87	128.06	773.42	26.88	1.39	58.70	0.06	6.29	0.11	0.00
Median	9100	5.69	1430	6.9	250.0	521	67.55	5.01	75	0.04	100	0.14	0.00
Coefficient of Variability	0.45	0.47	0.32	0.68	0.70	1.24	0.66	0.46	0.91	1.20	0.11	0.94	--
Distribution	normal	normal	normal	normal	normal	log-normal	normal	normal	normal	normal	bi-modal	uniform	uniform

Data provided by Robert Pitt, University of Alabama

APPENDIX F

ANALYTICAL PROCEDURES FOR OUTFALL MONITORING

APPENDIX F1: INDICATOR PARAMETER OVERVIEW

Ammonia

Ammonia is a good indicator of sewage, since its concentration is much higher there than in groundwater or tap water. High ammonia concentrations may also indicate liquid wastes from some industrial sites. Ammonia is relatively simple and safe to analyze. Some challenges include the tendency for ammonia to volatilize (i.e., turn into a gas and become non-conservative) and its potential generation from non-human sources, such as pets or wildlife.

Boron

Boron is an element present in the compound borax, which is often found in detergent and soap formulations. Consequently, boron is a good potential indicator for both laundry wash water and sewage. Preliminary research from Alabama supports this contention, particularly when it is combined with other detergent indicators, such as surfactants (Pitt, IDDE Project Support Material). Boron may not be a useful indicator everywhere in the country since it may be found at elevated levels in groundwater in some regions and is a common ingredient in water softeners products. Program mangers should collect data on boron concentrations in local tap water and groundwater sources to confirm whether it will be an effective indicator of illicit discharges.

Chlorine

Chlorine is used throughout the country to disinfect tap water, except where private wells provide the water supply. Chlorine concentrations in tap water tend to be significantly higher than most other discharge types. Unfortunately, chlorine is extremely volatile, and even moderate levels of organic materials can cause chlorine levels to drop below detection levels. Because chlorine is non-conservative, it is not a reliable indicator, although if very high chlorine levels are measured, it is a strong indication of a water line break, swimming pool discharge, or industrial discharge from a chlorine bleaching process.

Color

Color is a numeric computation of the color observed in a water quality sample, as measured in cobalt-platinum units (APHA, 1998). Both industrial liquid wastes and sewage tend to have elevated color values. Unfortunately, some "clean" flow types can also have high color values. Field testing by Pitt (IDDE Project Support Material) found high color values associated for all contaminated flows, but also many uncontaminated flows, which yielded numerous false positives. Overall, color may be a good first screen for problem outfalls, but needs to be supplemented by other indicator parameters.

Conductivity

Conductivity, or specific conductance, is a measure of how easily electricity can flow through a water sample. Conductivity is often strongly correlated with the total amount of dissolved material in water, known as Total Dissolved Solids. The utility of conductivity as an indicator depends on whether concentrations are elevated in "natural" or clean waters. In particular, conductivity is a poor indicator of illicit discharge in estuarine waters or in northern regions where deicing salts are used (both have high conductivity readings).

Field testing in Alabama suggests that conductivity has limited value to detect sewage or wash water (Pitt, IDDE Project Support Material). Conductivity has some

value in detecting industrial discharges that can exhibit extremely high conductivity readings. Conductivity is extremely easy to measure with field probes, so it has the potential to be a useful supplemental indicator in subwatersheds that are dominated by industrial land uses.

Detergents

Most illicit discharges have elevated concentration of detergents. Sewage and washwater discharges contain detergents used to clean clothes or dishes, whereas liquid wastes contain detergents from industrial or commercial cleansers. The nearly universal presence of detergents in illicit discharges, combined with their absence in natural waters or tap water, makes them an excellent indicator. Research has revealed three indicator parameters that measure the level of detergent or its components-- surfactants, fluorescence, and surface tension (Pitt, IDDE Project Support Material). Surfactants have been the most widely applied and transferable of the three indicators. Fluorescence and surface tension show promise, but only limited field testing has been performed on these more experimental parameters. Methods and laboratory protocols for each of the three detergent indicator parameters are reviewed in Appendix F2.

E. coli, Enterococci and Total Coliform

Each of these bacteria is found at very high concentrations in sewage compared to other flow types, and is a good indicator of sewage or septage discharges, unless pet or wildlife sources exist in the subwatershed. Overall, bacteria are good supplemental indicators and can be used to find "problem" streams or outfalls that exceed public health standards. Relatively simple analytical methods are now available to test for bacteria indicators, although they still suffer from two monitoring constraints. The first is the relatively long analysis time (18-24 hours) to get results, and the second is that the waste produced by the tests may be classified as a biohazard and require special disposal techniques.

Fluorescence

Laundry detergents are highly fluorescent because optical brighteners are added to the formula to produce "brighter whites." Optical brighteners are the reason that white clothes appear to have a bluish color when placed under a fluorescent light. Fluorescence is a very sensitive indicator of the presence of detergents in discharges, using a fluorometer to measure fluorescence at specific wavelengths of light. Since no chemicals are needed for testing, fluorometers have minimal safety and waste disposal concerns.

Some technical concerns do limit the utility of fluorescence as an indicator of illicit discharges. The concerns include the presence of fluorescence in non-illicit flow types such as irrigation water, the considerable variation of fluorescence between different detergent brands, and the lack of a readily standard or benchmark concentration for optical brighteners. For example, Pitt (IDDE Project Support Material) measured fluorescence in mg/L of Tide™ brand detergent, and found the degree of fluorescence varied regionally, temporally, and between specific detergent formulations.

Given these current limitations, fluorescence is best combined with other detergent indicators such as surfactants. Appendix F3 should be consulted for more detailed information on analytical methods and experimental field testing using fluorescence as an indicator parameter.

Fluoride

Fluoride is added to drinking water supplies in most communities to improve dental health, and normally found at a concentration of two parts per million in tapwater. Consequently, fluoride is an excellent conservative indicator of tap water discharges or leaks from water supply pipes that end up in the storm drain. Fluoride is obviously not a good indicator in communities that do not fluoridate drinking water, or where individual wells provide drinking water. One key constraint is that the reagent used in the recommended analytical method for fluoride is considered a hazardous waste, and must be disposed of properly.

Hardness

Hardness measures the positive ions dissolved in water and primarily include magnesium and calcium in natural waters, but are sometimes influenced by other metals. Field testing by Pitt (IDDE Project Support Material) suggests that hardness has limited value as an indicator parameter, except when values are extremely high or low (which may signal the presence of some liquid wastes). Hardness may be applicable in communities where hardness levels are elevated in groundwater due to karst or limestone terrain. In these regions, hardness can help distinguish natural groundwater flows present in outfalls from tap water and other flow types.

pH

Most discharge flow types are neutral, having a pH value around 7, although groundwater concentrations can be somewhat variable. pH is a reasonably good indicator for liquid wastes from industries, which can have very high or low pH (ranging from 3 to 12). The pH of residential wash water tends to be rather basic (pH of 8 or 9). The pH of a discharge is very simple to monitor in the field with low cost test strips or probes. Although pH data is often not conclusive by itself, it can identify problem outfalls that merit follow-up investigations using more effective indicators.

Potassium

Potassium is found at relatively high concentrations in sewage, and extremely high concentrations in many industrial process waters. Consequently, potassium can act as a good first screen for industrial wastes, and can also be used in combination with ammonia to distinguish wash waters from sanitary wastes. (See Chapter 12). Simple field probes can detect potassium at relatively high concentrations (5 mg/L), whereas more complex colorimetric tests are needed to detect potassium concentrations lower than 5 mg/L.

Surface Tension

Surfactants remove dirt particles by reducing the surface tension of the bubbles formed in laundry water when it is agitated. Reduced surface tension makes dirt particles less likely to settle on a solid surface (e.g., clothes or dishes) and become suspended instead on the water's surface. The visible manifestation of reduced surface tension is the formation of foam or bubbles on the water surface. Pitt (IDDE Project Support Material) tested a very simple procedure to measure surface tension that quantifies the formation of foam and bubbles in sample bottles. Initial laboratory tests suggest that surface tension is a good indicator of surfactants, but only when they are present at relatively high concentrations. Section F3 provides a more detailed description of the surface tension measurement procedure.

Surfactants

Surfactants are the active ingredient in most commercial detergents, and are typically measured as Methyl Blue Active Substances (or MBAS). They are a synthetic replacement for soap, which builds up deposits on clothing over time. Since surfactants are not found in nature, but are always present in detergents, they are excellent indicators of sewage and wash waters. The presence of surfactants in cleansers, emulsifiers and lubricants also makes them an excellent indicator of industrial or commercial liquid wastes. In fact, research by Pitt (IDDE Project Support Material) found that detergents were an excellent indicator of "contaminated" discharges in Alabama (i.e., discharges that were not tap water or groundwater). Several analytical methods are available to monitor surfactants. Unfortunately, the reagents used involve toluene, chloroform, or benzene, each of which is considered hazardous waste with a potential human health risk. The most common analysis method uses chloroform as a reagent, and is recommended because it is relatively safer when compared to other reagents.

Turbidity

Turbidity is a quantitative measure of cloudiness in water, and is normally measured with a simple field probe. While turbidity itself cannot always distinguish between contaminated flow types, it is a potentially useful screening indicator to determine if the discharge is contaminated (i.e., not composed of tap water or groundwater).

Research Indicators

In recent years, researchers have explored a series of other indicators to identify illicit discharges, including fecal steroids (such as coprostanol), caffeine, specific fragrances associated with detergents and stable isotopes of oxygen. Each of these research indicators is profiled in Pitt (IDDE Project Support Material) and summarized below in Table F1. Most research indicators require sophisticated equipment and specific expertise that limit their utility as a general indicator, given the high sampling cost and long turn-around times needed. To date, field tests of research indicators have yielded mixed results, and they are currently thought to be more appropriate for special research projects than for routine outfall testing. While they are not discussed further in this manual, future research and testing may improve their utility as indicators of illicit discharges.

Table F1: Summary of Research Indicators Used for Identifying Inappropriate Discharges into Storm Drainage		
Parameter Group	**Comments**	**Recommendation**
Coprostanol and other fecal sterol compounds	Used to indicate presence of sanitary sewage	Possibly useful. Expensive analysis with GC/MSD. Not specific to human wastes or recent contamination. Most useful when analyzing particulate fractions of wastewaters or sediments.
Specific detergent compounds (LAS, fabric whiteners, and perfumes)	Used to indicate presence of sanitary sewage	Possibly useful. Expensive analyses with HPLC. A good and sensitive confirmatory method.
Pharmaceuticals (colfibric acid, aspirin, ibuprofen, steroids, illegal drugs, etc.)	Used to indicate presence of sanitary sewage	Possibly useful. Expensive analyses with HPLC. A good and sensitive confirmatory method.
Caffeine	Used to indicate presence of sanitary sewage	Not very useful. Expensive analyses with GC/MSD. Numerous false negatives, as typical analytical methods not suitably sensitive.
DNA profiling of microorganisms	Used to identify sources of microorganisms	Likely useful, but currently requires extensive background information on likely sources in drainage. Could be very useful if method can be simplified, but with less specific results.
UV absorbance at 228 nm	Used to identify presence of sanitary sewage	Possibly useful, if UV spectrophotometer available. Simple and direct analyses. Sensitive to varying levels of sanitary sewage, but may not be useful with dilute solutions. Further testing needed to investigate sensitivity in field trials.
Stable isotopes of oxygen	Used to identify major sources of water	May be useful in area having distant domestic water sources and distant groundwater recharge areas. Expensive and time consuming procedure. Can not distinguish between wastewaters if all have common source.
GC/MSD - Gas Chromatography/Mass Selective Detector HPLC - High Performance Liquid Chromatography		

Appendix F2: "Off-the Shelf" Analytical Methodologies

F2.1 AMMONIA (0 TO 0.50 MG/L NH_3-N)

Equipment/Supplies Needed

- Hach bench top or portable spectrophotometer or colorimeter (see ordering information below)
- ammonia nitrogen reagent set for 25-mL samples
- ammonia nitrogen standard solution

Procedure

Refer to Hach method 8155 for Nitrogen, Ammonia Salicylate Method (0 to 0.50 mg/L NH_3-N) for a 25mL sample. In this method, ammonia compounds combine with chlorine to form monochloramine. Monochloramine reacts with salicylate to form 5-aminosalicylate. The 5-aminosalicylate is oxidized in the presence of sodium nitroprusside catalyst to form a blue-colored compound. The blue color is masked by the yellow color from the excess reagent present to give a final green-colored solution.

Duration of Test for Each Sample

Because of the duration of this test, samples should be run in batches of about six. From start to finish, each batch of six samples takes about 25 minutes, including the time taken to clean the sample cells and reset the instrument between each batch.

Hazardous Reagents

According to good laboratory practice, the contents of each sample cell, after the analysis, should be poured into another properly-labeled container for proper disposal.

Ease of Analysis

This procedure is time-consuming and should be performed indoors.

Ordering Information

Vendor: Hach Company
PO Box 389
Loveland, CO 80539-0389
Tel: 800-227-4224
Fax: 970-669-2932
Website: www.hach.com

[Note: The direct-Nessler method may be preferred due to its faster reaction times, but Nessler reagent is toxic and corrosive. Nessler reagent, according to its MSDS, causes severe burns, is an acute and a cumulative poison, and is a teratogen. It also contains from 5 to 10% mercuric iodide. It is now recommended that the more sensitive salicylate method because of the lower concentrations experienced in this research, and because of its lower toxicity and easier disposal requirements. The salicylate method was therefore used for this project, although prior research found it to be somewhat less satisfactory than the Nessler method.]

Equipment/Supplies Needed for Ammonia Analysis		
Item (Catalog Number)	**Quantity**	**Price**
One of the colorimeters, or spectrophotometers, listed previously will be needed. Alternatively, a dedicated colorimeter can be used, but that will only be useable for a single analyte.		
Ammonia-Nitrogen Reagent Set (25mL test) salicylate method (2243700)	1 set of 100 tests	$180.56
Ammonia cyanurate reagent powder pillows (2395566)	1 pk of 50 pillows	$ 20.20
Ammonia salicylate reagent powder pillows (2395366)	1 pk of 50 pillows	$ 25.55

F2.2 BORON (Low range 0 to 1.50 mg/L as B)

Equipment/Supplies Needed

- A Hach bench top or portable spectrophotometer or colorimeter (see ordering information below)
- Boron test kit
- 1-inch plastic sample cells (at least 2).

Procedure

Refer to Hach Azomethine-H Method 10061, which is adapted from ISO method 9390. In this procedure, Azomethine-H, a Schiff base, is formed by the condensation of an aminonaphthol with an aldehyde by the catalytic action of boron. The boron concentration in the sample is proportional to the developed color. Follow the Hach instructions that come with the reagent set for the specific procedure.

Duration of Test for Each Sample

Each batch of six samples takes approximately 20 minutes.

Hazardous Reagents

Standard laboratory practice requires that all unwanted chemicals be properly disposed.

Ease of Analysis

The procedure is a little time consuming, but several samples can be analyzed together.

Ordering information

Vendor: Hach Company
PO Box 389
Loveland, CO 80539-0389
Tel: 800-227-4224
Fax: 970-669-2932
Website: www.hach.com

Equipment/Supplies Needed for Boron Analysis		
Item (Catalog Number)	**Quantity**	**Price***
Boron Test Kit (0-1.5 mg/L) BoroTrace (Azomethine-H) Method (2666900)	1 set of 100 tests	$50.00
BoroTrace 2 reagent (2666669)	1 pk of 100 pillows	$30.00
BoroTrace 3 reagent (2666799)	1 pk of 100 pillows	$20.65
EDTA Solution 1M (2241925)	50 mL	
DR/890 portable colorimeter Programmed with 90 tests. Includes 2 sample cells, COD & TnT tube adapter, instrument, procedure manual and batteries. Portable instrument that can be used for many different analytes, but fewer than the following instruments. (48470000)[1]	1	$929.00
DR/2500 spectrophotometer includes 6 one-inch round sample cells, instrument and procedure manual, and DR/Check Absorbance Standards. Compact laboratory instrument having many capabilities. (5900000)[1]	1	$2200.00
DR/2400 portable spectrophotometer includes one-inch sample cells, instrument and procedures manuals. Portable instrument having many capabilities. (5940000)[1]	1	$1,995.00
DR/4000 V Spectrophotometer. Visible spectrum only (320 to 1100nm). Includes 1-inch matched sample cells/ AccuVacc and 16-mm vial adapters; a Single Cell Module; 1-inch and 1-cm cell adapters; dust cover; replacement lamp kit; an illustrated manual set; and a power cord. UV-Vis laboratory instrument having vast capabilities. (48100-00)[1]	1	$5500.00
[1]*Only one spectrophotometer is needed* **The per-sample expendable cost is therefore about $2.00.*		

F2.3 COLOR (0 – 100 APHA Platinum Cobalt Units)

Equipment/Supplies needed

One Hach color test kit Model CO-1 which measures color using a color disc for comparison.

Procedure

The following procedure is described in the test kit.

Low Range

1. Place the lengthwise viewing adapter in the comparator.
2. fill one sample tube to the line underlining "Cat. 1730-00" with the sample. This will be approximately 15mL. If not using 1730-00 tubes, fill to the line founds at approximately 3 inches up from the bottom of the tube.
3. Place the tube containing the water sample into the comparator in the right-hand position.
4. Fill the other sample tube with colorless water to the line underlining "Cat. 1730-00." Insert this tube in the left-side comparator opening.
5. Hold the comparator with the tube tops pointing to a window or light source at approximately a 45 degree angle (with the light coming in through the top of the tubes). View through the openings in the front of the comparator. When viewing, use care to not spill samples from unstoppered tubes.
6. Rotate the disc until a color match is obtained. The reading obtained through the scale window is the apparent color in APHA Platinum Cobalt Units.

High Range

1. If the lengthwise viewing adapter is in place, remove it.
2. Fill one of the tubes to the 5mL mark with the water sample.
3. Insert the tube in the right top opening of the comparator.
4. Fill the other tube to the 5mL mark with clear water and insert this tube into the left opening of the comparator.
5. Hold the comparator up to a light source as explained above. The reading obtained through the scale window is multiplied by 5 to obtained the apparent color.

Duration of Test for Each Sample

One minute

Hazardous Reagents

None.

Ease of Analysis

This procedure easy and fast and can be performed outside of the laboratory.

Ordering Information

Vendor: Hach Company
PO Box 389
Loveland, CO 80539-0389
Tel: 800-227-4224
Fax: 970-669-2932
Website: www.hach.com

Equipment/Supplies Needed for Color Analysis		
Item (Catalog Number)	**Quantity**	**Price**
Color Test Kit (0-100 mg/L) (223400)	one kit	$51.50

F2.4 CONDUCTIVITY

Equipment/Supplies Needed

- Cardy pocket-sized conductivity meter model B-173 made by Horiba
- Conductivity standard that comes with the meter.

Calibration

Before any measurements can be performed the instrument must first be calibrated. The meter should hold its calibration for an extended period, but it is best to check the calibration before each sample batch.

1. Press the POWER button.
2. Place a drop of the 1.41 µs/cm standard solution onto the sensor cell.
3. Press the CAL/MODE button to display the CAL mark and 1.41. Calibration is complete when the CAL mark disappears.
4. Wash the sensor with tap water, and dry with a tissue.

Measurement

1. Check first to see which mode the instrument is in by looking for the arrow pointing at the mS/cm or µS/cm.
2. Add a drop of the sample onto the sensor cell using a pipette (or the sensor may be immersed into the sample).
3. When the smiley face ☺ appears, take a reading. Be sure to note the units.

Duration of Test for Each Sample

1 minute

Hazardous Reagents

None

Ease of Analysis

Simple and fast. Can be used in the field.

Ordering Information

Vendor: Cole-Parmer Instrument Company
625 East bunker Court
Vernon Hills, IL 60061-1844
Phone: 1-800-323-4340
FAX: 847-247-2929
Website: www.coleparmer.com

Equipment/Supplies Needed for Conductivity Analysis	
Item (Catalog Number)	**Price**
Cardy pocket-sized conductivity meter and accessories (EW-05751-10)	$269.00
Replacement cardy conductivity sensor cartridge (EW-05751-52)	$ 82.00
Replacement cardy conductivity solution kit (EW-05751-70)	$ 43.00

F2.5 DETERGENTS (0-3 ppm)

Equipment/Supplies needed

- Detergents (anionic surfactants) kit from *CHEMetrics*.

Procedure

The following procedure comes with the Detergents kit. The Detergents CHEMets® test employs the methylene blue extraction method. Anionic detergents react with methylene blue to form a blue complex that is extracted into an immiscible organic solvent. The intensity of the blue color is directly related to the concentration of "methylene blue active substances (MBAS)" in the sample. Anionic detergents are one of the most prominent methylene blue active substances. Test results are expressed in mg/L linear alkylbenzene sulfonate.

1. Rinse the reaction tube with sample, and then fill it to the 5 mL mark with sample.
2. While holding the double-tipped ampoule in a vertical position, snap the upper tip using the tip-breaking tool.
3. Invert the ampoule and position the open end over the reaction tube. Snap the upper tip and allow the contents to drain into the reaction tube.
4. Cap the reaction tube and shake it vigorously for 30 seconds. Allow the tube to stand undisturbed for approximately 1 minute.
5. Make sure that the flexible tubing is firmly attached to the CHEMet ampoule tip.
6. Insert the CHEMet assembly (tubing first) into the reaction tube making sure that the end of the flexible tubing is at the bottom of the tube. Break the tip of the CHEMet ampoule by gently pressing it against the side of the reaction tube. The ampoule should draw in fluid only from the organic phase (bottom layer).
7. When filling is complete, remove the CHEMet assembly from the reaction tube.
8. Invert the ampoule several times, allowing the bubble to travel from end to end each time.
9. Using a tissue, remove the tubing from the ampoule tip. Wipe all liquid from the exterior of the ampoule, then place a small white cap firmly onto the tip of the ampoule.
10. Place the CHEMet ampoule, flat end downward into the center tube of the comparator. Direct the top of the comparator up toward a source of bright light while viewing from the bottom. Rotate the comparator until the color standard below the CHEMet ampoule shows the closest match. If the color of the CHEMet ampoule is between two color standards, a concentration estimate can be made.

Duration of Test for Each Sample

Approximately 7 minutes per sample.

Hazardous Reagents

The main components of the double-tipped ampoule are considered hazardous, and possibly carcinogenic (contains chloroform). The used ampoule should be placed back in the test kit box for later disposal at a hazardous waste facility. Use proper safety protection when performing this test: laboratory coat, gloves, and safety glasses. It is also strongly recommended that the test be performed under a laboratory fume hood. Wash hands thoroughly after handling the kit.

Ease of Analysis

This procedure may be performed outside of a standard laboratory, if well ventilated. Produces hazardous chemicals.

Ordering Information

Vendor: *CHEMetrics*, Inc
4295 Catlett Rd
Calverton, VA 20138
Phone 1-800-356-3072
FAX 1-540-788-4856
Website: www.chemetrics.com

Equipment/Supplies Needed for Detergents Analysis		
Item (Catalog Number)	**Quantity**	**Price***
Detergent kit (anionic surfactants) (K-9400)	20 tests	$63.15
Detergent kit refill (R-9400)	20 tests	$50.45
**The per-sample expendable cost is therefore $2.52.*		

F2.6 *E. COLI*

Equipment/Supplies Needed

- Colilert reagent, sterile sample bottles for 100 mL samples
- Quanti-Tray 2000
- Colilert comparator predispensed in a Quanti-Tray/2000incubator
- UV light from IDEXX.

Enumeration Procedure

1. Add contents of one Colilert snap pack to a 100 mL room temperature water sample in a sterile vessel. The standard Colilert reagent is recommended when evaluating Enterococci simultaneously so the samples are both ready to read in 24 hours. If only *E. coli* are to be evaluated, then the faster Colilert-18 reagent can be used if reading the results in 18 hours instead of 24 hours is important.
2. Cap vessel and shake until dissolved.
3. Pour sample/reagent mixture into a Quanti-Tray/2000 and seal in an IDEXX Quanti-Tray Sealer.
4. Place the sealed tray in a 35±0.5° C incubator for 24 hours.
5. Read results according to the Results Interpretation table below. Count the number of positive wells and refer to the MPN table provided with the Quanti-Trays to obtain a Most Probable Number.

Results Interpretation

Appearance	Result
Less yellow than the comparator	Negative for total coliforms and *E. coli*
Yellow equal to or greater than the comparator	Positive for total coliforms
Yellow and fluorescence equal to or greater than the comparator	Positive for *E. coli*

Duration of Test for Each Sample

Once the Quanti-Tray sealer is warm (10 min), it takes approximately 5 minutes per sample to label, seal and incubate the Quanti-Tray. After 24 hours, it takes 1-2 minutes to read the sample results under the UV lamp.

Hazardous Reagents

Used Quanti-Trays must be disposed of in a biohazard bag and handled by appropriate biohazard disposal facility, using similar practices as for alternative bacteria analysis methods.

Ease of Analysis

Not a difficult procedure to learn. Knowledge of proper handling of bacterial specimens is necessary. Cannot be performed in the field.

Ordering information

Vendor: IDEXX
1 IDEXX Drive
Westbrook, ME 04092
Phone: 1-800-321-0207
Fax: 207-856-0630
E-mail: water@idexx.com
Website: www.idexx.com/water

Equipment/Supplies Needed for *E. coli* Analysis		
Item (Catalog Number)[1]	**Quantity**	**Price***
Colilert reagent for 100mL sample (WP200)	200-pack	$1,020.00
120mL vessel with 100mL line, sodium thiosulfate & label (WV120ST-200)	200-pack	$90.00
97-well sterile Quanti-Tray/2000 trays (WQT-2K)	100-pack	$110.00
Quality control kit (E. coli, Klebsiela, Pseudomonas A). (WKT 1001)	n/a	$120.00
Colilert comparator predispensed in a Quanti-Tray/2000 (WQT2KC)	1	$6.00
Quanti-Tray Sealer (115V) with 51-well rubber insert (WQTS2X-115)	1	$3,500.00
6 watt UV lamp 110 volt (WL160)	1	$89.00
Incubator 120V, 30-65°C, 14"x14"x14" (WI300)	2	$389.00
[1] See the Enterococci table above for equipment that can be shared when conducting both analyses.		
**The per-sample expendable cost (reagent, bottle, and tray) is about $6.65.*		

F2.7 ENTEROCOCCI

Equipment/Supplies Needed

- Enterolert reagent
- Sterile sample bottles for 100 mL samples
- Quanti-Tray 2000
- Incubator
- UV light from IDEXX

Enumeration Test Procedure

1. Carefully separate a Snap Pack from its strip, taking care not to accidentally open the next pack.
2. Tap the reagent snap pack to ensure that all of the Enterolert powder is in the bottom part of the pack.
3. Open the pack by snapping back the top at the score line. Caution: Do not touch the opening of the pack.
4. Add the reagent to a 100 mL water sample in a sterile bottle.
5. Aseptically cap and seal the vessel.
6. Shake to completely dissolve reagent.
7. Pour the sample/reagent mixture into a Quanti-Tray avoiding contact with the foil pull tab. Seal the tray according to Quanti-Tray instructions.
8. Incubate for 24 hours at $41^{o}\pm5^{o}$ C.
9. Read the results at 24 hours by placing a 6 watt, 365 nm wavelength UV light within five inches of the Quanti-Tray in a dark environment. Be sure the light is facing away from your eyes and toward the Quanti-Tray. Count the number of fluorescent Quanti-Tray wells. The fluorescence intensity of positive wells may vary.
10. Refer to the MPN table provided with the Quanti-Tray to determine the Most Probable Number of Enterococci in your sample.

Procedural Notes

If the sample is inadvertently incubated over 28 hours without observation, the following guidelines apply:

- Lack of fluorescence after 28 hours is a valid negative test
- Fluorescence after 28 hours is an invalid result
- Use sterile water, not buffered water for making dilutions. Enterolert is already buffered. Always add Enterolert to the proper volume of diluted sample after making dilutions.
- For comparison, a water blank can be used when interpreting results.

Duration of Test for Each Sample

Once the Quanti-Tray sealer is warm (10 min), it takes approximately 5 minutes per sample to mix, label, seal and place the Quanti-Tray in the incubator. After 24 hours, it takes 1-2 minutes to read the sample results under the UV lamp.

Hazardous Reagents

Used Quanti-Trays must be disposed of in a biohazard bag and handled by appropriate biohazard disposal facility, just like any other bacteria analysis materials.

Ease of Analysis

Not difficult procedure to learn. Knowledge of proper handling of bacterial specimens is necessary. Cannot be performed in the field.

Ordering information

Vendor: IDEXX
1 IDEXX Drive
Westbrook, ME 04092
Phone: 1-800-321-0207
Fax: 207-856-0630
E-mail: water@idexx.com
Website: www.idexx.com/water

Equipment/Supplies Needed for Enterococci Analysis		
Item (Catalog Number)	**Quantity**	**Price***
Enteroletert reagent for 100 mL samples (WENT200)	200-pack	$ 1,020.00
120 mL pre-sterilized vessel with 100 mL line, sodium thiosulfate & label (WV120ST-200)[1]	200-pack	$ 90.00
97-well sterile Quanti-Tray/2000 trays (WQT-2K) [1]	100-pack	$ 110.00
Quality control kit (E. coli, Klebsiela, Pseudomonas A). (WKT 1001)	n/a	$ 120.00
Quanti-Tray Sealer (115V) with 51-well rubber insert (WQTS2X-115) [1]	1	$ 3,500.00
6 watt UV lamp 110 volt (WL160) [2]	1	$ 89.00
Incubator 120V, 30-65°C, 14"x14"x14" (WI300) [3]	2	$ 389.00

[1] Same expendable materials as for the E. coli method, additional should be ordered for each method

[2] Same as for the E. coli method and can be shared

[3] Although the same, a second incubator is needed for the E. coli method because of the different temperature settings and the normal need to evaluate Enterococci and E. coli simultaneously

** The per-sample expendable cost (reagent, bottle, and tray) is about $6.65.*

F2.8 FLUORIDE (0 TO 2.00 MG/L F^-)

Equipment/Supplies Needed

- Hach bench top or portable spectrophotometer or colorimeter (see ordering information below)
- AccuVac Vial Adaptor (for older spectrophotometers)
- SPADNS Fluoride Reagent AccuVac Ampuls.

Procedure

Refer to Hach SPADNS Method 8029 which is adapted from Standard Methods for the Examination of Water and Wastewater. This procedure involves the reaction of fluoride with a red zirconium-dye solution. The fluoride combines with part of the zirconium to form a colorless complex, thus bleaching the red color in an amount proportional to the fluoride concentration.

Duration of Test for Each Sample

Each samples takes an average of 3 minutes to test.

Hazardous Reagents

The SPANDS reagent is a hazardous solution. The used AccuVacs should be placed back in the Styrofoam shipping container for storage and then disposed properly through a hazardous waste disposal company.

Ease of Analysis

The procedure is relatively easy and fast and can be performed in the field using a portable spectrophotometer or colorimeter. However, as for all tests, it is recommended that the analyses be conducted in a laboratory, or at least in a work room having good lighting and water.

Ordering information

Vendor: Hach Company
PO Box 389
Loveland, CO 80539-0389
Tel: 800-227-4224
Fax: 970-669-2932
Website: www.hach.com

Equipment/Supplies Needed for Fluoride Analysis	
Item (Catalog Number)	**Price**
Fluoride Reagent (SPADNS) AccuVac Ampuls [1 set of 25 AccuVacs (2 needed per test)] (2506025)	$ 17.00
Adapter, AccuVac vial (needed for older spectrophotometers DR/2000 and DR/3000) (43784-00)	$ 5.40
DR/890 portable colorimeter programmed with 90 tests. Includes 2 sample cells, COD & TnT tube adapter, instrument, procedure manual and batteries. Portable instrument that can be used for many different analytes, but fewer than the following instruments. (48470000) [1]	$ 929.00
DR/2500 spectrophotometer includes 6 one-inch round sample cells, instrument and procedure manual, and DR/Check Absorbance Standards. Compact laboratory instrument having many capabilities. (5900000) [1]	$ 2,200.00
DR/2400 portable spectrophotometer includes one-inch sample cells, instrument and procedures manuals. Portable instrument having many capabilities. (5940000) [1]	$ 1,995.00
DR/4000 V Spectrophotometer. Visible spectrum only (320 to 1100nm). Includes 1-inch matched sample cells/ AccuVacc and 16-mm vial adapters; a Single Cell Module; 1-inch and 1-cm cell adapters; dust cover; replacement lamp kit; an illustrated manual set; and a power cord. UV-Vis laboratory instrument having vast capabilities. (48100-00) [1]	$ 5,500.00
[1] only one spectrophotometer is needed **The per-sample expendable cost is about $1.36.*	

F2.9 pH

Equipment/Supplies Needed

- Cardy pocket-sized pH meter model B-213 made by Horiba
- pH standards that come with the meter.

Calibration

The meter should hold its calibration for an extended period, but it is best to check the calibration before each sample batch.

1. Press the ON/OFF button.
2. Place approximately 1 mL of the yellow pH 7.0 standard solution onto the sensor cell (be careful not to touch the sensor with the dropper or pipette, the cell is covered with a very thin and fragile glass cover slip).
3. Press the CAL button to display the black CAL mark in the upper right corner and 7.0.
4. Calibration is complete when the CAL mark disappears. Wash the sensor with tap or distilled water and dry with a tissue.
5. Press CAL again so that 4.01 and CAL are displayed to calibrate using the pink pH 4.01 buffer. Follow the same procedure as above.

Measurement

1. Place a drop of the sample water onto the sensor cell (usually around 1 mL). Alternatively, you may dip the meter into the water to be tested.
2. When the smiley face ☺ appears, read the number.
3. Press the ON/OFF button to turn the power OFF.
4. Wash the sensor with tap water or distilled water. Wipe off any residual water on the sensor with a tissue.
5. Be sure the protective cap is covering the sensor and put the pH meter back in its protective case.

Duration of Test for Each Sample

Calibration takes around 3 minutes, and testing of each sample is only about 30 seconds.

Hazardous Reagents

None

Ease of Analysis

Simple and fast. Can be used in the field.

Ordering Information

Vendor: Cole-Parmer Instrument Co.
625 East Bunker Court
Vernon Hills, IL 60061-1844
Phone: 1-800-323-4340
FAX: 847-247-2929
Website: www.coleparmer.com

Equipment/Supplies Needed for pH Analysis	
Item (Catalog Number)	**Price**
Cardy twin pH meter and accessories (EW-05759-00)	$238.00
Replacement pH sensor cartridge (EW-05759-0)	$105.00
Replacement pH solution kit (EW-05751-70)	$ 29.00

F2.10 POTASSIUM

Equipment/Supplies Needed

- Cardy potassium compact meter by Horiba model C-131
- Accessories that come with the meter.

Two-Point Calibration (Monthly)

1. Turn the power ON
2. Open the sensor cover and wipe the sensor pad clean with a piece of tissue and deionized water, then wipe it dry with a piece of tissue. Repeat this several times.
3. Place a piece of sampling sheet onto the sensor pad, and drip 2 to 5 drops of the standard STD solution onto it (or drip the solution directly onto the sensor pad).
4. After the readout has stabilized, adjust the STD dial so that the display reads 20X100. After cleaning the sensor according to step (2), follow the same procedure using the standards SLOPE solution and after the readout has stabilized, adjust slope volume so that the display reads 15X10.
5. After cleaning several times with deionized water, measure the standard STD solution again.
6. Recalibrate if the reading is not (20±2)X100.
7. Wipe the sensor pad with deionized water, then wipe it dry.

One-Point Calibration (Daily)

1. Turn the power ON.
2. Open the sensor cover, and wipe the sensor pad clean with deionized water, then wipe it dry.
3. Repeat this procedure several times.
4. Place a piece of sampling sheet onto the sensor pad, and drip 2 to 5 drops of the standard STD solution on it (or drip the solution directly onto the sensor pad).
5. After the readout has stabilized, adjust the STD dial so that the display reads 20X100.
6. Wipe the sensor pad with deionized water, and then wipe it dry.
7. If the sample is below 500 ppm (mg/L), use the SLOPE solution and adjust the STD dial to read 15X10.

Measurement

1. Place the sample directly onto the sensor pad or measurement can be aided by placing the sample onto a piece of sampling sheet.
2. Read the concentration directly from the display.
3. Clean the sensor with deionized water and wipe it clean after each sample is analyzed.
4. When finished with all samples, turn the power OFF.
5. Clean the surface of the sensor pad with deionized water and wipe dry for storage.

Duration of Test for Each Sample

Calibration takes around 5 minutes and testing of each sample is only 30 seconds.

Hazardous Reagents

None

Ease of Analysis

Simple and fast. Can be used in the field.

Ordering information

Vendor: Cole-Parmer Instrument Company
625 East Bunker Court
Vernon Hills, IL 60061-1844
Phone: 1-800-323-4340
FAX: 847-247-2929
Website: www.coleparmer.com

Equipment/Supplies Needed for pH Analysis	
Item (Catalog Number)	**Price**
Cardy potassium compact meter and accessories (EW-05755-00)	$239.00
Replacement cardy potassium sensor cartridge (EW-05755-500)	$ 64.00
Replacement cardy potassium solution kit (EW-05755-60)	$ 33.00

Note: This procedure is rapid and inexpensive, however, it only has a detection limit of about 1 mg/L, and reads in increments of 1 mg/L. This level of precision is not typically a problem for moderately contaminated samples (when the results are most useful); however, it presents challenges when used for cleaner water. Specifically, since the Flow Chart Method relies on the ammonia to potassium ratio to distinguish between washwaters and sanitary wastewaters, a "non detect" (i.e., <1) potassium concentration results in an indeterminant ratio value. Where clean water is being analyzed and more sensitive potassium values are needed, the only real option is to use other laboratory methods (either ICP or atomic absorption). Other simple field procedures (such as the method supplied by HACH) rely on a photometric measurement of a floc and are not very repeatable for these types of samples.

F2.11 TOTAL HARDNESS (10 – 4000 mg/L as CaCO3)

Equipment/Supplies Needed

- Hach digital titrator
- Total hardness titration cartridge
- ManVer 2 hardness indicator
- Hardness 1 buffer solution.

Procedure

Refer to Hach Method 8213 for Hardness, Total (10-4000 mg/L as $CaCO_3$) digital titrator method using EDTA. This procedure involves buffering the sample first to pH 10.1, adding of the ManVer 2 Hardness Indicator, which forms a red complex with a portion of the calcium and magnesium in the sample, and then titrating with EDTA. The EDTA titrant reacts first with the free calcium and magnesium ions, then with those bound to the indicator, causing it to change to a blue color at the end point.

Duration of Test for Each Sample

Approximately 5 minutes.

Hazardous Reagents

The mixture of sample, buffer solution, hardness indicator, and EDTA must be stored properly in a labeled container until disposal by a hazardous waste disposal facility.

Ease of Analysis

This procedure is not recommended to be performed in the field. Produces hazardous chemicals.

Ordering information

Vendor: Hach Company
PO Box 389
Loveland, CO 80539-0389
Tel: 800-227-4224
Fax: 970-669-2932
Website: www.hach.com

Equipment/Supplies Needed for Total Hardness Analysis		
Item (Catalog Number)	**Quantity**	**Price***
Digital Titrator with plastic case, manual and 5 straight delivery tubes (1690001)	1 titrator	$105.00
Total hardness titration cartridge (EDTA 0.0800M) (1436401)	1	$10.70
Total hardness titration cartridge (EDTA 0.800M) (1439901)	1	$10.70
Delivery tube, (straight with J hook) for titration (1720500)	Pack of 5	$4.85
ManVer 2 Hardness Indicator Powder Pillow (85199)	1 pack of 100 pillows	$9.85
Hardness 1 buffer solution (42432)	One 100 mL bottle	$8.40
**The per sample expendable cost is about $0.25, depending on the hardness level.*		

F2.12 TURBIDITY

Equipment/Supplies Needed

- Benchtop or portable turbidimeter. The range of readings in NTU will depend upon the instrument.

Procedure

(This is a general procedure for turbidity. Follow your turbidimeter's instructions):

1. First, the instrument must be calibrated using the standards supplied with the instrument. If calibration is satisfactory, continue with sample measurement.
2. Samples are normally stored under refrigeration. Before analyzing for turbidity, the samples must first be brought back to room temperature. This is done to prevent the formation of frost on the outside of the glass sample cells used in the turbidity measurement.
3. Pour the sample into a sample cell (until almost full or to the fill line), cap the cell, then turn it upside down 2 to 3 times for mixing. Do not shake vigorously.
4. Keep the sample cell vertical for 4-5 seconds and wipe the outside to remove fingerprints.
5. Place the cell into the turbidity meter and take a reading.

Duration of test for each sample

Approximately one minute. This does not include the time spent bringing the sample to room temperature.

Hazardous Reagent

None

Ease of Analysis

Relatively simple and may be performed outside of the laboratory using a portable turbidimeter.

Ordering Information

Vendor: Hach Company
PO Box 389
Loveland, CO 80539-0389
Tel: 800-227-4224
Fax: 970-669-2932
Website: www.hach.com

Equipment/Supplies Needed for Turbidity Analysis		
Item (Catalog Number)	**Quantity**	**Price**
2100P Portable Turbidimeter range 1-1000 NTU Includes nine sample cells, primary standards, silicone oil & oiling cloth, manual, quick reference card and case. (4650000)	1	$837.00

Appendix F3. METHODOLOGIES AND LAB TESTING OF TECHNIQUES TO MEASURE DETERGENTS

F3.1 *CHEMETRICS* DETERGENT TEST KIT

Detergents were measured using the *CHEMetrics* detergent test kit, which detects Methylene Blue Active Substances (MBAS), an important ingredient of detergent products. The minimum detection limit (MDL) of the kit is 0.25mg/L. This is a very simple test, but the accuracy of the tests depends on the analyst's skill with the color comparator. One of the problems with this method is the upper limit of 3 mg/L. Higher values can only be measured with dilution of the sample prior to analysis. This extra step requires extra time when measuring laundry, carwash and sewage samples, when the detergent values are in hundreds of mg/L.

This kit also contains chloroform, an expected carcinogen. Great care must therefore be taken when conducting this analysis and when handling the kit materials. The alternative detergent field test kit from HACH uses much larger quantities of benzene, also a known carcinogen, and is not as well contained as the chloroform in this preferred kit. An important aspect of this research was investigating alternative analytes that could be used instead of detergents.

The main components of the *CHEMetrics* detergent test kit (Figure F3.1) are:

1. Test tube
2. Comparator device
3. Snapper
4. Double tipped ampoule containing chloroform and other reagents (blue stained)
5. CHEMets ampoule (empty vacuum ampoule)



Figure F3.1: *CHEMetrics* detergent test kit components

Test Procedure Summary

This test should preferably be conducted in a laboratory fume hood due to the possibility of exposure to chloroform.

1. Pour 5 mL of the sample into the test tube.
2. Snap one tip of the double tipped ampoule, keeping the other tip inside the tube, but above the sample level. Invert the snapped tip into the tube and snap the other tip of the ampoule. Let the blue chemical (containing chloroform) completely empty into the test tube.
3. Cap the tube tightly and shake the solution for 30 seconds. Keep the solution undisturbed for 1 minute in a test tube rack.
4. Remove the cap from the tube and insert the vacuum CHEMets ampoule into the test tube. Care must be taken so that the small plastic tube at the tip of the ampoule touches the bottom of the tube.
5. Snap the CHEMets ampoule tip by the side of the test tube and let the solution flow through the tube into the CHEMets ampoule.
6. Take off the plastic tube and wipe off the tip of the ampoule. Put the provided white cap on the tip of the ampoule and place it in the color comparator.
7. Compare the color of the solution inside the ampoule with the color comparator. The colors range from light blue (0.25 mg/L) to dark blue (3 mg/L). If the color is darker than the given colors in the comparator, the sample needs to be diluted and retested. No color indicates <0.25 mg/L value for detergents. The test tube needs to be disposed of carefully because it contains a hazardous chemical (chloroform).

Harmful Chemicals in *CHEMetrics* Detergent Test Kit

The main components of the double tipped ampoule are methylene blue, sulfuric acid, sodium phosphate, water and chloroform. Chloroform may affect the liver, kidney and central nervous system, and is a known carcinogen. On exposure, it causes irritation to eyes, skin and mucous membranes. It may also cause burning of the throat, mouth esophagus and stomach. It may also cause nausea, vomiting and diarrhea. Wash your hands thoroughly after handling the kit and conduct the analysis in a well-ventilated area, preferably in a laboratory fume hood. Avoid contact with the eyes. Safety glasses and gloves are required while doing this test. If there is a spill, take up with an absorbent material. Keep the reagents in the ampoule for final disposal, in accordance with regulations.

F3.2 Fluorescence Monitoring using the GFL-1 Fluorometer

Introduction

Fluorescence is the property of the whiteners in detergents that cause treated fabrics to fluoresce in the presence of ultraviolet rays, giving laundered materials an impression of extra cleanliness. These are also referred to as bluing, brighteners or optical brighteners and have been an important ingredient of most laundry detergents for many years. The effectiveness of the brighteners varies by the concentration of the detergents in the wash water. The detection of optical brighteners has been used as an indicator for the presence of laundry wastewater, and municipal sewage, in urban waters.

One method of quantifying fluorescence in the laboratory is by using a fluorometer calibrated for detergents. In our tests, we used the GFL-1 Portable Field fluorometer (Figure F3.2).

The components of the GFL-1 Fluorometer are the power switch, sample chamber, battery compartment, source module, detector filter cartridge, display, keypad, and the interface port. A 1.2 Ah rechargeable lead-acid battery powers the unit when in the field. The fluorometer contains high efficiency interference filters optimized for fluorescence detection. It contains a silicon photodiode detector and a LED source. The interface port is also used as the battery charger port. A 192 X 192 dot LCD screen is used for text and graphical data presentation.



Figure F3.2: GFL-1 Portable Field Fluorometer

Calibration

Before the instrument is used, it should be calibrated with a detergent solution. No general standard detergent solution is available, so a commercially available detergent is used to prepare standard solutions. For this research, a common commercial detergent, Procter & Gamble's *Tide ™* was used. The purpose of calibrating the fluorometer is to set the instrument fluorescent signal levels to correspond to different concentrations of this commercial detergent. Single point and multipoint calibrations are available with this fluorometer. The manufacturers report that the solution used in calibration is unimportant in that the procedure is the same regardless of the solution used. A five-point calibration method is used for instrument calibration. To test a sample, the instrument must be in "test mode." The test mode cannot be used until a calibration table has been built, or an existing one is made active. If there is no active calibration table, the test mode screen will automatically default to the "calibration menu" screen.

To install a new calibration table, select CREATE CAL TABLE by pressing 1 on the keypad. Soon the cal table builder screen appears on the display. Since a five point calibration is being done, six different concentrations of Tide detergent were made: 0.5mg/L, 5mg/L, 10mg/L, 50mg/L, 100mg/L, 500mg/L. A concentration of 25 mg/L of Tide corresponds to a typical working solution for a batch of laundry. The sample bottles for the GFL-1 fluorometer come with the instrument. These are the only sample bottles that can be used for the measurement of fluorescence. There are five steps in making a calibration table:

Step 1

The screen will prompt to insert the most concentrated reference in order to set the detector gain. In this case, the highest concentration is 500mg/L. Press ENTER.

Step 2

Insert the blank and press ENTER.

Step 3

The next step is to enter the calibration units (e.g., mg/L). Pressing the ENTER key takes takes the user to the next step.

Step 4

This step prompts the user to insert a reference sample of any concentration. After inserting the reference sample, press ENTER. The screen will then prompt the user to enter the concentration value for the inserted reference sample. After setting the known reference, the screen will ask whether or not to do another point. Press YES and repeat the above sequence until you have inserted all the prepared reference samples. The reference samples should be inserted in a random fashion and not in the order of increasing or decreasing values of concentration.

Step 5

The last step prompts the user to name the calibration table. It should be noted that calibration tables are not saved until a name is given to the table. Then press ENTER.

Now the fluorometer is ready to start running samples.

Sample Test Mode

Figure F3.3 is the first screen display shown after switching on the fluorometer. Press 1 for the test mode, since the calibration table has already been saved.

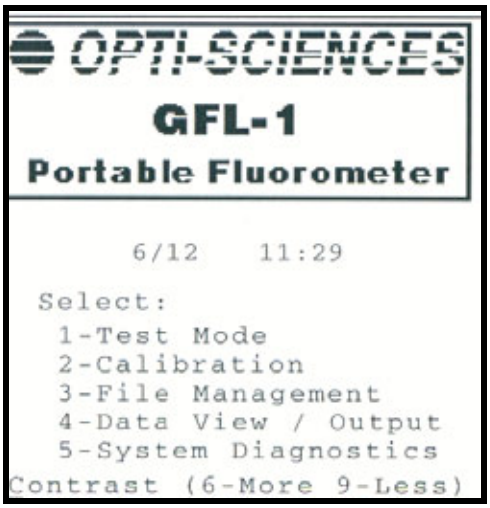


Figure F3.3: Main Menu

The screen will then display the following (Figure F3.4):



Figure F3.4: Calibration Menu

Press 2 for using the saved calibration table as the active calibration table in the memory. The next screen would prompt you to enter the desired table number saved. If you have saved only one calibration table, press 1.

Place a blank sample in the sample chamber and press ENTER (Figure F3.5). You will then see the screen displayed in Figure F3.6.



Figure F3.5: Placing Sample into Sample Chamber

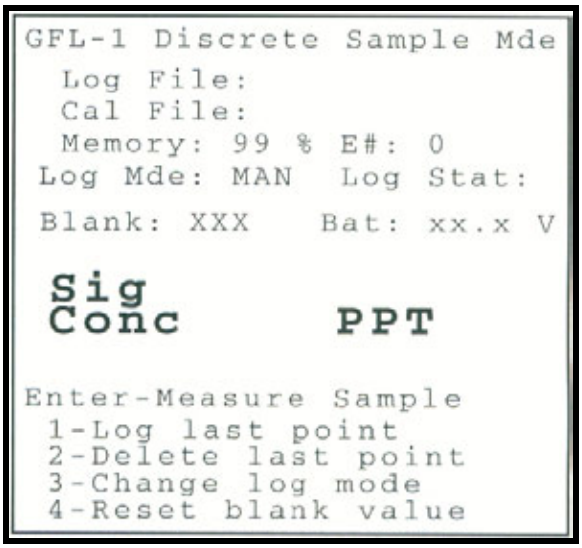


Figure F3.7: Discrete Sample Mode

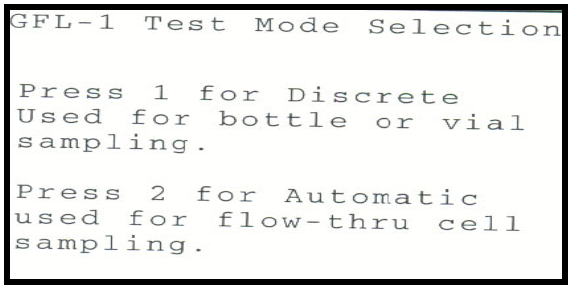


Figure F3.6: Test Mode Selection

Press 1 for doing discrete bottle sampling.
A new screen will appear (Figure F3.7).

With calibration complete, the instrument is ready to analyze the samples. To run a test, simply load a sample into the chamber and press ENTER. The unit will measure the sample and present the data a few seconds later. A busy message indicates that the test is in progress. Press ESC to return to the main menu.

Initial Tests using the Fluorometer

Initial tests were conducted after the first calibration to get an indication of the repeatability and drift of the results obtained from the new instrument. Five different concentrations of Tide detergent samples were made and tested for fluorescence after varying periods of time. The results of these tests are shown in Figure F3.8.

It is obvious that the fluorescence signal from Tide degrades with time and that the analyses should be evaluated within two hours. Other samples of commercial and household detergents were also evaluated and degradation of fluorescence with time was also identified. The largest changes occurred between about one and two hours after sample preparation. There was very little change after this initial two hour period. In the real world, the time between mixing of a laundry detergent with the washwater at the laundry, its discharge, and its analysis in the laboratory is at least two hours. Therefore, the fluorescence values used are those obtained after the signals have reached a relatively constant value. The results of the tests on certain commercial and household detergents are shown in Figure F3.9.

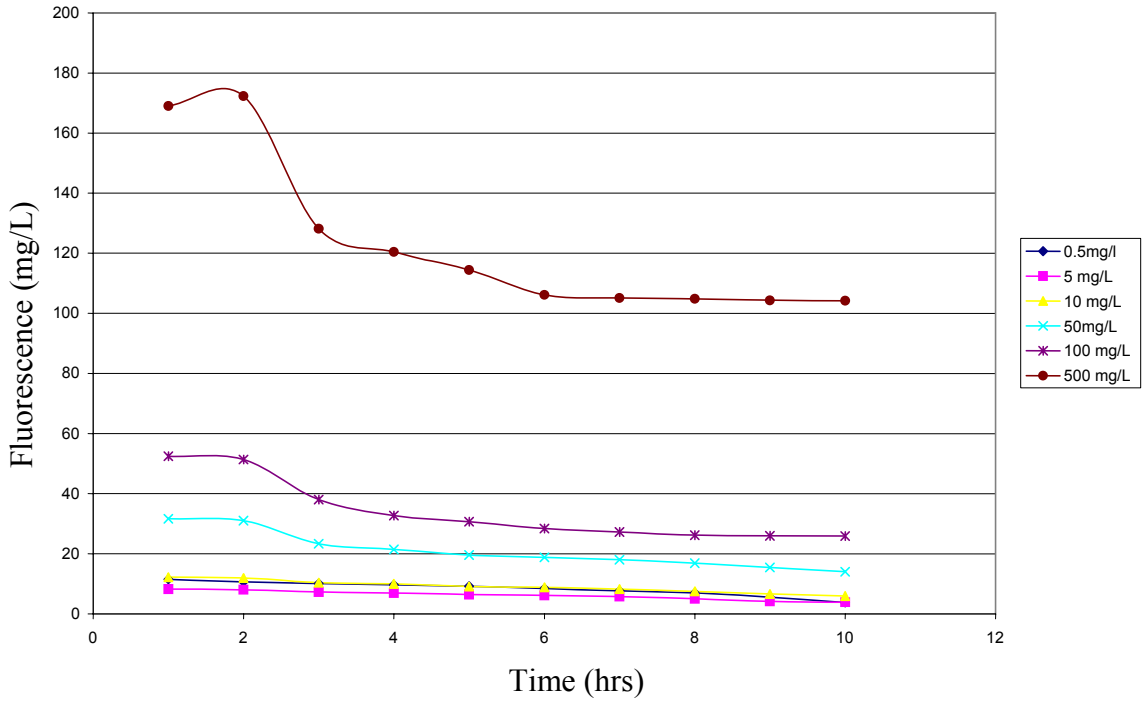


Figure F3.8: Changes in Tide DetergentFluorescence over Time

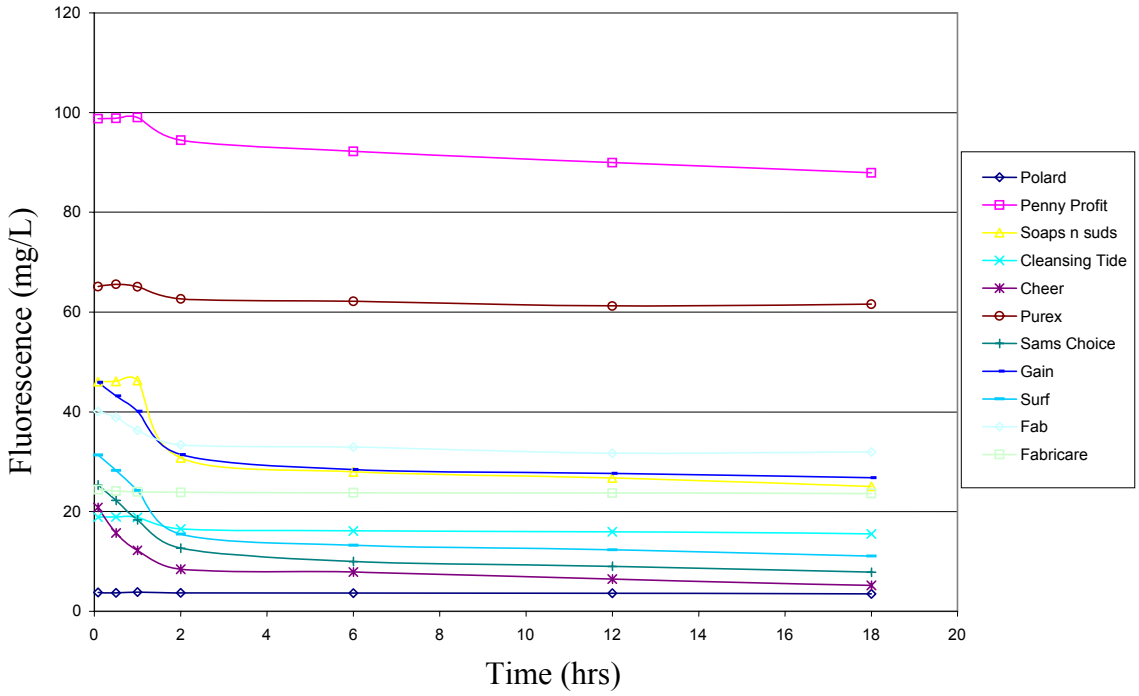


Figure F3.9: Changing Fluorescence with Time

The commercial laundry detergent samples in this graph were *Polard, Penny Profit, Soaps n Suds, and Cleansing Tide*. The others are household detergents (*Cheer, Purex, Sam's Choice, Gain, Surf, Fab, and Fabricare*). *Soaps n Suds* had a steep drop in fluorescence after one hour of preparation of the sample. After two hours, the fluorescence values stayed relatively constant without further changes. There was only one sample (*Polard*, a commercial detergent) that did not show any change in its fluorescence value. This detergent also had the lowest fluorescence signal of any of the samples. Although equal concentrations of all of these detergents were evaluated (50 mg/L), the fluorescence values ranged from 5 mg/L to 100 mg/L, as Tide. Obviously, the ingredients of the different detergents varied greatly.

F3.3 Surface Tension Test for the Detection of Detergents

Introduction

This discussion presents a proposed sensitive method to detect detergents without hazardous chemicals and with standard laboratory equipment. The method uses the property of the detergent to decrease the surface tension of the bubbles formed when the sample is agitated. Different detergents at different pHs were used during these tests. Results indicate that the method can be used to detect detergent concentrations above 1 mg/L, and can be used as a presence/absence test for concentrations above 0.3 mg/L. The method also was verified with samples collected from a known inappropriate detergent discharge.

One of the effects of detergents in water is the reduction in surface tension. When a sample of water with detergent is agitated, air is mixed with water, creating bubbles. Because the surface tension is reduced, the tension that controls the pressure of the air is low and the surface film is not destroyed. This property can be used to estimate the detergent concentration based on the amount of foam produced after the sample is agitated.

The amount of foam formed after a sample of water with detergent is agitated can be affected by various parameters. Temperature can affect the surface tension of the water. An increase in the temperature will reduce the surface tension. Foam production can also be affected by the chemical composition of the water. As an example, low pH will decrease the foam production.

The following discussion presents an inexpensive, safe, and reasonably sensitive method to estimate the detergent concentrations in a water sample using common laboratory equipment and without hazardous reagents.

Methods

General laboratory equipment was used to generate foam from samples of distilled water and detergent at different concentrations. The idea of the experiment was to drop the sample inside a burette from a constant elevation and to measure the height of the foam created 10 seconds and 1 minute after the last drop fell.

Apparatus:

- A rectangular base support and rod assembly
- A 50 mL burette
- A clamp to hold the burette
- A 25 mL blowout pipette
- Two 10 mL pipettes
- A stop watch
- A 200 mL volumetric flask
- A portable pH meter

A rectangular base support was used to hold the burette vertically. Using a 25 mL pipette, a 25 mL sample was released into the 50 mL burette. The sample was released by free fall from near the top of the burette, taking care that the sample does not touch the wall of the burette to maximize the amount of bubbles that can be produced. An initial reading of the foam height was taken 10 seconds after the pipette was drained. A final reading was obtained 50 seconds later.

Reagents:

- Detergent (Tide)
- Distilled water
- 500 mL NaOH 1N
- 500 mL H_2SO_4 0.02N

Four samples at the same concentration were created at the same time. Four stands and four burettes were used for each concentration. After the reading, the burettes were washed for more than 2 minutes until they were clean.

To obtain more foam during the experiment, the pH was increased up to 12. The sample was diluted with distilled water and 10 mL of 1N NaOH added. The sample was prepared in a 200 mL volumetric flask. NaOH was selected because it is present in most of the detergents. After the reading was taken, the sample (200 mL) was neutralized with 100 mL 0.05N H_2SO_4 before disposal.

Results

Table F3.11 shows the foam reading above the water surface 10 seconds and 1 minute after the last drop.

The results indicate that this method can be used as a presence/absence test for detergent concentrations between 0.2 and 1 mg/L (as Tide) and to estimate concentrations above 1 mg/L. The method is simple and does not require specialized equipment.

An advantage of this method is that the equipment is easily available and inexpensive. The disadvantages are the variability in readings due to changes in temperature and characteristics of the detergents.

Figure F3.10 shows the results from concentrations between 10 and 50 mg/L. For readings above 10 mg/L, if the level of detergent increases the height of the foam also increases in a parabolic shape. It was also observed that the repeatability of the results decrease at high levels.

For levels of detergent lower than 10 mg/L, there is not an important change in the reading. The minimum reading that can be obtained from the burette is 0.05 mL. For samples in this range the reading is close to the precision of the instrument. Figure F3.11 shows the results from concentrations between 0 and 5 mg/L.

Readings below 1.0 mg/L create a circle of bubbles around the wall of the pipette. This circle was not present when distilled water was used. This procedure can be used as a presence/absence test. The circle was observed for concentration of detergent higher than 0.2 mg/L.

Conclusions

The new method is an inexpensive, safe and moderately accurate method to estimate the presence of detergents in concentrations above 0.2 mg/L. For detergent concentrations above 10 mg/L, the method can be used to quantify the concentrations. These higher concentrations have been observed in sewage, industrial discharges, laundries and car wash areas.

Table F3.11: Foam Readings Over Time

Concentration (mg/L, as Tide)	Foam Height after 10 sec. (mL)	Foam Height after 1 min. (mL)
0	0	0
0.1	0	0
0.2	T	T
0.3	T	T
0.4	T	T
0.5	T	T
0.7	T	T
1	0.05, 0.05, 0.05, 0.05	0.05, 0.05, 0.05, 0.05
2	0.1, 0.1, 0.1, 0.1	0.1, 0.1, 0.1, 0.1
3	0.1, 0.1, 0.15, 0.15	0.1, 0.1, 0.15, 0.15
5	0.15, 0.15, 0.15, 0.15	0.15, 0.15, 0.15, 0.15
10	0.2, 0.2, 0.2, 0.2	0.35, 0.4, 0.4, 0.4
20	0.8, 0.6, 0.6, 0.6	1.5, 1.3, 1.4, 1.3
50	2.6, 2.6, 3.0, 2.8	3.8, 3.5, 3.7, 3.6

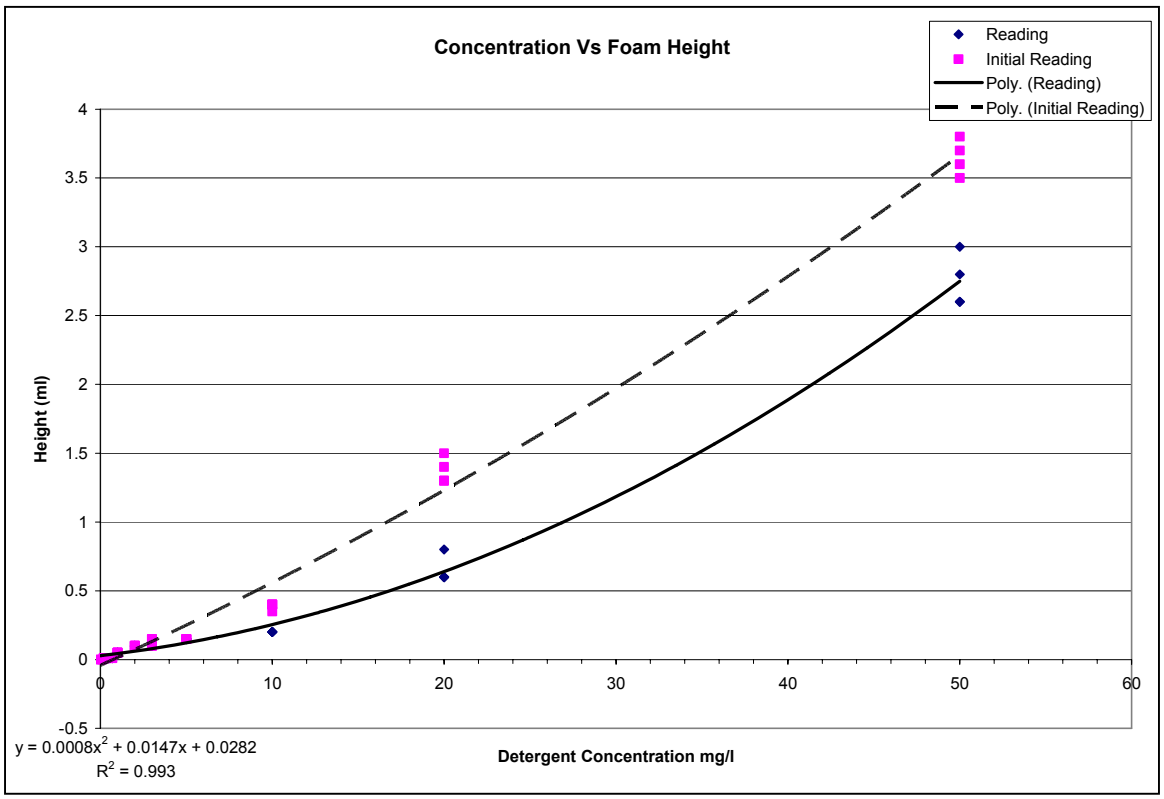


Figure F3.10: Correlation Between Concentration and Foam Height at Higher Concentrations

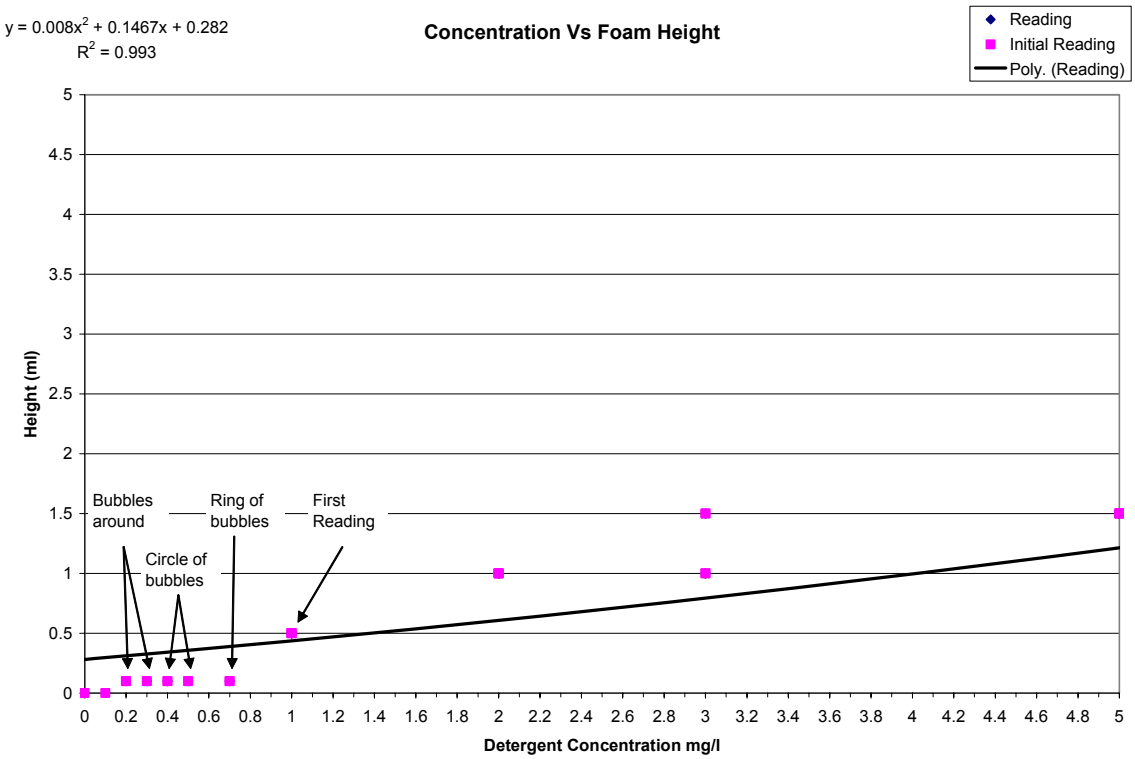


Figure F3.11: Correlation Between Concentration and Foam Height at Lower Concentrations

APPENDIX F4: LAB TESTING OF "OPTICAL BRIGHTENER MONITORING" TO FIND INTERMITTENT DISCHARGES

Introduction

Fabric brighteners are fluorescent dyes added to soaps and detergents. These are used to produce a brightening effect after laundering. They absorb the UV rays of the sunlight and then fluoresce as a bright blue.

Optical Brightener Monitoring (OBM) is a new method for detecting fluorescent materials in water samples. It is based on a method used to measure the presence of strongly fluorescent tracer dyes.

Briefly, cotton pads that are free of fabric brighteners are used for checking the presence of optical brighteners in water samples. Cotton pads are soaked in the water sample and then dried in a darkened room. The pads are then viewed with ultraviolet (UV) light to check for the presence of fluorescence. This is an inexpensive, but much less sensitive, method for the detection of fluorescence compared to fluorometers.

Homemade OBM traps are inexpensive and easy to make. Table F4.1 lists the average costs of the supplies needed to make OBM traps, most of which can be found at a local hardware or home improvement store.

The following tests were conducted to determine how effective this test would be to detect inappropriate discharges originating from washwaters or sanitary wastewaters to storm drainage systems. This test may have several advantages compared to other methods used to detect these wastewaters: fluorometers are very expensive, detergent analyses can be hazardous, and the boron content of detergents varies widely. In addition, the OBM method usually involves placing the test pads in the targeted water for extended periods (up to several days) and may therefore be sensitive to intermittent discharges. These tests were therefore conducted to determine the sensitivity of the OBM method and to investigate its reliability under both field and laboratory conditions.

Table F4.1: Start-Up Costs for Optical Brightener Monitoring
(Source: Sargent and Castonguay, 1998)

Equipment	Cost
25 - 1/2” wire mesh (cages)	$ 75.75
42 feet black plastic mesh	$ 4.50
100 yards 20 lb. test monofilament	$ 2.00
500 elastics	$ 10.00
1000 staples	$ 5.00
Unexposed labels	$ 12.00
5 boxes plastic bags	$ 5.00
200 craft sticks	$ 2.00
25 aluminum spikes	$ 23.00
1 case unwashed cotton pads	$ 88.00
12 rubber gloves	$ 16.00
6 watt UV light with 2 bulbs	$ 240.00
Total	**$ 483.25**

Test Procedure

Step One:
Care should be taken so that samples are handled properly with no cross contamination. Gloves free of fabric brightener should be worn at all times when handling the test materials. The field test kit includes brightener-free cotton pads and a sampler cage to hold the pads in place if they are to be deployed for extended periods. The sampler cage is a non-metallic plastic, or a vinyl coated black wire cage having 0.5" openings. The cage consists of two hinged pieces approximately 5" by 5". This cage should be fabricated so that it will hold the fabric pads at approximately a 30 to 45 degree angle. The open end of this cage is held closed with an elastic band. A 4 to 6 watt long-wave fluorescent UV ultraviolet light is used to observe fluorescence on the fabric.

Step Two: (Placement)
At an outfall or small stream sampling location, the wire cage is secured by a heavy monofilament fishing line tied to a branch, a rock, or an aluminum spike. In sampling catchbasins, the wire cage is lowered into the catch basin by the monofilament fishing line that is then tied to the grate cover or other object. The wire cage is suspended within the water flow. The fabric pad is generally exposed for seven days. If intermittent flows are present, the device may be kept for an even longer period. However for quick sampling, the pad needs to be exposed to a water sample for at least one hour. If rust or sediment obscures the sample, then the duration needs to be shortened.

Step Three: (Retrieval)
After the samplers are retrieved from the water, the pads are removed from the sampling device. The pads are then rinsed in the sampling water to remove any surface sediment, and squeezed to remove excess water without tearing or ripping the pads. The pads are also labeled (see Figure F4.2).

All labels must be analyzed using the UV light to check for the presence of brighteners, as most white paper contains optical brighteners that can interfere with the optical brightener measurements of the pads. Label information should include, location, day/time of placement, and day/time of removal. The stiff paper labels are stapled to the retrieved sampling pads, placed in a zip lock bag, and kept in the dark as they are being transported to the laboratory. Upon arrival at the laboratory, the pads are dried in a darkened room (where they will not come into contact with direct sunlight) by hanging on a non-cotton monofilament line (see Figure F4.2). The line should either be replaced or cleaned by a cotton pad after every use.

Step Four: (Analysis)
The pads are viewed in a darkened room using a long-wavelength UV light source. The pads are easiest to examine in a dark room using a special UV lamp viewing cabinet. A non-exposed pad is used as a control. The pad will fluoresce if it is positive for brighteners, while it will be noticeably drab like the control pad if it is negative. Uneven exposure of the pad to optical brighteners may result in uneven fluorescence of the pad. If the reason for partial fluorescence can be explained then the pad should be regarded as positive. Specks or spots of fluorescence on the pads may be ignored.



Figure F4.2: Labeling the Pad



Figure F4.3: Drying the Pads

Method Modifications

While reviewing the prior methods for the OBM for inappropriate discharge detection, the following issues were brought up:

a) Do the pads need to be left in the field for extended periods and how long should the pads be exposed to the sample water?

b) Are there any detrimental effects of direct exposure to sunlight while drying the cotton pads?

c) What is the sensitivity of the OBM compared to the other tests used to detect washwaters and sanitary wastewaters?

The above points are discussed in the following paragraphs.

Leaving the cotton pad and the sampling device at the sampling location

If there is continuous flow at an outfall, there is no need to keep the pads at the outfall for extended periods. If grab samples are collected from the flowing outfalls for later chemical tests, a separate sample bottle can be conveniently collected for optical brightener tests. During our analyses, the cotton pads were immersed in the sample bottles at the time of sample collection. This sampling modification greatly reduced the time and effort needed to conduct the tests. Our initial tests indicated that the high sediment loads associated with the outfall discharges would hinder the ability to measure the fluorescence due to coating the fabrics with silt. If the pads were placed in the OBM sample bottles when the water was collected, the time required to bring the samples to the laboratory was thought to be sufficient to affect the pads. Tests were conducted in the laboratory to determine the time needed to affect the pads. The standard procedure used at least a one hour exposure period.

Direct exposure to sunlight while drying the cotton pads.

There was a concern related to the degradation of fabric fluorescence in the presence of sunlight, especially after the fluorometer tests indicated significant decreases in water sample fluorescence during the first hour or two after detergent mixing. In order to test this concern, two samples were prepared with the same concentration of detergents. Two cotton pads were immersed in each of the bottles. One was dried under the direct exposure of sunlight, while the other one was dried in a dark room. After 24 hours, both sets of pads gave the same fluorescence under the ultraviolet light. Therefore, it was concluded that direct sunlight exposure to the dried cotton pads did not affect the test results.

Other sampling and laboratory practices that were important included using gloves while handling the pads, and testing the cotton pads for fluorescence under the UV lamp before their use.

Laboratory Verification using Standard Samples and Field Use in Cribbs Mill Creek

The basic OBM method is a presence/absence test, with unknown sensitivity. In order to make this test more useful, additional tests were conducted. The initial test used different Tide detergent standards. Tide detergent samples were made with concentrations of 0.5 mg/L, 5 mg/L, 10 mg/L, 20 mg/L, 30 mg/L 50 mg/L, 100 mg/L, and 500 mg/L. Samples from each dried test pad were attached onto a card, as shown in Figure F4.4.

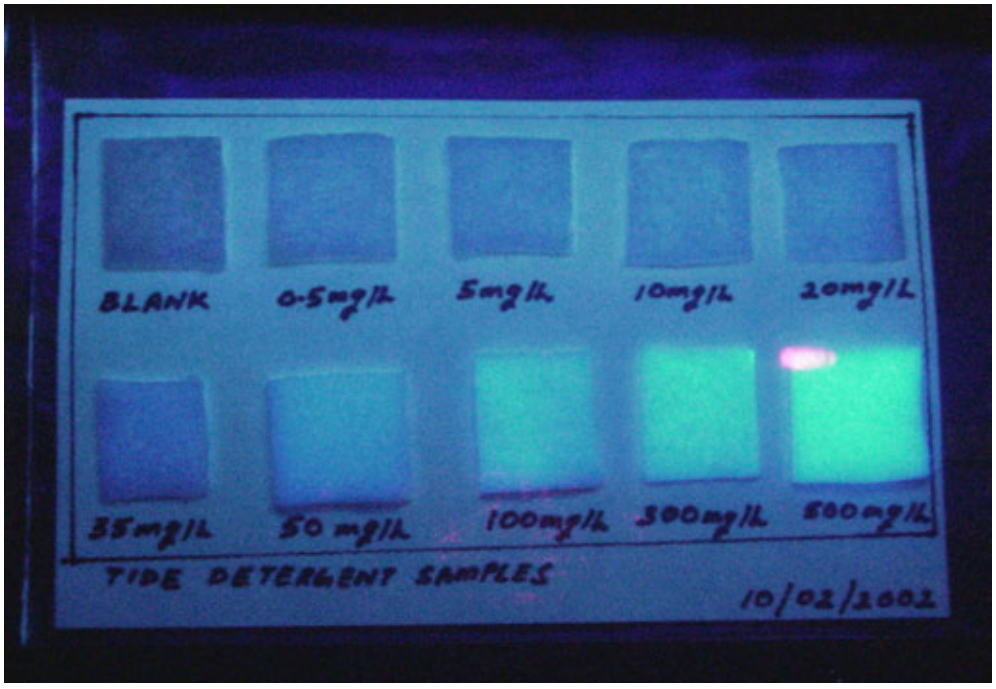


Figure F4.4: Standard Tide OBM Pads

As can be seen in Figure F3.4, concentrations below 35 mg/L all look identical. The 50 mg/L Tide solution (the first one with an obvious fluorescence response) is representative of a full-strength washwater as typically used in household laundry. Thus, it may be concluded that the OBM method may not be useful for samples having anything less than full-strength washwaters.

The maximum fluorescence concentration obtained from the Cribbs Mill Creek samples was 17mg/L (as Tide), and no positive responses for fluorescence using the OBM method were found.

Conclusion

This test was originally designed to identify faulty septic systems and storm drainage systems using fluorescent dyes. The fluorescent dyes (Fluorescence and Rhodamine FWT) used in these types of tests are very strong dyes and are used in moderate concentrations. They are therefore much easier to be detected by the cotton pads and the OBM method than the fabric brighteners in washwaters. OBM is a quick, easy, and inexpensive method, but can only reliably detect undiluted washwaters, and likely will miss the more common diluted washwaters found as inappropriate discharges. Other simple methods exist that are more sensitive, although the OBM method may be most suitable if intermittent discharges of undiluted washwaters are expected.

Appendix F5. IN-HOUSE ANALYTICAL CONSIDERATIONS FOR INDICATOR PARAMETERS

Introduction

Program managers need to understand the basic analytical options and safety considerations, for each analytical method used to measure indicator parameters. This understanding helps program managers choose what indicator parameters to collect and where they should be analyzed. This section provides a summary of the basics.

Table F5.1 summarizes the recommended analysis method associated with each indicator parameter. An extended description of each analysis method is provided below.

Colorimetric – Colorimetric methods utilize specialized instruments such as a colorimeter or a spectrophotometer (Figure F5.1). The two instruments are similar and quantify parameter concentrations by adding reagents to the sample and passing through a defined spectrum of light. In general, spectrophotometers can analyze a much broader range of parameters than colorimeters.

Table F5.1: Analytical Considerations for Illicit Discharge Indicator Parameters

Indicator Parameter	Method	Analysis Type	Limit of Detection
Ammonia	*HACH Method 8155*	Colorimetric	0.01 mg/L
Boron	*HACH Method 10061*	Colorimetric	0.02 mg/L
Chlorine	*HACH Method 8021*	Colorimetric	0.02 mg/L
Color	*HACH Color Wheel*	Color Comparator	1 color unit
Conductivity	Various Probe or Meter Techniques	Probe or Meter	N/A
Detergents – Surfactants	*Chemetrics Chemets*	Color Comparator	0.25 mg/L
E. coli, Total Coliform, Enterococci	IDEXX: Colilert Or Enterolert	IDEXX: Colilert Or Enterolert	1 MPN/100 mL
Fluoride	*HACH Method 8029*	Colorimetric	0.01 mg/L
Hardness	*HACH Method 8213*	Titration	1 mg/L
Potassium	*HACH Method 8049*	Colorimetric	0.1 mg/L
	Horiba Probe	Probe	5 mg/L
PH	Probe (Various)	Probe or Meter	1 pH unit
Turbidity	Various Turbidity Meters	Probe or Meter	1 NTU



Figure F5.1: Spectrophotometer

Color Comparator – This analysis method is a less quantitative version of the colorimetric method. Samples are prepared by adding reagents, and assessing the color in comparison to a color cube (see Figure F5.2) or color disk that assigns a concentration for different color shades.



Figure F5.2: HACH Color Cube Comparator

Probes – These methods use a probe to pass an electrical current through the sample for specific light wavelength (for most indicators) or measure the scatter of light (for turbidity). While results are immediate, lab analysts need to frequently calibrate the probe using standard solutions to assure accurate data.

Titration – Titration techniques measure the concentration of indicator parameters by determining the amount of a reagent needed to produce a specific reaction in the sample, which is often indicated by a color change. Lab analysts carefully record the amount of reagent added to the sample using a "burette," which is a graduated cylinder with a valve-controlled opening at the bottom. An alternative and more precise technique is a digital titrator. Both methods rely on equations or lookup tables that relate to the amount of reagent added to the estimated concentration of the indicator parameter.

IDEXX Techniques: Colilert or Colisure - These proprietary methods are used to measure *E. coli*, total coliform and Enterococci bacteria. Samples are sealed along with a reagent in a specialized tray that is then placed into an incubator for 24 hours. The analyst then measures the number of cells in the tray that have changed color or shine under a fluorescent bulb, which is used to indicate the amount of bacteria in the sample (Figure F5.3). The IDEXX method uses a standard chart to relate the number of cells that have a positive reaction to the presence of bacteria. The IDEXX method is fairly simple and safe, but requires fairly expensive equipment.

Safety and Waste Management Considerations

Each analysis method has special safety and waste disposal considerations, which are outlined in Table F5.2.

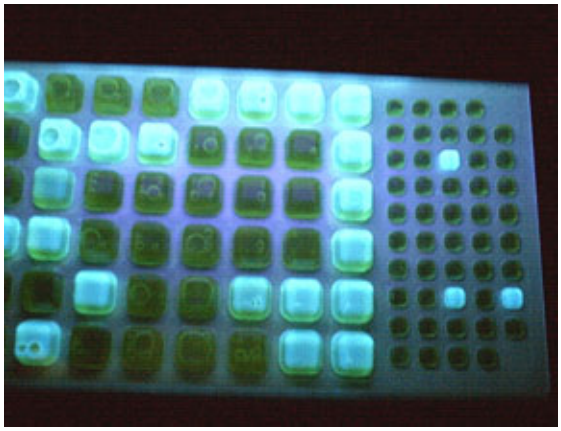


Figure F5.3: IDEXX Results

Table F5.2: Special Safety and Waste Management Considerations			
Indicator Parameter	**Method**	**Major Health Risks**	**Special Disposal Requirements**
Detergents – Surfactants	Chemetrics Chemets	Carcinogenic. Causes dermatitis and lung infection. Need to provide ventilation.	Hazardous Waste
E. coli; Total Coliform; Enterococci	*IDEXX: Colilert Or Enterolert*	OK	Potential Biohazard (Consult State Health Agency for requirements)
Fluoride	HACH Method 8029	Causes erosion of teeth.	Reagent is a hazardous waste.
Hardness	HACH Method 8213	No major	Reaction produces a hazardous waste.

TIP

The IDEXX technique requires a special adaptation when used to measure *E. coli* in discharges from storm drain outfalls. The concentration that distinguishes sewage from other dischares is greater than 12,000MPN/100ml. Using this method, the maximum redable concentration is only 2,619MPN/ml. Dilute outfall samples to 10-20% of their original concentrations with deionized water in order to read the very high concentrations of *E. coli* that identify sewage discharges.

References

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APPENDIX G

SAMPLING PROTOCOL CONSIDERATIONS

Developing a Consistent Sample Collection Protocol

A good field sampling protocol incorporates eight basic elements:

1. Where to collect samples
2. When to collect samples
3. Sample bottle preparation
4. Sample collection technique
5. Storage and preservation of samples
6. Sample labeling and chain of custody plan
7. Quality assurance/control samples
8. Safety considerations

1. Where to Collect Samples

Indicator sampling normally occurs at three principle locations in the storm drain system to detect illicit discharges - at the outfall, in the stream, and within the storm drain pipe network.

Monitoring of dry weather flows from outfalls is the most common location in most IDDE programs, and the majority of this chapter focuses on these techniques.

In-stream monitoring involves sample collection at perennial stream channels during dry weather flow conditions. Stream monitoring is less precise than outfall monitoring at detecting individual discharges. It can, however, screen stream reaches for those with the greatest illicit discharge potential, detect the most severe or high volume discharges, and measure progress over time in terms changes in stream water quality.

In-pipe sampling is often needed to track down and isolate individual discharges once a potential discharge problem is encountered at an outfall. Many of the sample collection protocols discussed in this section can be applied for in-pipe sampling, although additional testing methods to track down sources are described in Chapter 13.

2. When to Collect Samples

Indicator samples should be collected during dry weather periods to avoid flowing outfalls caused by storm water or groundwater infiltration. While the traditional definition of dry weather has been 72 hours without rainfall, some communities have shortened this window to 48 hours to make sampling more practical. An exception to this rule is sampling to respond to hotline complaints, which should be conducted immediately. Time of day that sampling is conducted is particularly important when the suspected source is residential sewage. Peak water usage occurs in the morning and evening, therefore sampling in the early morning (i.e., beginning of the work day) is recommended in these situations. In some regions of the country, sampling should be scheduled to coincide with the seasons where shallow groundwater influence is minimal.

3. Sample Bottle Preparation

Most indicator samples are stored in a polyethylene plastic sample bottle that is opaque or clear. Sample bottles can be reused, but only if they are acid-washed between field visits. If bacteria samples are collected, a new 120 ml sealed sample bottle is needed for each sample. Samples requiring a preservative are addressed in element 5.

4. Protocols for Sample Collection

Sample collection should reduce the potential for contamination, and prevent the field crew from being exposed to harmful

pollutants. Some considerations for sample collection include:

- Wear surgical gloves (unpowdered nytrile gloves are recommended to limit chances of contamination) when collecting the sample, and wash hands with sanitary wipes after the sample(s) is collected.
- Dry weather flows can be shallow, have low flow volumes, and be hard to reach. In some cases, alternative sample collectors may be used. A "dipper," consisting of a measuring cup at the end of a long pole, can be used to catch flows from the outfall. A pre-measured, cut-off plastic milk jug can be used to capture shallow flows from the pipe (see Figure G.1). In either case, make sure not to disturb any sediments or benthic growth in the pipe as a sample is taken. Also, be sure to rinse these alternative sample collectors three times with sample water before collecting the sample.
- Fill the bottle completely to the top (i.e., with the meniscus at the rim).
- Do not touch the inside of the lid or bottle.
- Add any needed preservative at the time of sample collection. (See Step 5).
- Label the bottle immediately. Ensure that samples stay at 4°C (40°F). On a hot day, put samples in an ice-filled cooler immediately, or carry "blue ice" in a backpack.

5. Sample Storage and Preservation

If the field crew cannot get the samples back for analysis within the same day, they will need to preserve the samples using the techniques outlined in Table G.1. Some suppliers and contract labs provide pre-packaged sample bottles that contain required preservatives. Each indicator parameter has a unique sample preservation technique and a maximum hold time for laboratory analysis.

Tip

When analyzing multiple parameters and preserving samples, the field crew may need to collect up to four samples at a site: one preserved with H_2SO_4, one preserved with HNO_3, one sealed new bottle preserved with Na_2SO_3 for bacteria, and one unpreserved.



Figure G.1: A dipper (a) is helpful when the outfall is hard to reach. A milk jug (b) can be used to collect samples from shallow flow.

Table G.1: Sample Preservation and Storage Requirements for Typical Outfall Monitoring Parameters
(Primary Source: APHA, 1998)

Parameter	Preservation[3]	Maximum Hold Time[4]
Ammonia	H_2SO_4 to pH<2 Refrigerate to 4°C	7 to 28 days
Boron	HNO_3 to pH<2	28 days to 6 months
Chlorine[1]	Not Applicable	15 minutes
Color	Refrigerate to 4°C	48 hours
Conductivity	Refrigerate to 4°C	28 days
Detergents – Surfactants[2]	None Required	48 hours
Bacteria (*E. coli*, Enterococci, Total Coliform)[2]	$Na_2S_2O_3$ in chlorinated waters Refrigerate to 4°C	6 to 24 hours
Fluoride	None Required	28 days
Hardness	HNO_3 or H_2SO_4 to pH<2	6 months
pH[1]	Not Applicable	15 minutes
Potassium[2]	HNO_3 to pH<2	28 days
Turbidity	Refrigerate to 4°C Store in the dark	24-48 hours

1. Indicates parameters that should be analyzed in the field.
2. Data for these parameters taken from the National Environmental Methods Index (www.nemi.gov)
3. Many contract labs will provide sample bottles with preservative already added.
4. For parameters with a range, the lower number is recommended by the reference, and the higher number is the regulatory requirement for sample storage.

6. Sample Labeling and Chain of Custody

The labeling and integrity of each sample are important parts of the sampling protocol. Program managers should develop a process to track the "chain of custody" from the time the sample is initially collected until it is analyzed and reported as data. The process limits errors resulting from mis-labeling, lost samples, and improper laboratory analysis. Table G.2 outlines the nine minimum elements of a chain of custody, recommended by APHA (1998).

Table G.2: Nine Elements of a Chain of Custody	
Element of Chain of Custody	**Description**
1. Sample Labels	Labels should include a unique ID, type of sample, name of collector, date and time of collection, date and time of preservation, and preservative used (if applicable).
2. Sample Seals	Seals the lid on the label to ensure they are not tampered with.
3. Field Log Book	Includes basic information about sample collection, usually the Outfall Reconnaissance Inventory (ORI) field form can be used for this purpose.
4. Chain-of-Custody Record	A sheet that tracks the transfer of samples between individuals.
5. Sample Analysis Request Sheet	A sheet that requests specific analysis types from the laboratory.
6. Sample Delivery to the Laboratory	Ensure that sample delivery is timely. Include chain of custody records with the sample.
7. Receipt and Logging of Sample	The lab needs to document time of receipt of the sample
8. Assignment of Sample for Analysis	The lab supervisor assigns an analyst to the sample. The lab supervisor or analyst is responsible at this point.
9. Disposal	Save samples until results are confirmed and finalized. Dispose of according to US EPA approved methods.

7. Quality Assurance Measures During Sample Collection

To ensure sampling results are accurate, it is important to institute quality assurance measures as part of the sampling protocol. Quality assurance samples serve as a check against biases introduced during sample collection, or within the laboratory. Quality assurance samples also assess the accuracy of the analysis method and its consistency for samples collected at the same site. The sampling protocol should define a minimum fraction of samples that will be used for quality assurance purposes (typically about 5% - 10% of all samples collected). Examples of quality assurance samples include field blanks, duplicate samples, split samples and spiked samples, which are described below:

Field Blanks – Field blanks are deionized water samples prepared in the field at the time of sample collection. If the lab results for field blanks have non-zero values, it indicates that impurities were introduced to the sample during collection or lab analysis. The distilled deionized water should be placed in whatever is used to collect samples (e.g., sample scoop, dipper, plastic milk bottle) and then poured in the sample bottle, just as if it had been scooped or dipped as a real sample.

Duplicate (Replicate) Samples – This quality assurance technique relies on the collection of two or more samples from the same location and flow source during the same field visit. A discrepancy between the two sample measurements indicates a lack of precision or repeatability introduced during sample collection or lab analysis.

Field Spikes – A field spike is a sample to which a known concentration of an indicator parameter is added (e.g., an ammonia concentration of 1.0 mg/L). Any difference between the known concentration and the final laboratory measurement reveals errors introduced during sampling and laboratory analysis.

Split Samples – Splits consist of a single field sample that is divided into two separate sub-samples for subsequent laboratory analysis. Typically, split samples are submitted to different laboratories, or analyzed by different analysts to determine the precision of laboratory results. Alternatively, split samples can be analyzed at a single laboratory without knowledge of the sample origin (referred to as a "blind sample"). Any discrepancy between the two sub-samples suggests a lack of precision or repeatability introduced during sample collection or lab analysis.

8. Safety Considerations

Whenever sampling is done there are safety considerations that require planning. This is even more important when sampling is being conducted in urban stream environments where there is potential for contact with contaminated water, sharp debris and objects, and threatening individuals (both animals and humans). Field crews should be comprised of at least two individuals, each equipped with proper foot (e.g., sturdy boots or waders) and hand wear (latex gloves). Key equipment for crews to carry include cell phones, a list of contact and emergency numbers, a gps unit, and a first aid kit. Private properties should not be accessed unless proper notification has been provided, preferably in advance. Lastly, program managers may want to consider requiring/recommending field crews to be vaccinated against Hepatitis B, particularly if the crews will be accessing waters known to be contaminated with illicit sewage discharges.

References

American Public Health Association (APHA).1998. *Standard Methods for the Examination of Water and Wastewater – 20th Edition*. Washington, D.C.

APPENDIX H

TWO ALTERNATIVE FLOW CHARTS

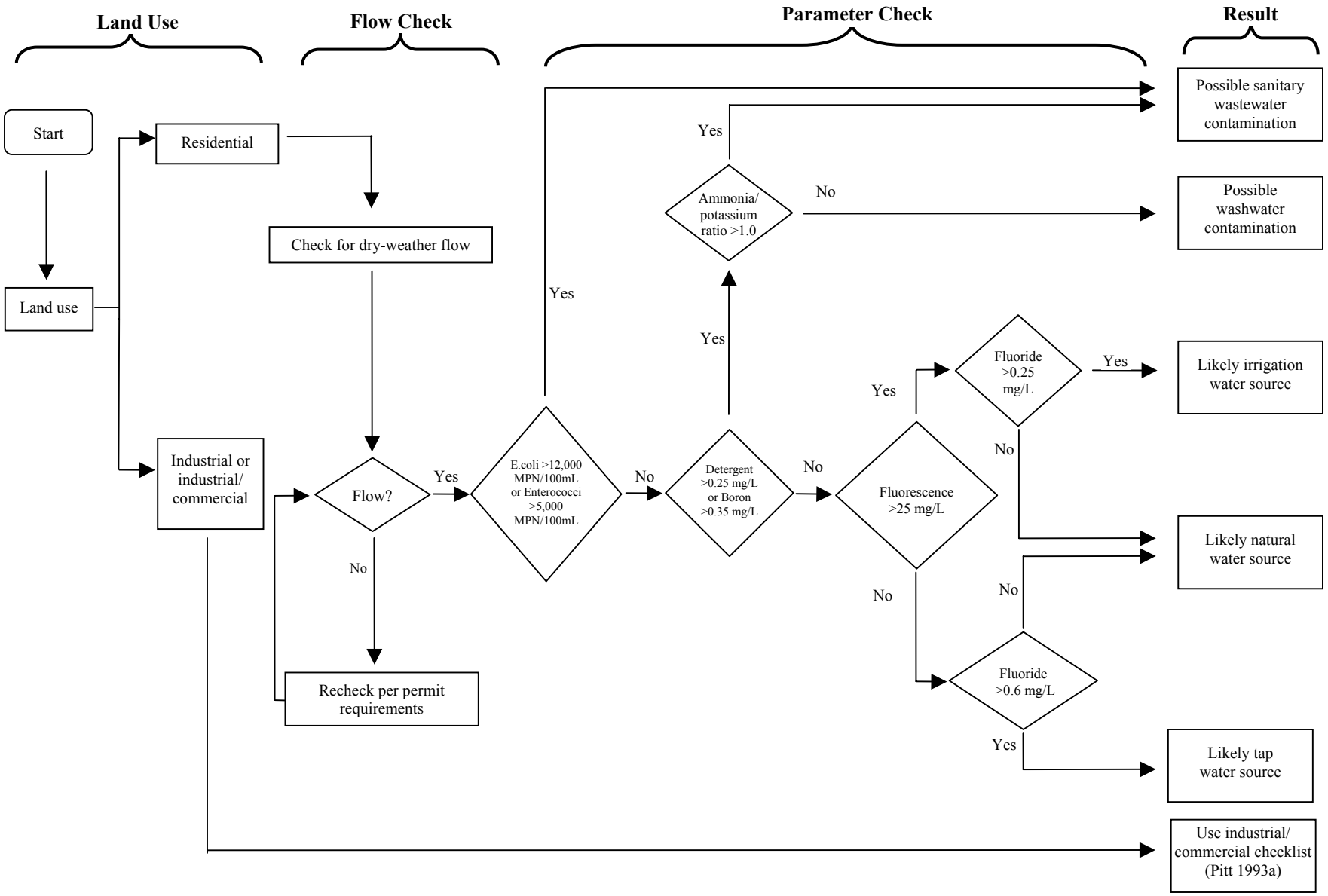
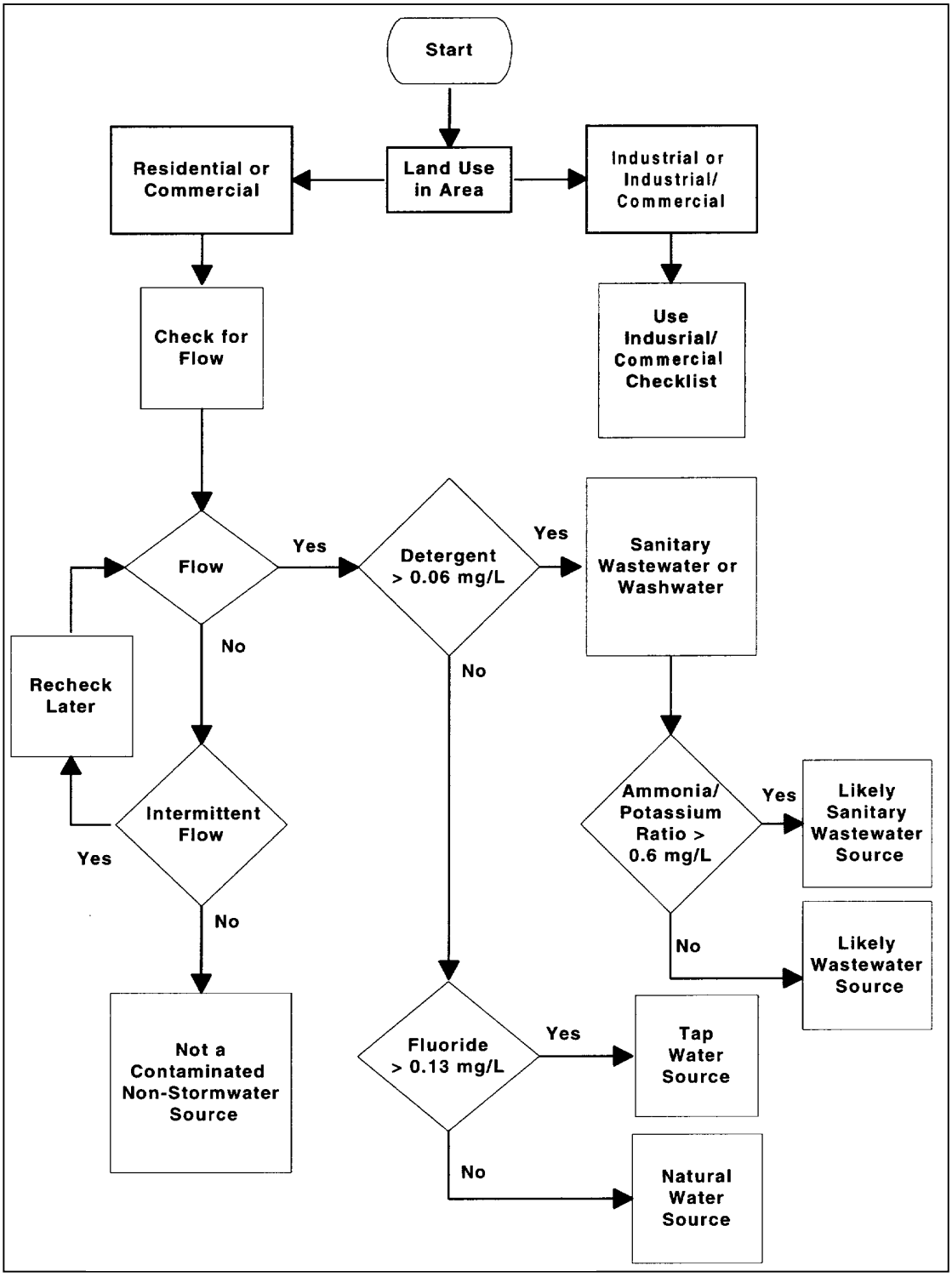


Figure H.1 Complete Flow Chart (Including Additional Confirmatory Parameters) from Tuscaloosa, Alabama

Source: Pitt (2004)

Figure H.2 Original Flow Chart Derived from Data in Birmingham
(Pitt and Lalor, 1993)



References

Pitt, R. 2004. *Methods for Detection of Inappropriate Discharge to Storm Drain Systems.* IDDE Project Support Material.

Pitt, R. and M. Lalor. 1993. *A User's Guide for the Assessment of Non-Stormwater Dischargers Into Separate Storm Drainage Systems.* EPA/600-R-92-238. Risk Reduction Engineering Laboratory, USEPA. Cincinnati, OH.

APPENDIX I

USER'S GUIDE FOR THE CHEMICAL MASS BALANCE MODEL VERSION 1.0

(Adapted from Karri, 2004)

Overview of the Model

The Chemical Mass Balance Model (CMBM) estimates the most likely source components that contribute to outfall flows during dry weather. In order to use the model, the user must have a Library File in the form of an Excel file in a specified format. This library file describes the concentration characteristics of potential local contributing flows. In the CMBM, the user selects the sources to be evaluated for an outfall, enters the values of the concentrations of the tracers measured at the outfall, and obtains a plot of the most likely source component in tabular form, and in probability plots.

Installation of the Model

The user must first install the model by inserting the disk and then clicking the 'CMBM_setup.exe' icon and following the on-screen instructions.

Model Inputs

The user enters the following data:

1. The potential sources to be evaluated for a particular outfall. The number of sources is entered in the first form (Figure I.1) and the user must then select the same number of sources and tracers when the lists of the sources and tracers are loaded.
2. The source library file containing source flow characteristics (median, COV, and distribution type) for the Monte Carlo statistical simulations (Figure I.2).
3. The tracer parameters for these sources and outfall contained in the library file. The user selects the specific tracers to be used from the check boxes when they are loaded in the first form.
4. The number of Monte Carlo simulations that are to be used by the model, up to 10,000 runs.
5. The observed outfall concentrations of the selected tracer parameters measured for a particular outfall (in the second form of the model). Press the continue button when these concentrations are entered.

In the first form

- Navigation from one step to another can be done by using either the mouse or the 'tab' button.
- Changing the value entered for 'Number of contributing sources to be evaluated' after entering subsequent steps will likely result in an error message. If the user wishes to change this value after starting on later forms, the user must use the 'Start over again' button (third form) and re-enter the earlier forms.
- The model can run up to eight sources and tracers in a single trial.

In the third form

- The user must first save the output file to run the Monte Carlo simulation.
- The user must first save the graph to view or print it.
- The user must first save the table to print it.
- If the table cannot be viewed properly, it can be resized.

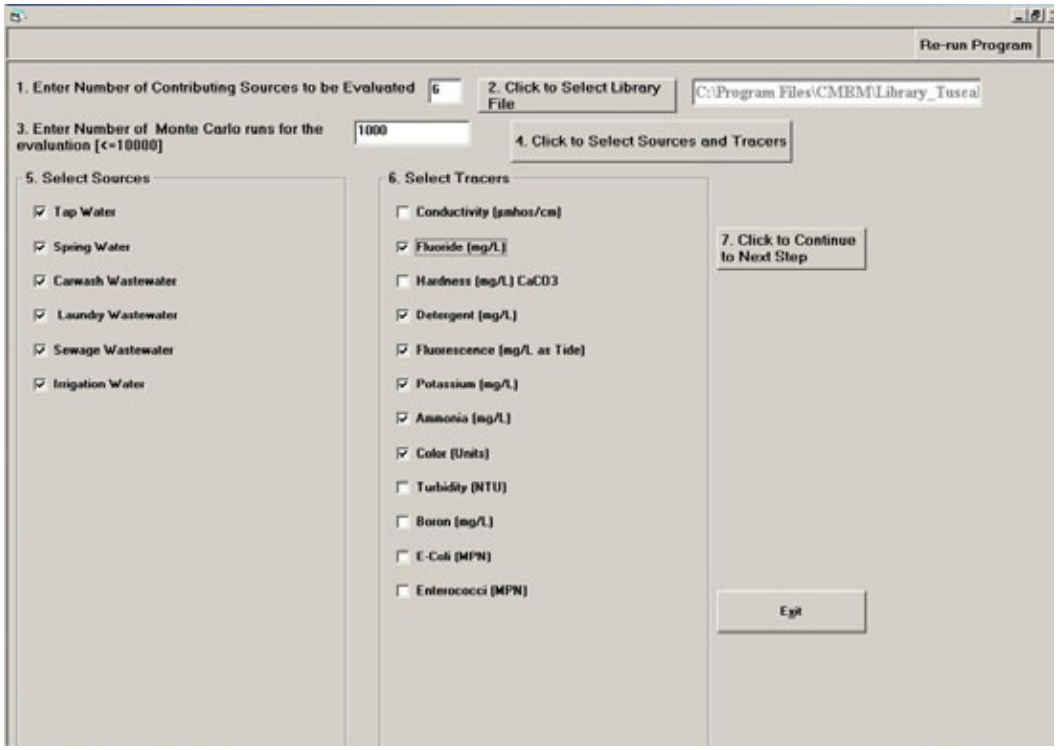


Figure I.1: Form-1 (Model inputs)

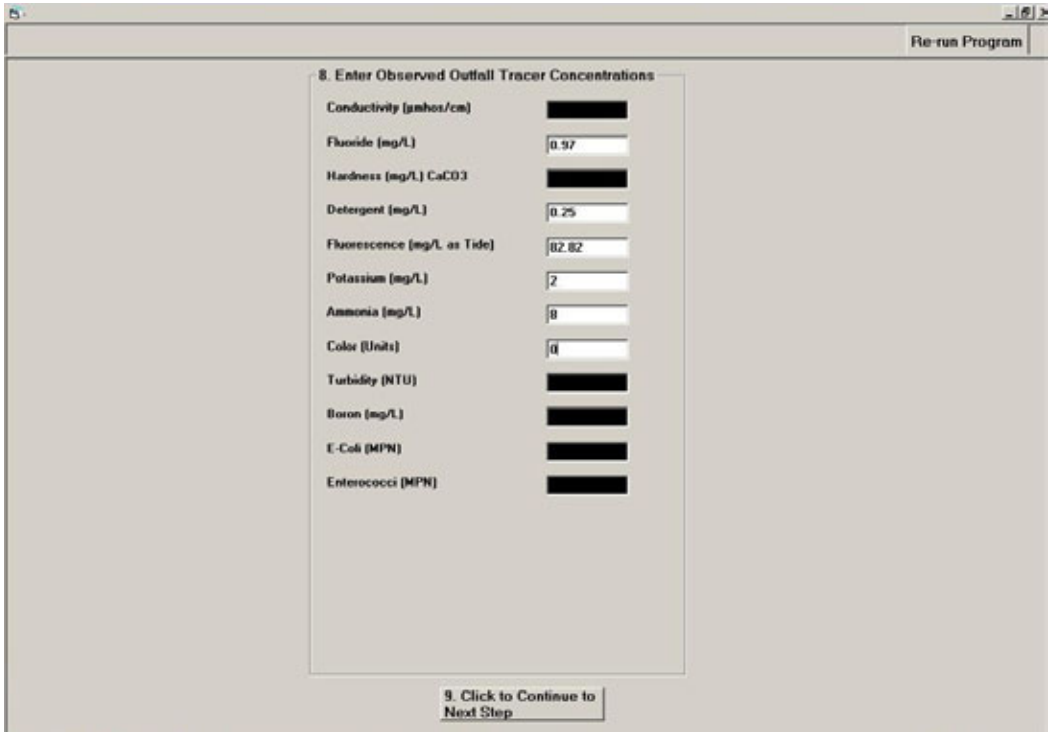


Figure I.2: Form-2 (Model inputs)

Model Outputs

The output of the model is in two forms:

- *A summary table lists the 95th percentile confidence interval (the 2.5th and the 97.5th percentile values) and the 50th percentile (median) values of the mass fraction for each source contributing to the outfall dry weather flow, as calculated by the CMBM and using the number of Monte Carlo simulations specified. This table also shows these values for an error term, μ (Mu):* This table can be saved and printed by selecting the options in the third form. In order to print the table (a small Excel spreadsheet), it must first be saved on the computer.

- *A probability plot of the calculated mass fractions for each selected source flow and also for the error term, μ (Mu)*: This plot (see Figure I.3) can be saved and printed by selecting the options in the third form. In order to print each figure, they must first be selected and saved on the computer.

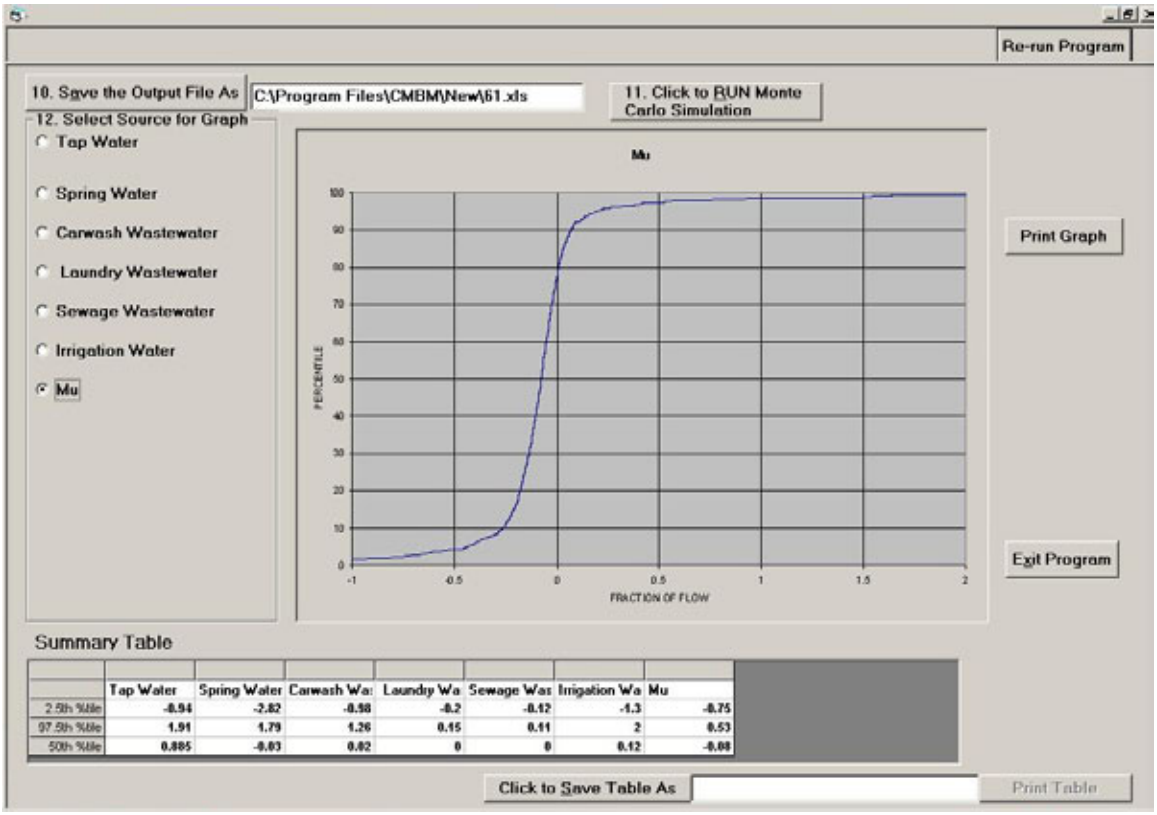


Figure I.3: Form-3 (Model output)

Library File Format

This model recognizes the source file for evaluation, only when it is in a specific format in an Excel spreadsheet.

- The data for each source is entered in an Excel file, with a separate worksheet being used for each individual source. Worksheets should be named according to the source (e.g., tap water, spring water, sewage, etc.)
- The first column of the Excel data sheet must contain the names of the tracers, starting with the second row, the second column must contain values of mean concentration, the third column, the coefficient of variation, and the fourth column the type of distribution. "N" is for "normal", or Gaussian, distributions, while "L" if for log-normal distributions. Figure I.4 is an example spreadsheet file for source area library flows.

Tracer	Mean Concentration	COV	Distribution
Conductivity (µmhos/cm)	274.67	0.46	N
Fluoride (mg/L)	1.23	1.57	L
Hardness (mg/L) $CaCO_3$	71.17	0.27	N
Detergent (mg/L)	140.91	0.21	N
Fluorescence (mg/L as Tide)	90.98	0.47	N
Potassium (mg/L)	3.58	0.67	L
Ammonia (mg/L)	0.90	1.42	L
Color (Units)	100.00	0.01	N
Turbidity (NTU)	156.81	0.78	N
Boron (mg/L)	0.65	0.74	L
E-Coli (MPN)	100.00	0.00	L
Enterococci (MPN)	10.00	0.00	L

Figure I.4: Excel Sheet in Library File

Example Problems

Example 1
This first example illustrates a verification procedure that is used to ensure the model is functioning as expected. It assumes the analysis of an undiluted flow.

Consider an outfall, which has the same data for the tracer parameters as were observed at the sewage treatment plant (which is the same as the library data for sewage wastewater). This means that the model must predict the most likely source component to be sewage and with a predicted fraction of flow for sewage close to one.

The library file used here is the Birmingham library file 'Library_BHM.xls' (which is included with the program). Let the number of Monte Carlo simulations considered be 1000, and the number of sources selected for evaluation be 4 (sewage wastewater, tap water, spring water, and landscape irrigation runoff). The tracers selected are conductivity, fluoride, potassium and ammonia. Figure I.5 shows these corresponding entries, while Figure I.6 shows the Excel spreadsheet for the library file used.

Figure I.7 shows the entries made in the second form. It should be noted that the values for the tracers entered are the same as those in the library file for sewage.

Figure I.8 shows the output form. The 50th percentile value for Sewage Wastewater flow in the summary table is 1.06, while the 95 percent confidence interval is 0.54 to 2.2. This table shows that the most likely source at the outfall is Sewage Wastewater, which is the same as the initial assumption. Also, the fraction of flow that is sewage is 1.06, very close to 1.0. Also, the sum of all 50th percentile flow contributions is 0.98, also very close to 1.0, indicating good agreement. The potential mass contributions for the other source flows are also close to zero.

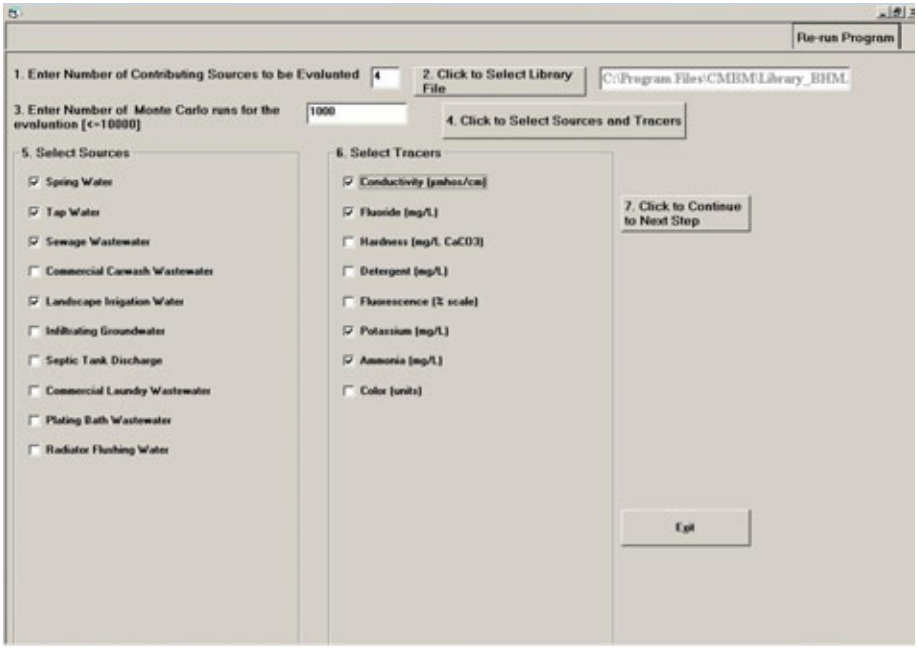


Figure I.5: Form 1 (Input for Example 1)

Tracer	Median Concentration	COV	Distribution
Conductivity (µmhos/cm)	419.86	0.13	N
Fluoride (mg/L)	0.76	0.23	N
Hardness (mg/L $CaCO_{3)}$	142.92	0.11	N
Detergent (mg/L)	1.5	0.82	N
Fluorescence (mg/L)	250.89	0.2	N
Potassium (mg/L)	5.97	0.23	N
Ammonia (mg/L)	9.92	0.34	L
Color (mg/L)	37.89	0.55	N

Figure I.6: Library File Excel Sheet (Sewage Wastewater)

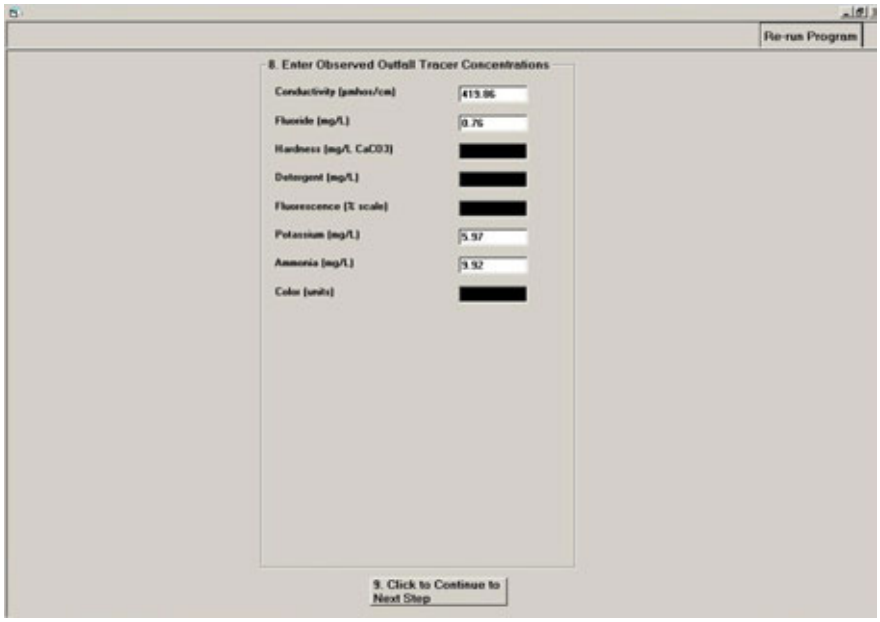


Figure I.7: Form 2 (Input)

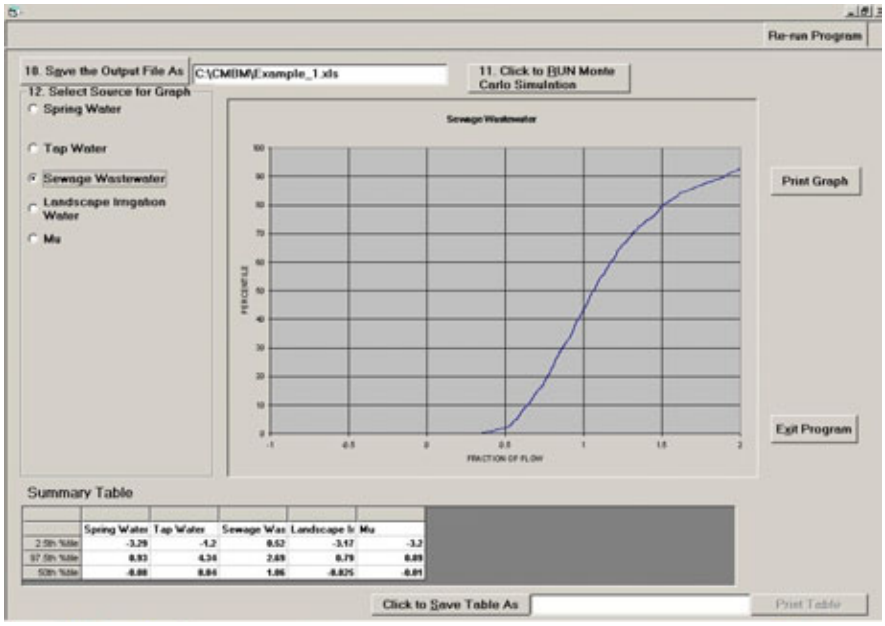


Figure I.8: Form 3 (Output for Example 1)

Example 2
In this example, eight possible source types and eight tracer parameters are selected, based on sample data from outfall # 20 in Birmingham, AL, collected on March 3, 1993.

The library file used in this example is also the Birmingham library file: 'Library_BHM.xls'. Let the number of Monte Carlo simulations be 1000, the number of sources selected for evaluation be 7 (spring water, tap water, sewage wastewater, commercial carwash wastewater, landscape irrigation water, infiltrating groundwater, and septic tank discharge. The seven tracers selected are conductivity, fluoride, hardness, detergents, fluorescence, potassium, and ammonia.

Figure I.9 shows all the corresponding entries using this information. Figure I.10 shows the entries made in the second form. Figure I.11 shows the output form. The fraction of flow as indicated for the 50th percentile value for tap water on the summary table is the highest value (0.72) compared to the other potential source flows. This indicates that the most likely source at the outfall is tap water, as verified through field observations. The spring water mass fraction is also relatively high (0.42), indicating that this source water may also be present.

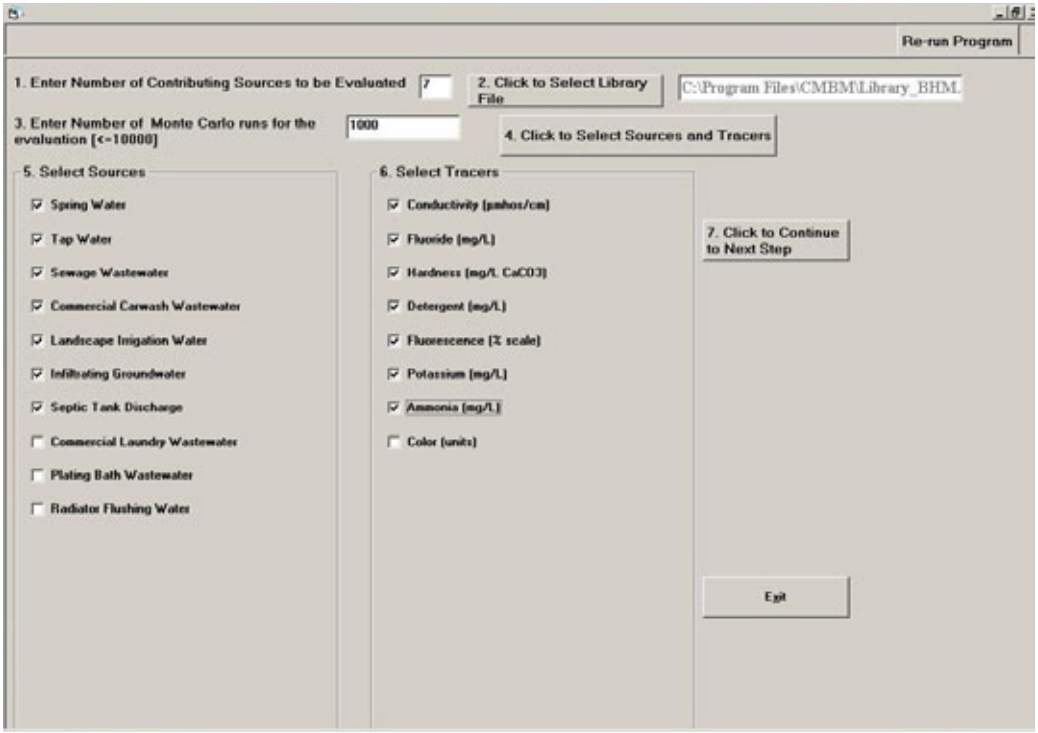


Figure I.9: Form 1 (Input for Example 2)

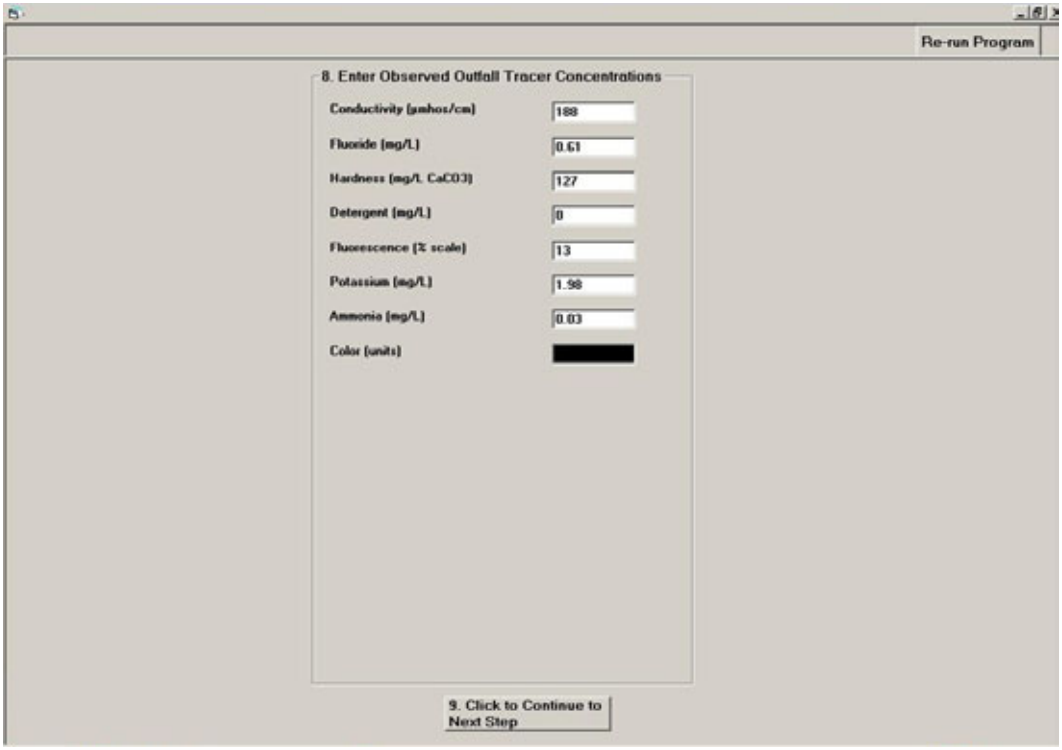


Figure I.10: Form 2 (Input for Example 2)

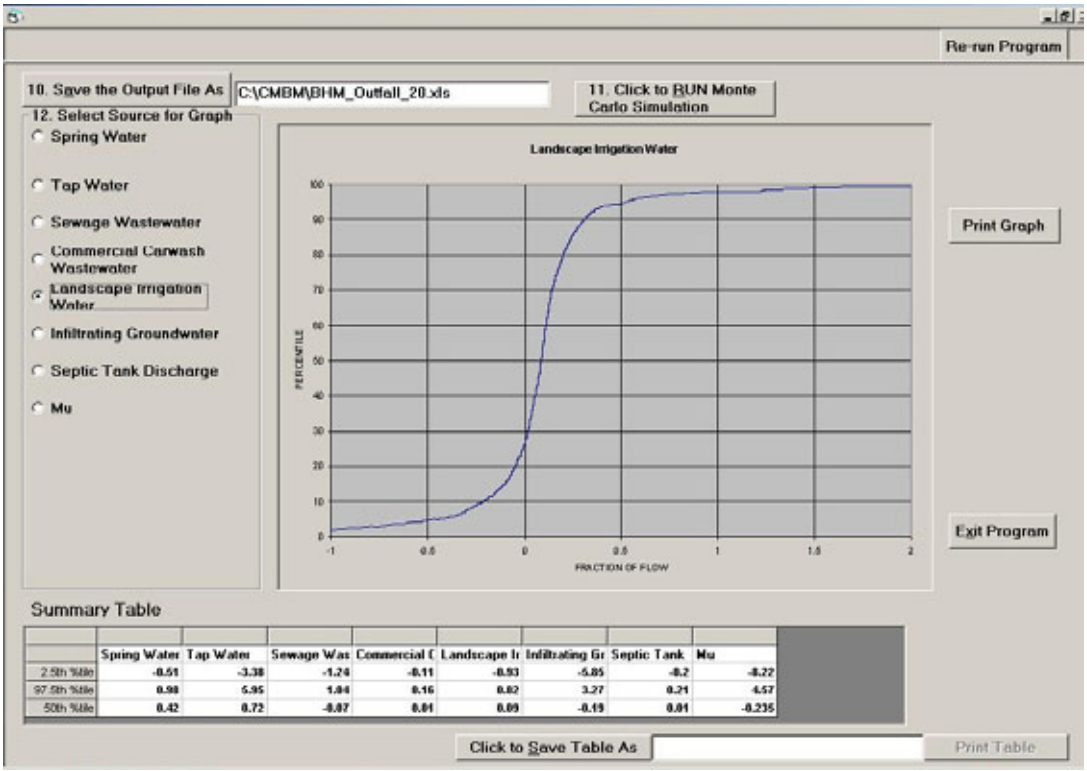


Figure I.11: Form 3 (Output for Example 2)

APPENDIX J

USING THE CHEMICAL LIBRARY TO DETERMINE THE UTILITY OF BORON AS AN INDICATOR OF ILLICIT DISCHARGES

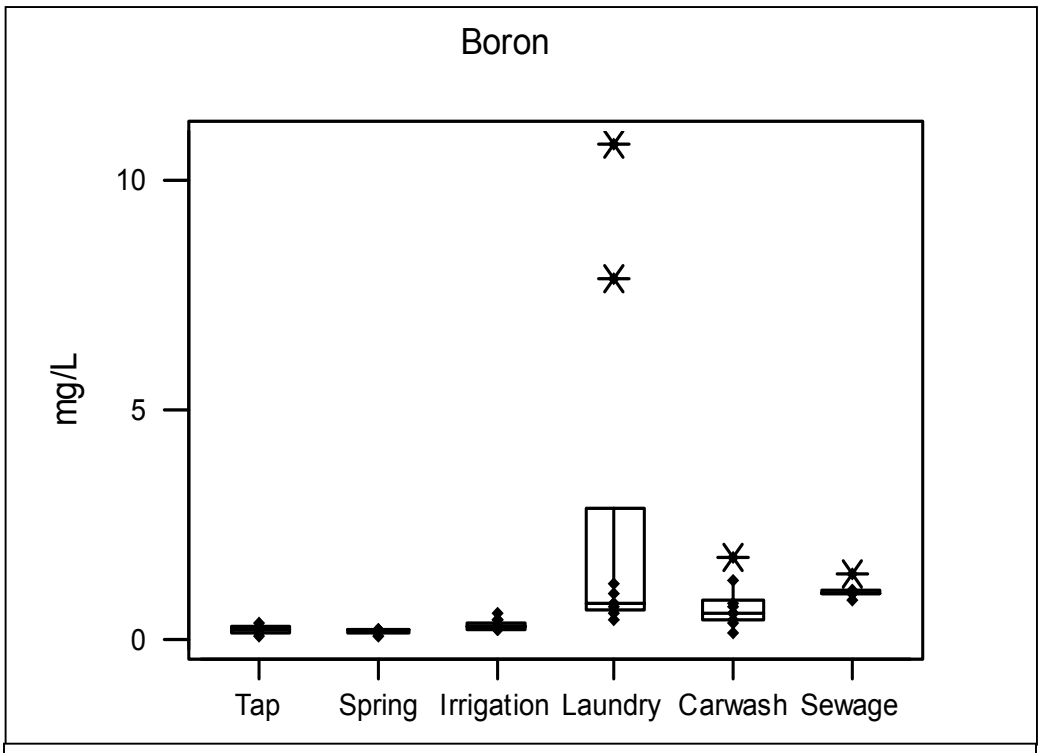
Introduction

In this example, library data from several flow types are analyzed to determine a good cut-off point to use boron as an indicator of illicit discharges. Both the data and the selected concentrations are derived from research in Tuscaloosa, Alabama (Pitt, 2004). Investigators examined the data from their chemical flow library both graphically and then in detail to select a concentration.

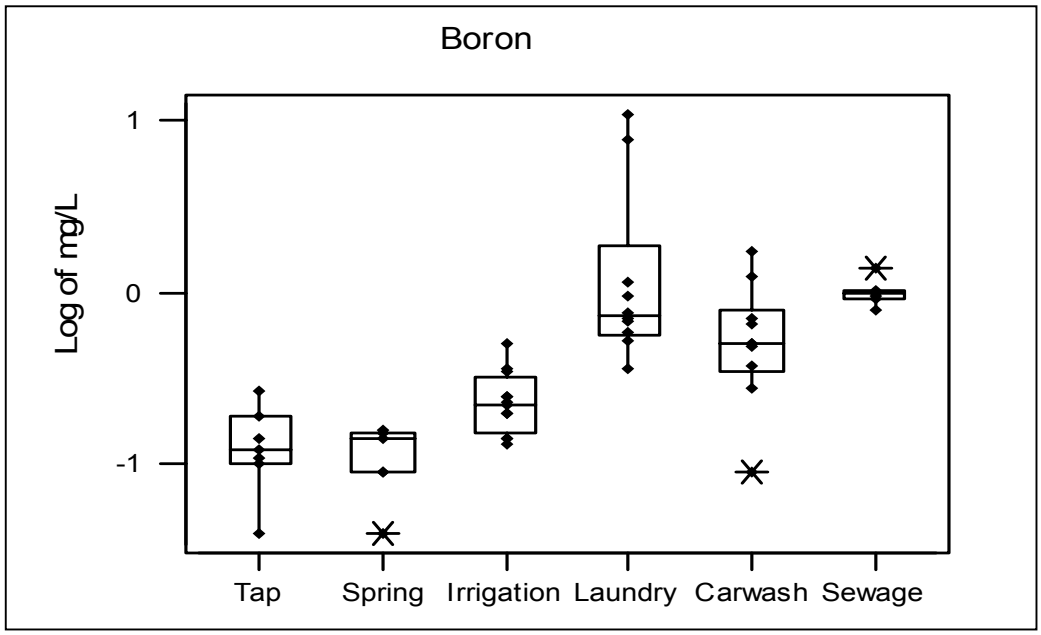
Step 1: Visually Analyze Data Using Box Plots

After collecting data from a select group of flow types, researchers assembled the data into box plots (see Plots 1 and 2). These plots help quickly identify the range of data. The "box" portion of the plot shows the first quartile, median, and third quartile for the data, and the individual data points show the data above and below this range.

A first look at the data shows that sewage, laundry, and wash water sources all have a higher concentration than the non-illicit flows: irrigation, tap water, and spring water. A closer look, using the log plot (i.e., the log of each concentration), shows some overlap between irrigation water and two of the illicit flow types: laundry and car wash. Although this overlap means that there will be some "false negatives" or "false positives" using this parameter, investigators select a concentration that is lower than the lowest concentration in laundry. This value appears to be somewhere between $10^{-0.5}$ (or 0.3 mg/L) and 10^{0} (or 1.0 mg/L).



Plot 1: Boron Concentration
(Source: Pitt, 2004)



Plot 2: Boron Concentration in Log Space
(Source: Pitt, 2004)

Step 2: Evaluate Tabular Data

The first step is a good general indicator of how to use boron as an indicator. The second step refines the initial evaluation to come up with a specific value to use as an indicator, and a numeric estimate of the number of "false positives" (i.e., identifying a non-illicit flow as illicit) and "false negatives" (i.e., identifying an illicit flow as non-illicit) that would result from using the parameter. (See Table below for the data used in this investigation).

Using data from the three sources with overlap, investigators select a concentration of >0.35 mg/L as an indicator of sewage or wash water. (This value captures all laundry flows). Using this value, two of 12 irrigation samples are identified as illicit (a 17% false positive rate) and two of 10 car wash samples are not captured as an illicit discharge (a 20% false negative rate).

Boron Concentration (mg/L) For Six Flow Types (Concentrations >0.35 mg/L indicate illicit discharges)					
Tap Water	**Spring Water**	**Irrigation**	**Laundry**	**Car Wash**	**Sewage**
0.04	0.04	0.13	0.36	0.09	0.78
0.1	0.09	0.14	0.53	0.28	0.93
0.11	0.09	0.14	0.58	0.37	0.97
0.12	0.14	0.2	0.67	0.48	0.98
0.14	0.15	0.2	0.7	0.5	1.01
0.19	0.15	0.22	0.75	0.5	1.05
0.27	0.16	0.23	0.97	0.65	1.38
		0.25	1.16	0.7	
		0.25	7.9	1.23	
		0.35	10.8	1.74	
		0.36			
		0.5			

Yellow shading indicates a false positive.

Pink shading indicates a false negative.

Source: Pitt (2004)

Step 3: Make a Determination

Based on these data, boron shows high promise as an indicator of illicit discharges. It correctly categorizes all flows from tap water, spring water, laundry and sewage, and has fairly low false positive or negative rates for identifying irrigation and car wash discharges. One potential concern, however, is that dilution occurring at the outfall may mask some illicit discharges. For example, a 50% dilution with spring water (using the median concentration of 0.14 mg/L) would result in a 20% false negative rate for laundry waters and a 60% false negative for car wash waters.

VERDICT: GOOD CANDIDATE FOR FLOW CHART METHOD. NEEDS FIELD TESTING!

References

Pitt, R. 2004. *Methods for Detection of Inappropriate Discharge to Storm Drain Systems.* IDDE Project Support Material.

APPENDIX K

SPECIFIC CONSIDERATIONS FOR INDUSTRIAL SOURCES OF INAPPROPRIATE POLLUTANT ENTRIES TO THE STORM DRAINAGE SYSTEM

(Adapted from Pitt, 2001)

Industrial Site Surveys

Additional pollutants associated with local commercial and industrial activities need to be monitored during outfall screening activities if these activities exist in the watersheds of interest. This monitoring will assist in identifying the classes of commercial or industrial activities responsible for the contamination. The first step in this process is to identify which industrial and commercial activities may contribute non-storm water discharges to the drainage system. The review of industrial user surveys or reports that are available needs to be done initially. It may be necessary to also send a questionnaire to industries in the watershed that are draining to the storm drainage system to identify the specific activities that may affect runoff quality and dry weather discharges. Site inspections will still be required because questionnaires may not be returned or may give incorrect details (either deliberately or unknowingly).

Industrial areas are known to contribute excessive wet-weather storm water discharges, along with contaminated dry weather entries into the storm drainage system. Therefore, additional industrial site investigations are needed to identify activities that most obviously contribute these contaminants to the storm drainage system. Figure K.1 is an example industrial site survey form prepared by the Non-Point Source and Land Management Section of the Wisconsin Department of Natural Resources (Bannerman, 2003). This form has been used to help identify industrial activities that contribute dry- and wet-weather non-storm water entries into the storm drainage system.

This form only considers outside sources that would affect the storm drainage system by entering through inlets or through sheetflow runoff into drainage channels. This sheet does not include any information concerning indoor activities, or direct plumbing connections to the storm drainage system. However, the information included on this sheet can be very helpful in devising runoff control programs for industrial areas. This information most likely affects wet-weather discharges much more than dry weather discharges. Obvious dry weather leaching or spillage problems are also noted on the form.

Table K.1 presents the types of activities in industrial areas that may contribute dry weather discharges to storm drainage systems. This table can be used to rank the most likely industries that may produce non-storm water discharges to a storm drainage system in an area. This table is used in conjunction with the industrial site survey form to catalog specific activities in the watershed that may need correction. After a listing of the candidate activities is known in the watersheds, additional tracer parameters may then be selected to add to the screening efforts.

Likely Dry Weather Discharge Characteristics for Different Industries

Chemical and Physical Properties
Table K.1 summarizes possible chemical and physical characteristics of non-storm water discharges, which could come from various industries. The properties considered are pH, total dissolved solids, odor, color, clarity, floatable materials, vegetation, and structural damage potential. The descriptions in each of these categories contain the most likely conditions for a non-storm water discharge coming from a

particular industry. It should be noted that a combination of just a few of these characteristics, or perhaps all of them, might occur at an outfall affected by a potential source. In addition, outfalls are likely to be affected by several sources simultaneously, further confusing the situation. Again, a complete watershed analysis describing the industrial and commercial facilities operating in each outfall watershed will be of great assistance in identifying which industries may be contributing harmful dry weather discharges to the storm system.

City: _____ Industry Name: _____
Site Number: _____ Photo # _____
Street Address: _____ Roll# _____
Type of industry: _____
Instructions: Fill in blanks or circle best answer in following (use back of sheet if necessary):

Material/waste Storage Areas

1. Type of material/waste: _____
2. Method of storage: pile tank dumpster other: _____
3. Area occupied by material/waste (acres): _____
4. Type of surface under material/waste: paved unpaved
5. Material/waste is disturbed: often sometimes never unsure
6. Description of spills (material, quantity & frequency): _____
7. Nearest drainage (feet) and drainage type: _____
8. Control practice: berm tarp buffer none other: _____
9. Tributary drainage area, including roofs (acres): _____
10. Does storage area drain to parking lot: yes no unsure

Heavy equipment storage

1. Type of equipment: _____
2. Area covered by equipment (acres): _____
3. Type of surface under equipment: paved unpaved
4. Nearest drainage (feet) and drainage type: _____
5. Control practice: berm tarp buffer none other: _____
6. Tributary drainage area, including roofs (acres): _____
7. Does storage area drain to parking lot: yes no unsure

Air pollution

1. Description of settleable air pollutants (types & quantities): _____
2. Description of particulate air pollutant controls: _____

Railroad yard

1. Size of yard (number of tracks): _____
2. General condition of yard: _____
3. Description of spills in yard (material, quantity & frequency): _____
4. Type of surface in yard: paved unpaved
5. Nearest drainage (feet) and drainage type: _____
6. Type of control practice: berm buffer other: _____
7. Does yard drain to parking lot: yes no unsure
8. Tributary drainage area, including roofs (acres): _____

Loading Docks

1. Number of truck bays: _____
2. Type of surface: paved unpaved
3. Description of spills in yard (material, quantity & frequency): _____
4. Nearest drainage (feet) and drainage type: _____
5. Type of control practice: berm buffer other: _____
6. Does loading area drain to parking lot: yes no unsure
7. Tributary drainage area, including roofs (acres): _____

Figure K.1: Industrial Inventory Field Sheet
Source: (Source: Bannerman, 2003)

Table K.1: Chemical and Physical Properties of Industrial Non-Storm Water Discharges									
Industrial Categories Major Classifications SIC Group Numbers	**Odor**	**Color**	**Turbidity**	**Floatables**	**Debris and Stains**	**Structural Damage**	**Vegetation**	**pH**	**Total Dissolved Solids**
Primary Industries									
20: Food and Kindred Products									
201 Meat Products	Spoiled Meats, Rotten Eggs and Flesh	Brown to Reddish-Brown	High	Animal Fats, Byproducts, Pieces of Processed Meats	Brown to Black	High	Flourish	Normal	High
202 Dairy Products	Spoiled Milk, Rancid Butter	Gray to White	High	Animal Fats, Spoiled Milk Products	Gray to Light Brown	High	Flourish	Acidic	High
203 Canned and Preserved Fruits and Vegetables	Decaying Products Compost Pile	Various	High	Vegetable Waxes, Seeds, Skins, Cores, Leaves	Brown	Low	Normal	Wide Range	High
204 Grain Mill Products	Slightly Sweet & Musty, Grainy	Brown to Reddish Brown	High	Grain Hulls and Skins, Straw & Plant Fragments	Light Brown	Low	Normal	Normal	High
205 Bakery Products	Sweet and or Spoiled	Brown to Black	High	Cooking Oils, Lard, Flour, Sugar	Gray to Light Brown	Low	Normal	Normal	High
206 Sugar and Confectionary Products	NA	NA	Low	Low Potential	White Crystals	Low	Normal	Normal	High
207 Fats and Oils	Spoiled Meats, Lard or Grease	Brown to Black	High	Animal Fats, Lard	Gray to Light Brown	Low	Normal	Normal	High
208 Beverages	Flat Soda, Beer or Wine, Alcohol, Yeast	Various	Mod.	Grains, Hops, Broken Glass, Discarded Canning Items	Light Brown	High	Inhibited	Wide Range	High
21: Tobacco Manufactures	Dried Tobacco, Cigars, Cigarettes	Brown to Black	Low	Tobacco Stems & Leaves, Papers and Fillers	Brown	Low	Normal	Normal	Low
22: Textile Mill Products	Wet Burlap, Bleach, Soap, Detergents	Various	High	Fibers, Oils, Grease	Gray to Black	Low	Inhibited	Basic	High
23: Apparel and Other Finished Products	NA	Various	Low	Some Fabric Particles	NA	Low	Normal	Normal	Low
Material Manufacture									
24: Lumber & Wood Products	NA	NA	Low	Some Sawdust	Light Brown	Low	Normal	Normal	Low
25: Furniture & Fixtures	Various	Various	Low	Some Sawdust, Solvents	Light Brown	Low	Normal	Normal	Low
26: Paper & Allied Products	Bleach, Various Chemicals	Various	Mod.	Sawdust, Pulp Paper, Waxes, Oils	Light Brown	Low	Normal	Wide Range	Low
27: Printing, Publishing, and Allied Industries	Ink, Solvents	Brown to Black	Mod.	Paper Dust, Solvents	Gray to Light Brown	Low	Inhibited	Normal	High
31: Leather & Leather Products	Leather, Bleach, Rotten Eggs or Flesh	Various	High	Animal Flesh & Hair, Oils, Grease	Gray to Black, Salt Crystals	High	Highly Inhibited	Wide Range	High
33: Primary Metal Industries	Various	Brown to Black	Mod.	Ore, Coke, Limestone, Millscale, Oils	Gray to Black	High	Inhibited	Acidic	High

Table K.1: Chemical and Physical Properties of Industrial Non-Storm Water Discharges									
Industrial Categories Major Classifications SIC Group Numbers	**Odor**	**Color**	**Turbidity**	**Floatables**	**Debris and Stains**	**Structural Damage**	**Vegetation**	**pH**	**Total Dissolved Solids**
34: Fabricated Metal Products	Detergents, Rotten Eggs	Brown to Black	High	Dirt, Grease, Oils, Sand, Clay Dust	Gray to Black	Low	Inhibited	Wide Range	High
32: Stone, Clay, Glass, and Concrete Products	Wet Clay, Mud, Detergents	Brown to Reddish-Brown	Mod.	Glass Particles Dust from Clay or Stone	Gray to Light Brown	Low	Normal	Basic	Low
Chemical Manufacture									
28: Chemicals & Allied Products									
2812 Alkalies and Chlorine	Strong Halogen or Chlorine, Pungent, Burning	Alkalies – NA; Chlorine - Yellow to Green	Low	NA	Alkalies – White Carbonate Scale Chlorine - NA	High	Highly Inhibited	Basic	High
2816 Inorganic Pigments	NA	Various	High	Low Potential	Various	Low	Highly Inhibited	Wide Range	High
282 Plastic Materials and Synthetics	Pungent, Fishy	Various	High	Plastic Fragments, Pieces of Synthetic Products	Various	Low	Inhibited	Wide Range	High
283 Drugs	NA	Various	High	Gelatin Byproducts for Capsulating Drugs	Various	Low	Highly Inhibited	Normal	High
284 Soap, Detergents & Cleaning Preparations	Sweet or Flowery	Various	High	Oils, Grease	Gray to Black	Low	Inhibited	Basic	High
285 Paints, Varnishes, Lacquers, Enamels and Allied Products (SB - Solvent Base)	Latex - Ammonia SB - Dependent Upon Solvent (Paint Thinner, Mineral Spirits)	Various	High	Latex - NA SB - All Solvents	Gray to Black	Low	Inhibited	Latex-Basic SB - Normal	High
286 Indust. Organic Chemicals									
2861 Gum and Wood Chemicals	Pine Spirits	Brown to Black	High	Rosins and Pine Tars	Gray to Black	Low	Inhibited	Acidic	High
2865 Cyclic Crudes, & Cyclic Intermediates Dyes, & Organic Pigments	Sweet Organic Smell	NA	Low	Translucent Sheen	NA	Low	Highly Inhibited	Normal	Low
287 Agricultural Chemicals									
2873 Nitrogenous Fertilizers	NA	NA	Low	NA	White Crystalline Powder	High	Inhibited	Acidic	High
2874 Phosphatic Fertilizers	Pungent Sweet	Milky White	High	NA	White Emorphous Powder	High	Inhibited	Acidic	High
2875 Fertilizers, Mixing Only	Various	Brown to Black	High	Pelletized Fertilizers	Brown Emorphous Powder	Low	Normal	Normal	High
29: Petroleum Refining and Related Industries									
291 Petroleum Refining	Rotten Eggs, Kerosene, Gasoline	Brown to Black	High	Any Crude or Processed Fuel	Black Salt Crystals	Low	Inhibited	Wide Range	High

Table K.1: Chemical and Physical Properties of Industrial Non-Storm Water Discharges									
Industrial Categories Major Classifications SIC Group Numbers	**Odor**	**Color**	**Turbidity**	**Floatables**	**Debris and Stains**	**Structural Damage**	**Vegetation**	**pH**	**Total Dissolved Solids**
30 Rubber & Miscellaneous Plastic Products	Rotten Eggs, Chlorine, Peroxide	Brown to Black	Mod.	Shredded Rubber Pieces of Fabric or Metal	Gray to Black	Low	Inhibited	Wide Range	High
Transportation & Construction									
15 Building Construction	Various	Brown to Black	High	Oils, Grease, Fuels	Gray to Black	Low	Normal	Normal	High
16 Heavy Construction	Various	Brown to Black	High	Oils, Grease, Fuels, Diluted Asphalt or Cement	Gray to Black	Low	Normal	Normal	High
Retail									
52 Building Materials, Hardware, Garden Supply, and Mobil Home Dealers	NA	Brown to Black	Low	Some Seeds, Plant Parts, Dirt, Sawdust, or Oil	Light Brown	Low	Normal	Normal	Low
53 Gen. Merchandise Stores	NA	NA	NA	NA	NA	Low	Normal	Normal	Low
54 Food Stores	Spoiled Produce, Rancid, Sour	Various	Low	Fragments of Food, Decaying Produce	Light Brown	Low	Flourish	Normal	Low
55 Automotive Dealers & Gasoline Service Stations	Oil or Gasoline	Brown to Black	Mod.	Oil or Gasoline	Brown	Low	Inhibited	Normal	Low
56 Apparel & Accessory Stores	NA	NA	Low	NA	NA	Low	Normal	Normal	Low
57 Home Furniture, Furnishings, & Equip. Stores	NA	NA	Low	NA	NA	Low	Normal	Normal	Low
58 Eating & Drinking Places	Spoiled Foods Oil & Grease	Brown to Black	Low	Spoiled or Leftover Foods	Brown	Low	Normal	Normal	Low
Coal Steam Electric Power	NA	Brown to Black	High	Coal Dust	Black Emorphous Powder	Low	Normal	Slightly Acidic	Low
Nuclear Steam Electric Power	NA	Light Brown	Low	Oils, Lubricants	Light Brown	Low	Normal	Normal	Low

Other Chemicals Indicative of Manufacturing Industrial Activities
Table K.2 lists the various chemicals that may be associated with a variety of different industrial activities. It may be possible to examine non-storm water outfall flow for specific chemicals, such as shown on this list to identify which specific manufacturing industrial activities may be contributing the flows.

Example Problems for Locating an Industrial Source

Locating An Industrial Source
Hypothetical examples have been created to demonstrate how dry weather discharges can be characterized so that their likely industrial sources can be identified. These examples show how observations of outfall conditions and simple chemical analyses, combined with a basic knowledge of wastewater characteristics of industrial and commercial operations located in the drainage area can be used to identify the possible pollutant sources. The initial activities include pollutant analyses of outfalls being investigated. This requires the characterization on the non-storm water flows, the identification of the likely industries responsible for the observed discharges, and finally, locating the possible specific sources in the watershed.

The industries identified in a hypothetical storm water drainage area (from the watershed analysis) included a vegetable cannery, general food store, fast food restaurant, cheese factory, used car dealer, cardboard box producer, and a wood treatment company. The methods used to determine the most likely industrial source of the dry weather discharges are considered for three hypothetical situations of outfall contamination.

Case Example 1
The hypothetical results of the pollutant analysis for the first situation found constant dry weather flow at the outfall. The measurements indicated a normal pH (6) and low total dissolved solids concentrations (300 mg/L). Other outfall characteristics included a strong odor of bleach, no distinguishing color, moderate turbidity, sawdust floatables, a small amount of structural corrosion, and normal vegetation.

The significant characteristic in this situation is the sawdust floatables (see Figure K.2). The industries that could produce sawdust and have dry weather flow drainage to this pipe are the cardboard box company and the wood treatment company. According to their SIC codes, these companies would fall under the category of "Paper and Wood Products." Looking up these two industries by their corresponding SIC group numbers in Table K.1 and comparing the listed properties indicates that the paper industry has a strong potential for the odor of bleach. Wood products does not indicate any particular smell.

Based upon these data, the most likely industrial source of the non-storm water discharge would be the cardboard box company. Table A.1 (Appendix A) indicates a high potential for direct connections at paper and wood product facilities. At this point, further testing should be conducted at the cardboard box company to determine if the constant source of contamination is coming from cooling waters, process waters, or direct piping connections (process waters are the most likely source, given the bleach and sawdust characteristics).

Table K.2: Significant Chemicals in Industrial Wastewaters	
Chemical	**Industry**
Acetic acid	Acetate rayon, pickle and beetroot manufacture
Alkalies	Cotton and straw kiering, cotton manufacture, mercerizing, wool scouring, laundries
Ammonia	Gas and coke manufacture, chemical manufacture
Arsenic	Sheep-dipping, fell mongering
Chlorine	Laundries, paper mills, textile bleaching
Chromium	Plating, chrome tanning, aluminum anodizing
Cadmium	Plating
Citric acid	Soft drinks and citrus fruit processing
Copper	Plating, pickling, rayon manufacture
Cyanides	Plating, metal cleaning, case-hardening, gas manufacture
Fats, oils	Wool scouring, laundries, textiles, oil refineries
Fluorides	Gas and coke manufacture, chemical manufacture, fertilizer plants, transistor manufacture, metal refining, ceramic plants, glass etching
Formalin	Manufacture of synthetic resins and penicillin
Hydrocarbons	Petrochemical and rubber factories
Hydrogen peroxide	Textile bleaching, rocket motor testing
Lead	Battery manufacture, lead mining, paint manufacture, gasoline, manufacture
Mercaptans	Oil refining, pulp mills
Mineral acids	Chemical manufacture, mines, Fe and Cu pickling, brewing, textiles, photo-engraving, battery manufacture
Nickel	Plating
Nitro compounds	Explosives and chemical works
Organic acids	Distilleries and fermentation plants
Phenols	Gas and coke manufacture; synthetic resin manufacture; textiles; tanneries; tar, chemical, and dye manufacture; sheep-dipping
Silver	Plating, photography
Starch	Food, textile, wallpaper manufacture
Sugars	Dairies, foods, sugar refining, preserves, wood process
Sulfides	Textiles, tanneries, gas manufacture, rayon manufacture
Sulfites	Wood process, viscose manufacture, bleaching
Tannic acid	Tanning, sawmills
Tartaric acid	Dyeing; wine, leather, and chemical manufacture
Zinc	Galvanizing, plating, viscose manufacture, rubber process

Source: Klein (1962). *River Pollution 2: Causes and Effects*. Butterworth & Co. presented in *The Water Encyclopedia*, D. Todd, Water Information Center, Port Washington, N.Y., 1979.

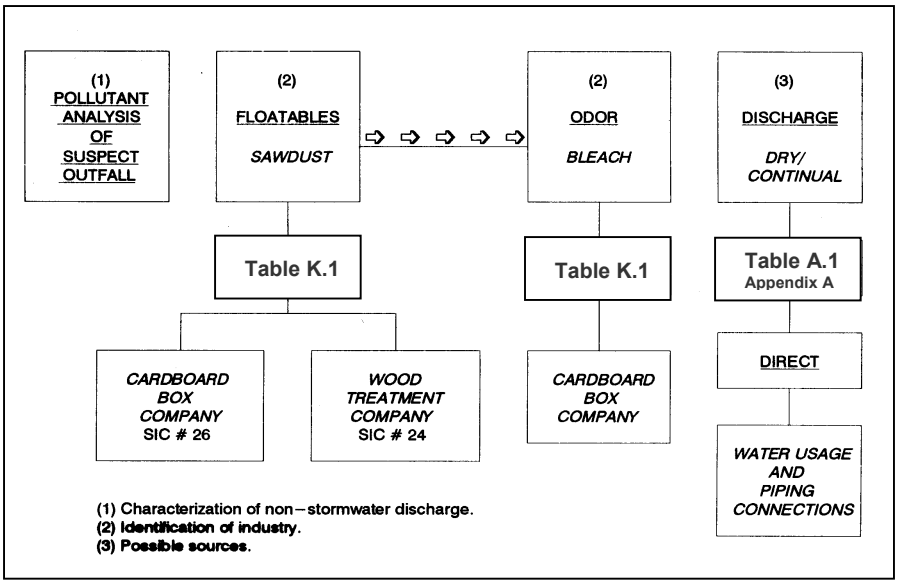


Figure K.2: Flowsheet for Case Example 1

Case Example 2

Pollutant analysis for the second situation found intermittent dry weather discharges at the outfall. The test measurements indicated an acidic pH (3) and high total dissolved solids concentrations (approximately 6,000 mg/L). Other characteristics included a rancid-sour odor, grayish color, high turbidity, gray deposits containing white gelatin-like floatable material, structural damage in the form of spalling concrete, and an unusually large amount of plant life.

The rancid-sour smell and the presence of floatable substances at this outfall indicate that some type of food product is probably spoiling. This narrows the possible suspect industries to the fast food restaurant, cheese factory, vegetable cannery, and food store (see Figure K.3). The corresponding SIC categories for each of these industries are "Eating and Drinking Places" (SIC# 58), "Dairy Products" (SIC# 202), "Canned and Preserved Fruits and Vegetables" (SIC# 203), and "Food Stores" (SIC# 54).

Comparison of the properties listed in Table K.1 for these SIC codes indicates that elevated plant life is common to industrial wastes for the "Dairy Products" and "Food Stores" categories. However, the deciding factor is the acidic pH, which is only listed for "Dairy Products". Thus, the white gelatin-like floatables are most likely spoiled cheese byproducts from the cheese factory, which are also the probable cause of the sour-rancid smell.

Since dry weather entry to the storm drainage system occurs intermittently, flow could be caused by either a direct or indirect connection. To locate the ultimate source of this discharge coming from the cheese factory, both direct and indirect industrial situations are considered under the category of "Food Processing" with SIC code of 2020 in Table A1 (see Appendix A). Thus, further examination of the loading dock procedures, water usage, and direct piping connections should be conducted since these categories all exhibit some potential for pollution in dairy production.

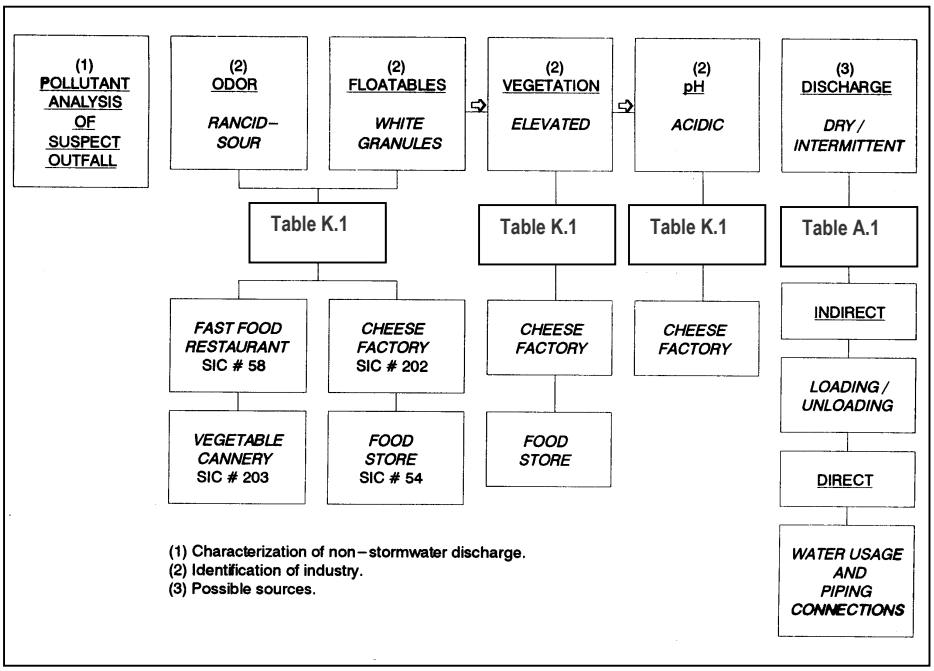


Figure K.3: Flowsheet for Case Example 2

Case Example 3

The results of the test measurements for the final situation found a normal pH (6) and low total dissolved solids (about 500 mg/L). Signs of contaminated discharges were found at the outfall only during and immediately following rainfalls. Other outfall properties observed included an odor of oil, deep brown to black color, a floating oil film, no structural damage, and inhibited plant growth (see Figure K.4).

According to Table K.1, the fast food restaurant and the used car dealer are the only two industrial sources in this hypothetical drainage area with a high potential for causing oily discharges. Their respective SIC categories are "Eating and Drinking Places" (SIC# 58) and "Automotive Dealers" (SIC# 55). Comparison of the properties shown in Table K.1 indicates inhibited vegetation only for the second category. Thus, the most likely source of the discharge is the used car dealer.

Furthermore, the source of contamination must likely be indirect, since the discharge occurs only during wet weather. Reference to Table A.1 (see Appendix A) under the category of "Car Dealers," indicates a medium potential for indirect contamination. This fact, plus the knowledge that most used cars are displayed outdoors, makes it clear that surface runoff is probably carrying spilled automotive oil into the storm drain during rains.

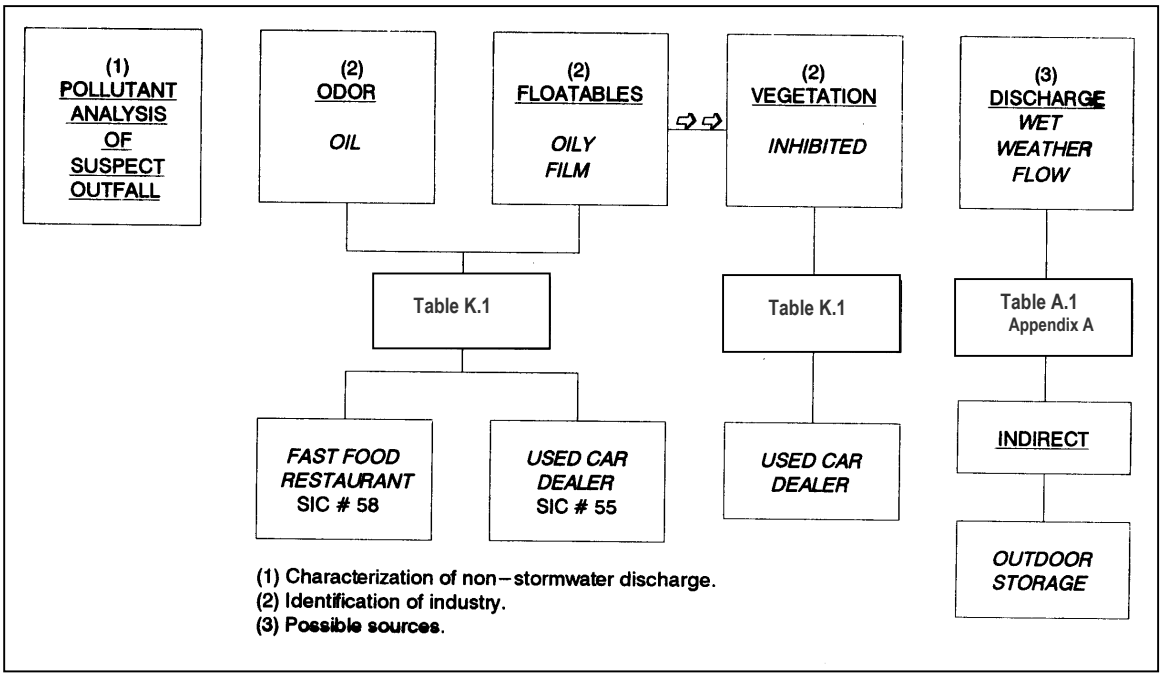


Figure K.4: Flowsheet for Case Example 3

References

Bannerman, R. 2003. Personal communication with Dr. Robert Pitt, University of Alabama.

Klein, L. 1962. "River Pollution 2: Causes and Effects." in D. Todd. 1979. The Water Encyclopedia. Water Information Center. Port Washington, N.Y.

Pitt, R. 2001. *Methods for Detection of Inappropriate Discharges to Storm Drainage Systems: Background Literature and Summary of Findings*. IDDE Project Support Material.

ATTACHMENT 9

ILLICIT DISCHARGE INSPECTION CHECKLIST

OUTFALL RECONNAISSANCE INVENTORY/ SAMPLE COLLECTION FIELD SHEET

Section 1: Background Data

Subwatershed:		Outfall ID:	
Today's date:		Time (Military):	
Investigators:		Form completed by:	
Temperature (°F):	Rainfall (in.): Last 24 hours:	Last 48 hours:	
Latitude:	Longitude:	GPS Unit:	GPS LMK #:
Camera:		Photo #s:	

Land Use in Drainage Area (Check all that apply):

☐ Industrial
☐ Ultra-Urban Residential
☐ Suburban Residential
☐ Commercial
☐ Open Space
☐ Institutional
Other: _____
Known Industries: _____

Notes (e.g., origin of outfall, if known):

Section 2: Outfall Description

LOCATION	MATERIAL	SHAPE		DIMENSIONS (IN.)	SUBMERGED
☐ **Closed Pipe**	☐ RCP ☐ CMP ☐ PVC ☐ HDPE ☐ Steel ☐ Other: _____	☐ Circular ☐ Eliptical ☐ Box ☐ Other: _____	☐ Single ☐ Double ☐ Triple ☐ Other: _____	Diameter/Dimensions: _____	In Water: ☐ No ☐ Partially ☐ Fully With Sediment: ☐ No ☐ Partially ☐ Fully
☐ **Open drainage**	☐ Concrete ☐ Earthen ☐ rip-rap ☐ Other: _____	☐ Trapezoid ☐ Parabolic ☐ Other: _____		Depth: _____ Top Width: _____ Bottom Width: _____	
☐ **In-Stream**	**(applicable when collecting samples)**				
Flow Present?	☐ Yes ☐ No	***If No, Skip to Section 5***			
Flow Description (If present)	☐ Trickle ☐ Moderate ☐ Substantial				

Section 3: Quantitative Characterization

FIELD DATA FOR FLOWING OUTFALLS				
PARAMETER		**RESULT**	**UNIT**	**EQUIPMENT**
☐Flow #1	Volume		Liter	Bottle
	Time to fill		Sec	
☐Flow #2	Flow depth		In	Tape measure
	Flow width	_____' _____"	Ft, In	Tape measure
	Measured length	_____' _____"	Ft, In	Tape measure
	Time of travel		S	Stop watch
Temperature			°F	Thermometer
pH			pH Units	Test strip/Probe
Ammonia			mg/L	Test strip

Outfall Reconnaissance Inventory Field Sheet

Section 4: Physical Indicators for Flowing Outfalls Only

Are Any Physical Indicators Present in the flow? ☐ Yes ☐ No (*If No, Skip to Section 5)*

INDICATOR	CHECK if Present	DESCRIPTION	RELATIVE SEVERITY INDEX (1-3)		
Odor	☐	☐ Sewage ☐ Rancid/sour ☐ Petroleum/gas ☐ Sulfide ☐ Other:	☐ 1 – Faint	☐ 2 – Easily detected	☐ 3 – Noticeable from a distance
Color	☐	☐ Clear ☐ Brown ☐ Gray ☐ Yellow ☐ Green ☐ Orange ☐ Red ☐ Other:	☐ 1 – Faint colors in sample bottle	☐ 2 – Clearly visible in sample bottle	☐ 3 – Clearly visible in outfall flow
Turbidity	☐	See severity	☐ 1 – Slight cloudiness	☐ 2 – Cloudy	☐ 3 – Opaque
Floatables -Does Not Include Trash!!	☐	☐ Sewage (Toilet Paper, etc.) ☐ Suds ☐ Petroleum (oil sheen) ☐ Other:	☐ 1 – Few/slight; origin not obvious	☐ 2 – Some; indications of origin (e.g., possible suds or oil sheen)	☐ 3 - Some; origin clear (e.g., obvious oil sheen, suds, or floating sanitary materials)

Section 5: Physical Indicators for Both Flowing and Non-Flowing Outfalls

Are physical indicators that are not related to flow present? ☐ Yes ☐ No (*If No, Skip to Section 6)*

INDICATOR	CHECK if Present	DESCRIPTION	COMMENTS
Outfall Damage	☐	☐ Spalling, Cracking or Chipping ☐ Peeling Paint ☐ Corrosion	
Deposits/Stains	☐	☐ Oily ☐ Flow Line ☐ Paint ☐ Other:	
Abnormal Vegetation	☐	☐ Excessive ☐ Inhibited	
Poor pool quality	☐	☐ Odors ☐ Colors ☐ Floatables ☐ Oil Sheen ☐ Suds ☐ Excessive Algae ☐ Other:	
Pipe benthic growth	☐	☐ Brown ☐ Orange ☐ Green ☐ Other:	

Section 6: Overall Outfall Characterization

☐ Unlikely ☐ Potential (presence of two or more indicators) ☐ Suspect (one or more indicators with a severity of 3) ☐ Obvious

Section 7: Data Collection

1. Sample for the lab?	☐ Yes	☐ No	
2. If yes, collected from:	☐ Flow	☐ Pool	
3. Intermittent flow trap set?	☐ Yes	☐ No	If Yes, type: ☐ OBM ☐ Caulk dam

Section 8: Any Non-Illicit Discharge Concerns (e.g., trash or needed infrastructure repairs)?

ATTACHMENT 10

LIST OF TRAINED INDIVIDUALS

LIST OF TRAINED INDIVIDUALS

Construction Oversight Program	
Name	**Date**
David Fritts, CPESC, CESWI / Town Consulting Engineer	January 2025

4-hour DEC-Endorsed Training in E&S Control	
Name	**Date**
Jesse Braun / Town Consulting Engineer	1/19/24
Justin Palmeri / Town Consulting Engineer	1/19/24
David Schuyler/ Town Consulting Engineer	February 2023

Post Construction SMP Inspection and Maintenance Program	
Name	**Date**
David Fritts, CPESC, CESWI / Town Consulting Engineer	January 2025

ATTACHMENT 11

CONSTRUCTION SITE INVENTORY

Job Name	Active?	Environmental Professional	Contact	E&S Inspector	SPDES #	SWPPP Approval Date	MS4 Acceptance	LOCC Received?	NOT Date	Date of Approved Plans	Project Address/Location	Permitee	Project Contractor	Project Owner	Violations			RECEIVING WATERBODY NAME AND CLASS	WI/PWL SEGMENT ID	PRIORITIZATION	REASON FOR PRIORITIZATION
															Date of Violation	Description	Violation Closed				
Planning Board Projects																					
Town of Warwick																					
Hickory Hill Golf Course	Yes				NYR10E186						NYS Rte 17A	Orange County						N/A	N/A	**Low**	Complies with Section V.A
Appel Professional Building	Yes				NYR10F948						Wisner Road & Ronald Reagan Blvd.	Javic Development Corp. - Dr. Marc Appel						N/A	N/A	**Low**	Complies with Section V.A Through C
Rock Spring Estates - Paige	Yes				NYR10I441						Prices Switch Road	Michael & Dawn Hazard						N/A	N/A	**Low**	Complies with Section V.A Through C
Wickham Lake Homes	Yes				NYR10I800						Airport Road & Knights Lane	Wickham Lake Homes, Inc.						N/A	N/A	**Low**	Complies with Section V.A Through C
Pelton Crossing	Yes	HIGGINS DAVID			NYR10J616						Sandfordville Road/County Route 1A	Pelton Crossing, LLC						N/A	N/A	**Low**	Complies with Section V.A Through C
Lands of Moore	Yes	Rother Kirk			NYR10L082						50 Little York Road	Chi Maple, LLC						N/A	N/A	**Low**	Complies with Section V.A Through C
Eagle Trace	Yes	Rother Kirk			NYR10M459						Ridgeway Loop	Eagle Wood Custom Builders, Inc.						N/A	N/A	**Low**	Complies with Section V.A Through C
SLEEPY VALLEY ACRES INC	Yes	CLEVERLEY BRADLEY			NYR10M795						SLEEPY VALLEY ROAD	COUNTRY GARDENER						N/A	N/A	**Low**	Complies with Section V.A Through C
FAIRGROUNDS, THE	Yes	GETZ DAVID			NYR10Q433						142 STATE HIGHWAY 94	FAIRGROUNDS, LLC C/O WARWICK, 2012 LLC						N/A	N/A	**Low**	Complies with Section V.A Through C
FAIRGROUNDS 2	Yes	GETZ DAVID			NYR10T649						146 STATE HIGHWAY 94	FAIRWICK, LLC						N/A	N/A	**Low**	Complies with Section V.A Through C
WHEELER ROAD ESTATES	Yes	PFAU JOSEPH			NYR10T984						WHEELER ROAD	WHEELER ASSOCIATES						N/A	N/A	**Low**	Complies with Section V.A
Hudson Sports Complex	Yes	Ross	ross@ep-pc.com		NYR11G015						122 State school	Hudson Sports LLC						N/A	N/A	**Low**	Complies with Section V.A
Warwick Ridge II Subdivision	Yes	Getz David	Dave@ep-pc.com		NYR11K997						306 Ridge Road	Elias Muhlrad						N/A	N/A	**Low**	Complies with Section V.A
SUBDIVISION FOR DOORWAYTO, LLC	Yes	HIGGINS DAVID	DEH@LANCTULLY.COM		NYR11M253						22 TAYLOR ROAD	DOORWAYTO, LLC						N/A	N/A	**Low**	Complies with Section V.A
Warwick Isle Cluster Subdivision	Yes	Rother, Kirk	krother@kirkrother.com		NYR11M344						1041 County Route 1	Warwick Isle Group, LLC						N/A	N/A	**High**	Greater than 5 Acres Disturbance
Fence Road Farm Brewery	Yes	Getz, David	Dave@ep-pc.com		NYR11M509						13 Fence Road (Union Corners Road)	The Oasis at Warwick						N/A	N/A	**Low**	Complies with Section V.A Through C
75 Belcher Subdivision and Lot Line Change	Yes	Getz, David	Dave@ep-pc.com		NYR11M539						75 Belcher Road	Dr. Charles E. Brown						N/A	N/A	**Low**	Complies with Section V.A
Round Hill Subdivision & Lot Line Change	Yes	Getz, David	Dave@ep-pc.com		NYR11N552						490 Wheeler Road	Wheeler RE Development, LLC						N/A	N/A	**Low**	Complies with Section V.A Through C
Johnny Hayseed Property	Yes	Pitingaro, Jason	info@panddengineers.com		NYR11N841						111 Glenwood Road	Johnny Hayseed LLC, Trustee						N/A	N/A	**Low**	Complies with Section V.A Through C

ATTACHMENT 12

MS4 CONSTRUCTION SITE
COMPLIANCE INSPECTION REPORT

MHE ENGINEERING

CONSTRUCTION SITE INSPECTION REPORT FOR SPDES MS4 GENERAL PERMIT

Project Name:		Date:	
Project Location:		Weather:	
Permit # (if any): NYR	Contacted: ☐ Yes ☐ No	Entry Time:	Exit Time:
Name of SPDES Permittee[1]/ SWPPP Contact Name:		Inspection Type:	☐ NOT ☐ Complaint
Phone Number(s):			☐ Compliance ☐ Referral
On-site Representative(s) and Company(s):		MS4 Operator Name:	
		MS4 Permit ID: NYR20A	

SPDES AUTHORITY

	Yes	No	N/A		Citation
1.	☐	☐	☐	Does the project have permit coverage?	GP-0-20-001: I.A & II. B
2.	☐	☐	☐	Is a copy of the NOI and Acknowledgment Letter available on site and accessible for viewing?	GP-0-20-001: II.D.2
3.	☐	☐	☐	Is a copy of the MS4 SWPPP Acceptance Form available on site and accessible for viewing?	GP-0-20-001: II.D.2
4.	☐	☐	☐	Is an up-to-date copy of the signed SWPPP retained at the construction site?	GP-0-20-001: II.D.2. & III.A.4
5.	☐	☐	☐	Is a copy of the SPDES General Permit retained at the construction site?	GP-0-20-001: II.D.2
6.	☐	☐	☐	Does the NOI accurately report the number of acres to be disturbed?	GP-0-20-001: II.B.4

SWPPP CONTENT

	Yes	No	N/A		Citation
7.	☐	☐	☐	Does the SWPPP describe and identify the erosion and sediment control measures to be employed?	GP-0-20-001: III.B.1.e
8.	☐	☐	☐	Does the SWPPP provide an inspection schedule and maintenance requirements for the E&SC measures?	GP-0-20-001: III.B.1.i
9.	☐	☐	☐	Does the SWPPP describe and identify the stormwater management practices to be employed?	GP-0-20-001: III.B.2
10.	☐	☐	☐	Does the SWPPP identify the contractor(s) and subcontractor(s) responsible for each measure?	GP-0-20-001: III.A.6
11.	☐	☐	☐	Does the SWPPP identify at least one trained individual from each contractor(s) and subcontractor(s) companies?	GP-0-20-001: III.A.6
12.	☐	☐	☐	Does the SWPPP include all the necessary Contractor Certification Statements and signatures?	GP-0-20-001: III.A.6
13.	☐	☐	☐	Is the SWPPP signed by the permittee?	GP-0-20-001: VII.H.2

NEW YORK OFFICE
33 Airport Center Drive, Suite 202, New Windsor, NY 12553
845-567-3100 | F: 845-567-3232 | mheny@mhepc.com

PENNSYLVANIA OFFICE
111 Wheatfield Drive, Suite 1, Milford, PA 18337
570-296-2765 | F: 570-296-2767 | mhepa@mhepc.com

14. ☐ ☐ ☐	Is the SWPPP prepared by a qualified professional (if post-construction stormwater management required)?	GP-0-20-001: III.A.3
15. ☐ ☐ ☐	Do the SMPs conform to the Enhanced Phosphorus Removal Standards (projects in TMDL watersheds)?	GP-0-20-001: III.B.3

RECORDKEEPING

Yes No N/A		Citation
16. ☐ ☐ ☐	Are self-inspections performed as required by the permit (weekly, or twice weekly for >5 acres disturbed)?	GP-0-20-001:IV.C.2.a & b
17. ☐ ☐ ☐	Are the self-inspections performed and signed by a qualified inspector and retained on site?	GP-0-20-001:II.C.2., IV.C.6 & VII.H.3
18. ☐ ☐ ☐	Do the qualified inspector's reports include the minimum reporting requirements?	GP-0-20-001: IV.C.4
19. ☐ ☐ ☐	Do inspection reports identify corrective measures that have not been implemented or are recurring?	GP-0-20-001: IV.C.5

VISUAL OBSERVATIONS

Yes No N/A		Citation
20. ☐ ☐ ☐	Are all erosion and sediment control measures installed properly?	GP-0-20-001: VII.L
21. ☐ ☐ ☐	Are all erosion and sediment control measures being maintained properly?	GP-0-20-001: IV.A.1
22. ☐ ☐ ☐	Was written authorization issued for any disturbance greater than 5 acres?	GP-0-20-001: II.D.3
23. ☐ ☐ ☐	Have stabilization measures been implemented in inactive areas per Permit (>5acres) or ESC Standard?	GP-0-20-001: II.D.3.b & III.B.1.f
24. ☐ ☐ ☐	Are post-construction stormwater management practices constructed/installed correctly?	GP-0-20-001: III.B.2
25. ☐ ☐ ☐	Has final site stabilization been achieved and temporary E&SC measures removed prior to NOT submittal?	GP-0-20-001: V.A.2
26. ☐ ☐ ☐	Was there a discharge from the site on the day of inspection?	
27. ☐ ☐ ☐	Is there evidence that a discharge caused or contributed to a violation of water quality standards?	ECL 17-0501, 6 NYCRR 703.2
28. ☐ ☐ ☐	Have comments referenced in previous MS4 Inspection Reports been addressed?	& GP-0-20-001: I *

WATER QUALITY OBSERVATIONS

Describe the discharge(s): location, source(s), impact on receiving water(s), etc.

Describe the quality of the receiving water(s) both upstream and downstream of the discharge:

*Citation only associated with Line 27

Describe any other water quality standards or permit violations:

Additional Comments:

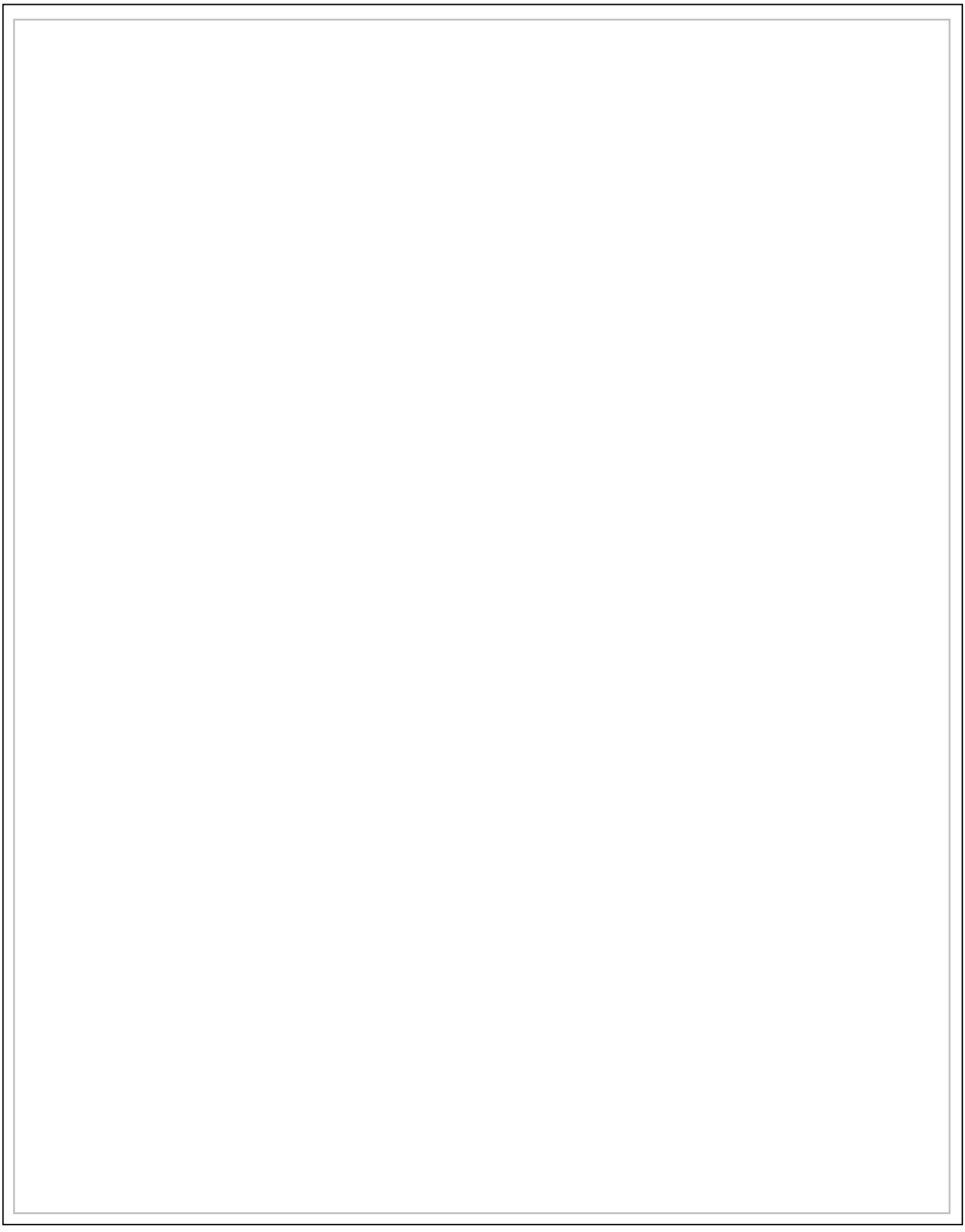
☐ Photographs attached

Overall Inspection Rating: ☐ Satisfactory ☐ Marginal ☐ Unsatisfactory	
Name/Agency of Lead Inspector:	Signature of Lead Inspector:
Names/Agencies of Other Inspectors:	

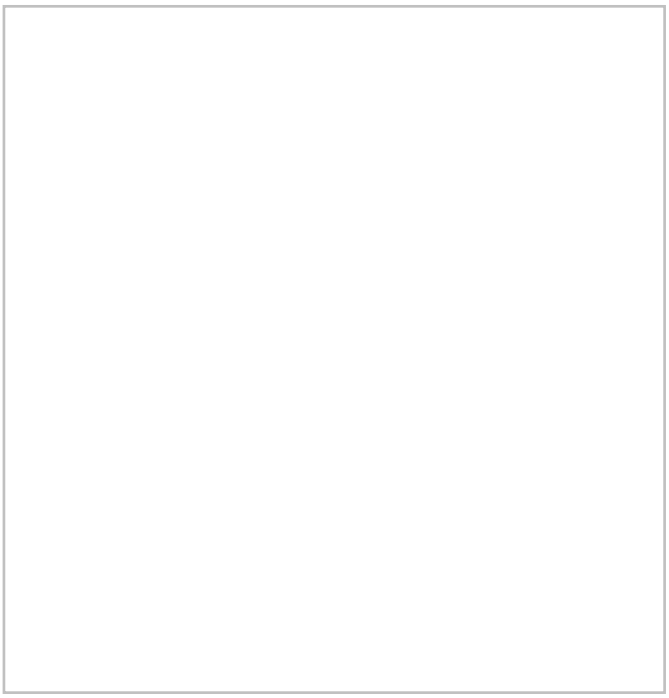
* Appendix D if the NYSDEC Permit MS4 GP-0-24-001 utilized as reference for this form

1 SWPPP Contact information referenced on NYSDEC Index of NOI Spreadsheet

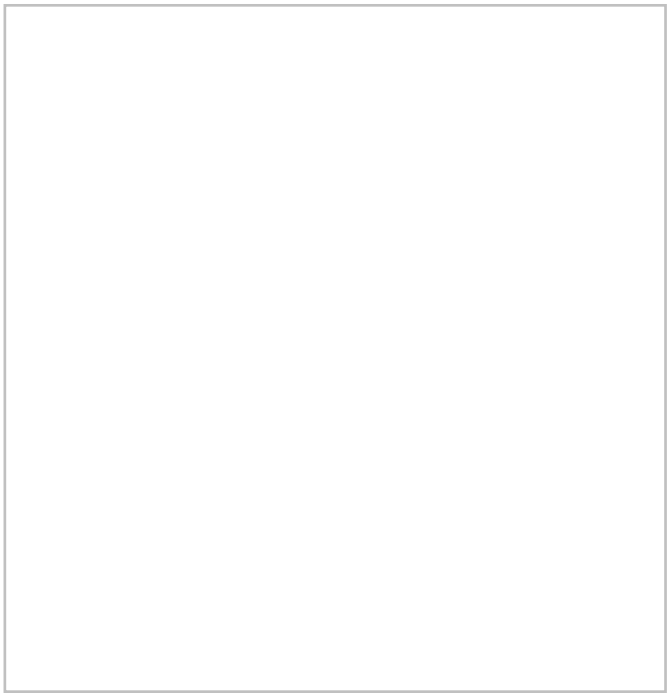
PLAN



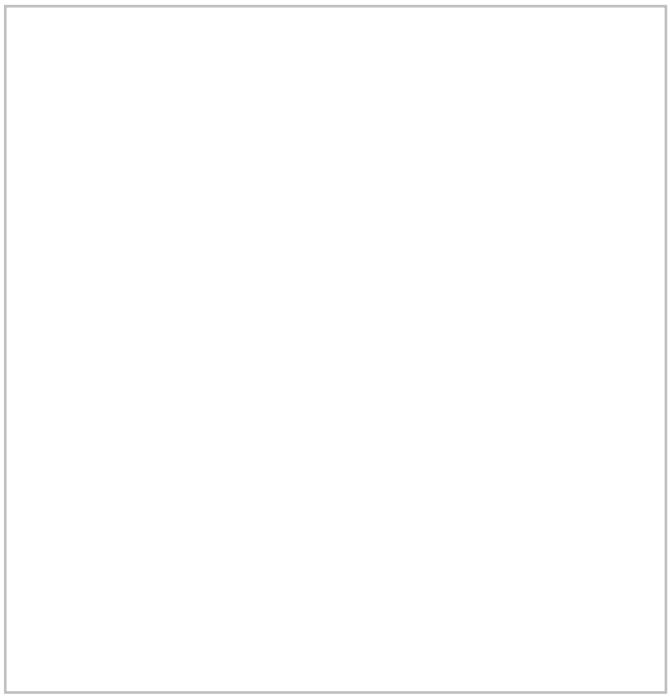
PICTURES



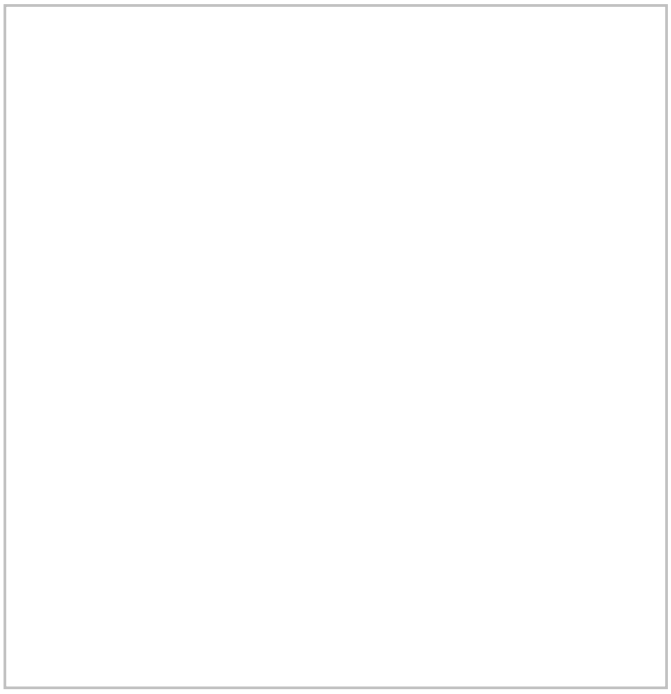
Description



Description



Description



Description

PICTURES

Description

Description

Description

Description

ATTACHMENT 13

INVENTORY OF POST-CONSTRUCTION STORMWATER MANAGEMENT PRACTICES (SMPs)

List of Post Construction SMPs
Warwick, NY

LatestSubmissionDate	ProgramID	FiveOrSixtyDays	WhichPermit	Terminated	FinalStabilizationDate	FacilityName	Address1	City	ESCComponent	Pos tConstruction Component	ł of Post Construction SMP	Post Construction Requirement Post Construction SMPRR Description	MS4SWPPPAcceptance	Erosion Sedimen tPractice Description
6/27/2003	NYR10E186		02-01	No		Hickory Hill Golf Course	NYS Rte 17A	Warwick	Yes	No	1	*To Be Field Verified	No	
8/20/2003	NYR10F948	5	02-01	No		Appel Professional Buildin	Wisner Road & Ronald Rea	Warwick	Yes	Yes	1	*To Be Field Verified	No	
2/28/2005	NYR10I441	5	02-01	No		Rock Spring Estates - Paige	Prices Switch Road	Warwick	Yes	Yes	1	*To Be Field Verified	No	
5/2/2005	NYR10I800	5	02-01	No		Wickham Lake Homes	Airport Road & Knights Lan	Warwick	Yes	Yes	1	*To Be Field Verified	No	
9/2/2005	NYR10J616	5	02-01	No		Pelton Crossing	Sandfordville Road/County	Warwick	Yes	Yes	1	*To Be Field Verified	No	CD, LS, PD, SB, SF, SCE, TS, GW, S, ROP
6/5/2006	NYR10L082	5	02-01	No		Lands of Moore	50 Little York Road	Warwick	Yes	Yes	1	*To Be Field Verified	No	CD, CRS, DC, RD, ST, SF, SCE, TS, M, S, TS, T, D, LW, ROP
3/15/2007	NYR10M459	5	02-01	No		Eagle Trace	Ridgeway Loop	Warwick	Yes	Yes	1	*To Be Field Verified	No	CD, DC, LS, ST, SF, SCE, TS, S, T, LW, ROP
5/8/2007	NYR10M795	5	02-01	No		SLEEPY VALLEY ACRES INC	SLEEPY VALLEY ROAD	WARWICK	Yes	Yes	1	*To Be Field Verified	No	CRS, SF, SCE, SD, S, T
5/5/2008	NYR10P687	5	08-001	No		Cedar Ridge	Wheeler Road	Warwick	Yes	Yes	1	*To Be Field Verified	No	CD, SB, SF, SCE, SDIP, TS, GW, S, T, LG, LW, ROP
9/25/2008	NYR10Q433	5	08-001	No		FAIRGROUNDS, THE	142 STATE HIGHWAY 94	WARWICK	Yes	Yes	1	*To Be Field Verified	No	DC, ST, SF, TS, M, PV, S, T, LG
1/3/2011	NYR10T547	5	10-001	No		SUBDIVISION FOR FUSCO	TAYLOR ROAD	WARWICK	Yes	Yes	1	*To Be Field Verified	Yes	CD, DC, ST, SF, SCE, GW, M, S, SOD, T, VW, LG, ROP
2/3/2011	NYR10T649	5	10-001	No		FAIRGROUNDS 2	146 STATE HIGHWAY 94	WARWICK	Yes	Yes	1	*To Be Field Verified	Yes	DC, ST, SF, SCE, TS, M, PV, S, T, LG
3/1/2011	NYR10T984	5	10-001	No		WHEELER ROAD ESTATES	WHEELER ROAD	WARWICK	Yes	Yes	1	*To Be Field Verified	Yes	CD, CRS, DC, SB, ST, SF, SCE, SDIP, TS, GW, M, PV, S, SOD, TS, T, LG
4/13/2011	NYR10U237	5	10-001	No		GABLES AT WARWICK, THE	NYS ROUTE 17A	WARWICK	Yes	Yes	1	*To Be Field Verified	Yes	DC, ST, SF, SCE, SDIP, TS, M, PV, S, TS, T, LG
5/24/2011	NYR10U357	5	10-001	No		APPLEWOOD ORCHARDS	82 FOUR CORNERS ROAD	WARWICK	Yes	No	1	*To Be Field Verified	Yes	CD, SB, SF, SD, TS, M, S, LG, LW
12/31/2012	NYR10W255	5	10-001	No		WARWICK COMMONS	SHEFFIELD DRIVE	WARWICK	Yes	Yes	1	*To Be Field Verified	No	SB, ST, SF, SCE, S, RW,
6/24/2013	NYR10W872	5	10-001	No		RAVEN HILL FARMS	154 GLENMERE AVENUE	WARWICK	Yes	Yes	1	*To Be Field Verified	Yes	CD, SF, TS, M, S, ROP
1/10/2014	NYR10X546		10-001	No		ANSLEY 4 LOT SUBDIVISIO	WAYWAYANDA ROAD	WARWICK	Yes	No	1	*To Be Field Verified	No	CD, DC, SF, SCE, TS, T, LG, LW, ROP
1/10/2014	NYR10X547		10-001	No		ANSLEY 4 LOT SUBDIVISIO	WAYWAYANDA ROAD	WARWICK	Yes	No	1	*To Be Field Verified	No	CD, DC, SF, SCE, S, TS, T, LG, LW, ROP
3/24/2015	NYR10Z165	10	15-002	No		FROZEN ROPES - THE YARI	122 STATE SCHOOL ROAD	WARWICK	Yes	No	1	*To Be Field Verified	Yes	DC, SF, SCE, SDIP, TS, M, PV, S, SOD, T, LG
8/24/2015	NYR10Z826	10	15-002	No		HOMARC LAND, LLC	NYS ROUTE 94	WARWICK	Yes	Yes	3	Conservation of Natural Areas (RR-1), Disconnection of Rooftop Runoff (RR-4), Dry Swale (O-1)	No	CD, CRS, DC, LS, PD, PSD, SB, ST, SF, SCE, SDIP, TSD, BM, GW, M, PV, S, SOD, SP, T, VW, BM, D, LG, RW, ROP, SP
11/13/2015	NYR11A146	10	15-002	No		FROZEN ROPES - THE YARI	122 STATE SCHOOL ROAD	WARWICK	Yes	Yes	1	Infiltration Basin (I-2)	Yes	DC, SF, SCE, SDIP, TS, M, PV, S, T, LG
7/17/2017	NYR11C462	10	15-002	No		SANFORDVILLE ELEMENTA	144 SANFORDVILLE ROAD	WARWICK	Yes	No	1	*To Be Field Verified	No	CD, ED, PD, ST, SF, SCE, TS, S
5/14/2018	NYR11D657	5	15-002	No		Citiva	75 John Hicks Drive	Warwick	Yes	Yes	1	Infiltration Basin (I-2)	Yes	Check Dams, Perimeter Dike/Swale, Silt Fence, Stabilized Construction Entrance, Storm Drain Inlet Protection, Grassed Waterway, Mulching, Seeding, Topsoiling, None, Diversion, Land Grading, Lined Waterway (Rock), Rock Outlet
1/2/2019	NYR11E595			No		Citiva	75 John Hicks Drive	Town of Warwick	Yes	Yes	2	Vegetated Swale (RR-5), Infiltration Basin (I-2)	Yes	Perimeter Dike/Swale, Silt Fence, Stabilized Construction Entrance, Grassed Waterway, Mulching, Seeding, Topsoiling, None, Diversion, Land Grading, Lined Waterway (Rock), Rock Outlet Protection
7/17/2019	NYR11F448	10	15-002	No		Old Stone House Inn	21 Hathorn Road	Warwick	Yes	Yes	1	Bioretention (F-5)		Sediment Traps, Silt Fence, Stabilized Constructiion Entrance, Mulching, Seeding, Topsoiling, Diversion

List of Post Construction SMPs
Warwick, NY

1/3/2020	NYR11G015	10	15-002	No	Hudson Sports Complex	122 State school	Warwick	Yes	Yes	1			Dust Control, Silt Fence, Stabilized Constructiion Entrance, Storm Drain Inlet Protection, Temporary Swale - Temp Structural, Mulching, Protecting Vegetation, Seeding, Topsoiling, Land
2/3/2020	NYR11G155	5		No	Warwick Renewables, LLC	35 Union Corners Road	Town of Warick	Yes	Yes	2	*To Be Field Verified Vegetated Swale (RR-5), Porous Pavement (RR-9)	Yes	Dust Control, Silt Fence, Stabilized Construction Entrance, Seeding, Grassed Waterway, Mulching, None, None
4/16/2020	NYR11G525	5		No	Warwick Bike Route and Pe	Cascade Road	Town of Warwick	Yes	No	1		No	Construction Road Stabilization, Dust Control, Silt Fence, Water Bars, Topsoiling, Seeding, Mulching, None, None
10/16/2020	NYR11H314	10	20-001	No	KNIGHTS LANE	KNIGHTS LANE	WARWICK	Yes	Yes	1	*To Be Field Verified		Rock Outlet Protection, Silt Fence, Stabilized Constructiion Entrance, Grassed Waterway, Protecting Vegetation, Topsoiling, Diversion
12/27/2021	NYR11J178	5		No	Creamer Property	491 Newport Bridge Road	Town of Warwick	Yes	No	1	*To Be Field Verified	Yes	Stabilized Construction Entrance, Silt Fence, Mulching, Protecting Vegetation, Seeding, Topsoiling, None, Rock Outlet Protection
4/13/2023	NYR11K997	5		No	Warwick Ridge II Subdivisic	306 Ridge Road	Warwick	Yes	No	1	*To Be Field Verified	Yes	Construction Road Stabilization, Silt Fence, Stabilized Construction Entrance, Mulching, Protecting Vegetation, Seeding, None, Diversion
12/28/2023	NYR11M253	5		No	SUBDIVISION FOR DOORW	22 TAYLOR ROAD	TOWN OF WARWICK	Yes	Yes	3	Rain Garden (RR-6), Bioretention (F-5), Dry Swale (O-1)	Yes	Check Dams, Dust Control, Sediment Traps, Silt Fence, Stabilized Construction Entrance, Grassed Waterway, Mulching, Seeding, Sodding, Topsoiling, Vegetating Waterways, None, Land Grading, Rock Outlet Protection
3/1/2024	NYR11M344	5		No	Warwick Isle Cluster Subdi	1041 County Route 1	Town of Warwick	Yes	Yes	3	Bioretention (F-5), Dry Swale (O-1), Wet Pond (P-2)	Yes	Check Dams, Construction Road Stabilization, Dust Control, Sediment Traps, Silt Fence, Stabilized Construction Entrance, Grassed Waterway, Seeding, Topsoiling, None, Land Grading, Rock
4/19/2024	NYR11M509	5		No	Fence Road Farm Brewery	13 Fence Road (Union Corr	Town of Warwick	Yes	Yes	1	Bioretention (F-5)	Yes	Silt Fence, Sediment Traps, Storm Drain Inlet Protection, Stabilized Construction Entrance, Seeding, Mulching, Topsoiling, None, None
3/15/2024	NYR11M539	5		No	75 Belcher Subdivision anc	75 Belcher Road	Town of Warwick	Yes	No	1		Yes	Silt Fence, Stabilized Construction Entrance, Seeding, Topsoiling, None, None
9/9/2024	NYR11N274	5		No	Line 98 Transmission Struc	Long Meadow Road	Warwick	Yes	No	1	*To Be Field Verified	No	Stabilized Construction Entrance, Silt Fence, Seeding, Mulching, Protecting Vegetation, Streambank Protection, Wattling, Streambank Protection
											*To Be Field Verified		

List of Post Construction SMPs
Warwick, NY

11/21/2024	NYR11N552	5	No	Round Hill Subdivision & Lo	490 Wheeler Road	Town of Warwick	Yes	No	1	Yes	Stabilized Construction Entrance, Silt Fence, Seeding, Mulching, Protecting Vegetation, Topsoiling, None, None
1/28/2025	NYR11N841	5	No	Johnny Hayseed Property	111 Glenwood Road	Warwick	Yes	No	*To Be Field Verified 1	Yes	Silt Fence, Stabilized Construction Entrance, Temporary Swale, Dust Control, Topsoiling, Temporary Swale, None, Grade Stabilization Structure
								Total	*To Be Field Verified 47		

ATTACHMENT 14

STORMWATER MAINTENANCE AGREEMENT

Schedule B

SAMPLE STORMWATER CONTROL FACILITY MAINTENANCE AGREEMENT

Whereas, the Municipality of _____("Municipality") and the _____("facility owner") want to enter into an agreement to provide for the long term maintenance and continuation of stormwater control measures approved by the Municipality for the below named project, and

Whereas, the Municipality and the facility owner desire that the stormwater control measures be built in accordance with the approved project plans and thereafter be maintained, cleaned, repaired, replaced and continued in perpetuity in order to ensure optimum performance of the components. Therefore, the Municipality and the facility owner agree as follows:

1. This agreement binds the Municipality and the facility owner, its successors and assigns, to the maintenance provisions depicted in the approved project plans which are attached as Schedule A of this agreement.

2. The facility owner shall maintain, clean, repair, replace and continue the stormwater control measures depicted in Schedule A as necessary to ensure optimum performance of the measures to design specifications. The stormwater control measures shall include, but shall not be limited to, the following: drainage ditches, swales, dry wells, infiltrators, drop inlets, pipes, culverts, soil absorption devices and retention ponds.

3. The facility owner shall be responsible for all expenses related to the maintenance of the stormwater control measures and shall establish a means for the collection and distribution of expenses among parties for any commonly owned facilities.

4. The facility owner shall provide for the periodic inspection of the stormwater control measures, not less than once in every five year period, to determine the condition and integrity of the measures. Such inspection shall be performed by a Professional Engineer licensed by the State of New York. The inspecting engineer shall prepare and submit to the Municipality within 30 days of the inspection, a written report of the findings including recommendations for those actions necessary for the continuation of the stormwater control measures.

5. The facility owner shall not authorize, undertake or permit alteration, abandonment, modification or discontinuation of the stormwater control measures except in accordance with written approval of the Municipality.

6. The facility owner shall undertake necessary repairs and replacement of the stormwater control measures at the direction of the Municipality or in accordance with the recommendations of the inspecting engineer.

7. The facility owner shall provide to the Municipality within 30 days of the date of this agreement, a security for the maintenance and continuation of the stormwater control measures in the form of (a Bond, letter of credit or escrow account).

8. This agreement shall be recorded in the Office of the County Clerk, County of _____together with the deed for the common property and shall be included in the offering plan and/or prospectus approved pursuant to _____.

9. If ever the Municipality determines that the facility owner has failed to construct or maintain the stormwater control measures in accordance with the project plan or has failed to undertake corrective action specified by the Municipality or by the inspecting engineer, the Municipality is authorized to undertake such steps as reasonably necessary for the preservation, continuation or maintenance of the stormwater control measures and to affix the expenses thereof as a lien against the property.

10. This agreement is effective _____.

ATTACHMENT 15

POST-CONSTRUCTION SMPS INSPECTION CHECKLIST

NEW YORK STATE OF OPPORTUNITY | Department of Environmental Conservation

Bioretention Stormwater Management Practices Level 1 Inspection Checklist

SMP ID #		**SMP Owner**		☐ Private ☐ Public
SMP Location (Address; Latitude & Longitude)				
	Latitude		**Longitude**	

Party Responsible for Maintenance	**System Type**		**Type of Site**
☐ Same as SMP Owner ☐ Other _____	☐ Seasonal ☐ Continuous Use ☐ Other	☐ Above Ground ☐ Below Ground	☐ Commercial ☐ Industrial ☐ Residential ☐ State

Inspection Date		**Inspection Time**	
Inspector			
Date of Last Inspection			

BR Drainage Area

Look for areas that are uphill from the Bioretention cell.

Problem (Check if Present)	**Follow-Up Actions**
 ☐ Bare soil, erosion of the ground (rills washing out the dirt)	☐ Seed and mulch areas of bare soil to establish vegetation. ☐ Fill in erosion areas with soil, compact, and seed and straw to establish vegetation. ☐ If a rill or small channel is forming, try to redirect water flowing to this area by creating a small berm or adding topsoil to areas that are heavily compacted. ☐ Other:

BR Drainage Area

Look for areas that are uphill from the Bioretention cell.

Problem (Check if Present)	Follow-Up Actions
	☐ Kick-Out to Level 2 Inspection: Large areas of soil have been eroded, or larger channels are forming. May require rerouting of flow paths.
 ☐ Piles of grass clippings, mulch, dirt, salt, or other materials	☐ Remove or cover piles of grass clippings, mulch, dirt, etc. ☐ Other:
 ☐ Open containers of oil, grease, paint, or other substances	☐ Cover or properly dispose of materials; consult your local solid waste authority for guidance on materials that may be toxic or hazardous. ☐ Other:

BR Inlets

Stand in the Bioretention cell itself and look for all the places where water flows in. Often there will be multiple points of inflow to the practice.

Problem (Check if Present)	Follow-Up Actions
 ☐ Inlets collect grit and debris or grass/weeds. Some water may not be getting into the Bioretention cell. The objective is to have a clear pathway for water to flow into the cell.	☐ Use a flat shovel to remove grit and debris (especially at curb inlets or openings). Parking lots generate fine grit that will accumulate at these spots. ☐ Pull out clumps of growing grass or weeds and scoop out the soil or grit that the plants are growing in. ☐ Remove any grass clippings, leaves, sticks, and other debris that is collecting at inlets. ☐ For pipes and ditches, remove sediment and debris that is partially blocking the pipe or ditch opening where it enters the Bioretention cell. ☐ Dispose of all material properly where it will not re-enter the Bioretention cell. ☐ Other: ☐ Kick-Out to Level 2 Inspection: Inlets are blocked to the extent that most of the water does not seem to be entering the Bioretention cell.
 ☐ Some or all of the inlets are eroding so that rills, gullies, and other erosion is present, or there is bare dirt that is washing into the Bioretention cell.	☐ For small areas of erosion, smooth out the eroded part and apply rock or stone (e.g., river cobble) to prevent further erosion. Usually, filter fabric is placed under the rock or stone. ☐ In some cases, reseeding and applying erosion-control matting can be used to prevent further erosion. Some of these materials may be available at a garden center, but it may be best to consult a landscape contractor. ☐ Other: ☐ Kick-Out to Level 2 Inspection: Erosion is occurring at most of the inlets, and it looks like there is too much water that is concentrating at these points. The inlet design may have to be modified.

BR Ponding Area

Examine the entire Bioretention surface and side slopes

Problem (Check if Present)	Follow-Up Actions
 ☐ Mulch (if used) needs to be replaced or replenished. The mulch layer had decomposed or is less than 1-inch thick.	☐ Add new mulch to a total depth (including any existing mulch that is left) of 2 to 3 inches. The mulch should be shredded hardwood mulch that is less likely to float away during rainstorms. ☐ Avoid adding too much mulch so that inlets are obstructed or certain areas become higher than the rest of the Bioretention surface. ☐ Other:
 ☐ Minor areas of sediment, grit, trash, or other debris are accumulating on the bottom.	☐ Use a shovel to scoop out minor areas of sediment or grit, especially in the spring after winter sanding materials may wash in and accumulate. Dispose of the material where it cannot re-enter the Bioretention cell . ☐ If removing the material creates a hole or low area, fill with soil mix that matches original mix and cover with mulch so that the Bioretention surface area is as flat as possible. ☐ Remove trash, vegetative debris, and other undesirable materials. ☐ Other: ☐ Kick-Out to Level 2 Inspection: Sediment has accumulated more than 2-inches deep and covers 25% or more of the Bioretention surface. ☐ Kick-Out to Level 2 Inspection: The Bioretention cell is too densely vegetated to assess sediment accumulation or ponding; see BR-4, Vegetation.

BR Ponding Area

Examine the entire Bioretention surface and side slopes

Problem (Check if Present)	Follow-Up Actions
 ☐ There is erosion in the bottom or on the side slopes. Water seems to be carving out rills as it flows across the Bioretention surface or on the slopes, or sinkholes are forming in certain areas. ☐ Source: Stormwater Maintenance, LLC.	☐ Try filling the eroded areas with clean topsoil or sand, and cover with mulch. ☐ If the problem recurs, you may have to use stone (e.g., river cobble) to fill in problem areas. ☐ If the erosion is on a side slope, fill with clay that can be compacted and seed and mulch the area. ☐ Other: ☐ Kick-Out to Level 2 Inspection: The problem persists or the erosion is more than 3-inches deep and seems to be an issue with how water enters and moves through the Bioretention cell. ☐ Kick-Out to Level 2 Inspection: The problem does not seem to be caused by flowing water, but a collapse or sinking of the surface (e.g., “sinkhole”) due to some underground problem.
 ☐ The bottom of the Bioretention cell is not flat, and the water pools at one end, along an edge, or in certain pockets. The whole bottom is not uniformly covered with water. See design plan to verify that bioretention surface is intended to be flat. Check during or immediately after a rainstorm.	☐ If the problem is minor (just small, isolated areas are not covered with water), try raking the surface OR adding mulch to low spots to create a more level surface. You may need to remove and replace plantings in order to properly even off the surface. ☐ Check the surface with a string and bubble level to get the surface as flat as possible. ☐ Other: ☐ Kick-Out to Level 2 Inspection: Ponding water is isolated to less than half of the Bioretention surface area, and there seem to be elevation differences of more than a couple of inches across the surface.

BR Ponding Area

Examine the entire Bioretention surface and side slopes

Problem (Check if Present)	Follow-Up Actions
 ☐ Water stands on the surface more than 72 hours after a rainstorm and /or wetland-type vegetation is present. The Bioretention cell does not appear to be draining properly.	☐ Kick-Out to Level 2 Inspection: This is generally a serious problem, and it will be necessary to activate a Level 2 Inspection.

BR Vegetation

Examine all Bioretention cell vegetation.

Problem (Check if Present)	Follow-Up Actions
 ☐ Vegetation requires regular maintenance—pulling weeds, removing dead and diseased plants, replacing mulch around plants, adding plants to fill in areas that are not well vegetated, etc.	☐ If you can identify which plants are weeds or not intended to be part of the planting plan, eliminate these, preferably by hand pulling. ☐ If weeds are widespread, check with the local stormwater authority and/or Extension Office about proper use of herbicides for areas connected with the flow of water. ☐ Even vegetation that is intended to be present can become large, overgrown, and/or crowd out surrounding plants. Prune and thin accordingly. ☐ If weeds or invasive plants have overtaken the whole Bioretention cell , bush-hog the entire area before seedheads form in the spring. It will be necessary to remove the root mat manually or with appropriate herbicides, as noted above. ☐ Re-plant with species that are aesthetically pleasing and seem to be doing well in the Bioretention cell. ☐ Other: ☐ Kick-Out to Level 2 Inspection: You are unsure of the original planting design, or the vegetation maintenance task is beyond your capabilities of time, expertise, or resources. If you are unsure of the health of the vegetation (e.g. salt damage, invasives, which plants are undesirable) or the appropriate season to conduct vegetation management, consult a landscape professional before undertaking any cutting, pruning, mowing, or brush hogging.

BR Vegetation

Examine all Bioretention cell vegetation.

Problem (Check if Present)	Follow-Up Actions
 ☐ Vegetation is too thin, is not healthy, and there are many spots that are not well vegetated.	☐ The original plants are likely not suited for the actual conditions within the Bioretention cell . If you are knowledgeable about plants, select and plant more appropriate vegetation (preferably native plants) so that almost the entire surface area will be covered by the end of the second growing season. ☐ Other:
	☐ Kick-Out to Level 2 Inspection: For all but small practices (e.g., rain gardens), this task will likely require a landscape design professional or horticulturalist.

BR Outlets

Examine outlets that release water out of the Bioretention cell.

Problem (Check if Present)	Follow-Up Actions
☐ Erosion at outlet	☐ Add stone to reduce the impact from the water flowing out of the outlet pipe or weir during storms. ☐ Other:
	☐ Kick-Out to Level 2 Inspection: Rills have formed and erosion problem becomes more severe.
 ☐ Outlet obstructed with mulch, sediment, debris, trash, etc.	☐ Remove the debris and dispose of it where it cannot re-enter the Bioretention cell . ☐ Other:
	☐ Kick-Out to Level 2 Inspection: Outlet is completely clogged or obstructed; there is too much material to remove by hand or with simple hand tools.

Additional Notes:

Inspector:_____ Date: _____

Complete the following if follow-up/corrective actions were identified during this inspection:

Certified Completion of Follow-Up Actions:

"I hereby certify that the follow-up/corrective actions identified in the inspection performed on _____ (DATE) have been completed and any required maintenance deficiencies have been adequately corrected."

Inspector/Operator: _____ Date: _____

NEW YORK STATE OF OPPORTUNITY | Department of Environmental Conservation

Bioretention Stormwater Management Practices Level 2 Inspection Checklist

SMP ID #		**SMP Owner**		☐ Private ☐ Public
SMP Location (Address; Latitude & Longitude)				
	Latitude		**Longitude**	

Party Responsible for Maintenance	**System Type**		**Type of Site**
☐ Same as SMP Owner ☐ Other _____	☐ Seasonal ☐ Continuous Use ☐ Other	☐ Above Ground ☐ Below Ground	☐ Commercial ☐ Industrial ☐ Residential ☐ State

Inspection Date		**Inspection Time**	
Inspector			
Date of Last Inspection			

Level 2 Inspection: BIORETENTION NOTE: Key Source for this Information *(CSN, 2013)*	
Recommended Repairs	**Triggers for Level 3 Inspection**
Observed Condition: Water Stands on Surface for More than 72 Hours after Storm	
☐ Condition 1: Small pockets of standing water Use a soil probe or auger to examine the soil profile. If isolated areas have accumulated grit, fines, or vegetative debris or have bad soil media, try scraping off top 3 inches of media and replacing with clean material. Also check to see that surface is level and water is not ponding selectively in certain areas. ☐ Condition 2: Standing water is widespread or covers entire surface Requires diagnosis and resolution of problem: • Clogged underdrain? • Filter fabric between soil media and underdrain stone? • Need to install underdrain if not present? • Too much sediment/grit washing in from drainage area? • Too much ponding depth? • Improper soil media?	• Soil media is clogged and problem is not evident from Level 2 inspection. • Level 2 inspection identifies problem, but it cannot be resolved easily or is associated with the original design of the practice. ☐ Level 3 inspection necessary
Observed Condition: Vegetation is sparse or out of control	
☐ Condition 1: Original design planting plan seems good but has not been maintained, so there are many invasives and/or dead plants Will require some horticultural experience to restore vegetation to intended condition by weeding, pruning, removing plants, and adding new plants. ☐ Condition 2: Original design planting plan is unknown or cannot be actualized A landscape architect or horticulturalist will be needed to redo the planting plan. Will likely require analysis of soil pH, moisture, organic content, sun/shade, and other conditions to make sure plants match conditions. Plan should include invasive plant management and maintenance plan to include mulching, watering, disease intervention, periodic thinning/pruning, etc.	• Vegetation deviates significantly from original planting plan; Bioretention has been neglected and suffered from deferred maintenance. • Owner/responsible party does not know how to maintain the practice. ☐ Level 3 inspection necessary
Observed Condition: Bioretention does not conform to original design plan in surface area or storage	
☐ Condition 1: Level 2 Inspection reveals that practice is too small based on design dimension, does not have adequate storage (e.g., ponding depth) based on the plan, and/or does not treat the drainage area runoff as indicated on the plan Small areas of deviation can be corrected by the property owner or responsible party, but it is likely that a Qualified Professional will have to revisit the design and attempt a redesign that meets original objectives or that can be resubmitted to the municipality for approval.	• More than a 25% departure from the approved plan in surface area, storage, or drainage area; sometimes less than this threshold at the discretion of the Level 2 inspector. ☐ Level 3 inspection necessary

Level 2 Inspection: BIORETENTION
NOTE: Key Source for this Information *(CSN, 2013)*

Recommended Repairs	Triggers for Level 3 Inspection
Observed Condition: Severe erosion of filter bed, inlets, or around outlets	
☐ Condition 1: Erosion at inlets The lining (e.g., grass, matting, stone, rock) may not be adequate for the actual flow velocities coming through the inlets. First line of defense is to try a more non-erosive lining and/or to extend the lining further down to where inlet slopes meet the Bioretention surface. If problem persists, analysis by a Qualified Professional is warranted. ☐ Condition 2: Erosion of Bioretention filter bed This is often caused by "preferential flow paths" through and along the Bioretention surface. The source of flow should be analyzed and methods employed to dissipate energy and disperse the flow (e.g., check dams, rock splash pads). ☐ Condition 3: Erosion on side slopes Again, the issue is likely linked with unanticipated flow paths down the side slopes (probably overland flow that concentrates as it hits the edge of the slope). For small or isolated areas, try filling, compacting, and re-establishing healthy ground cover vegetation. If the problem is more widespread, further analysis is required to determine how to redirect the flow.	• Erosion (rills, gullies) is more than 12 inches deep at inlets or the filter bed or more than 3 inches deep on side slopes. • If the issue is not caused by moving water but some sort of subsurface defect. This may manifest as a sinkhole or linear depression and be associated with problems with the underdrain stone or pipe or underlying soil. ☐ Level 3 inspection necessary
Observed Condition: Significant sediment accumulation, indicating an uncontrolled source of sediment	
☐ Condition 1: Isolated areas of sediment accumulation, generally less than 3-inches deep Sediment source may be from a one-time or isolated event. Remove accumulated sediment and top 2 to 3 inches of Bioretention soil media; replace with clean material. Check drainage area for any ongoing sources of sediment. ☐ Condition 2: Majority of the surface is caked with "hard pan" (thin layer of clogging material) or accumulated sediment that is 3-inches deep or more This can be caused by an improper construction sequence (drainage area not fully stabilized prior to installation of Bioretention soil media) or another chronic source of sediment in the drainage area. Augering several holes down through the media can indicate how severe the problem is; often the damage is confined to the first several inches of soil media. Removing and replacing this top layer (or to the depth where sediment incursion is seen in auger holes) can be adequate, as long as the problem does not recur.	• More than 2 inches of accumulated sediment cover 25% or more of the Bioretention surface area. • "Hard pan" of thin, crusty layer covers majority of Bioretention surface area and seems to be impeding flow of water down through the soil media. • New sources of sediment seem to be accumulating with each significant rainfall event. ☐ Level 3 inspection necessary

Notes:

Inspector:_____ Date: _____

Complete the following if follow-up/corrective actions were identified during this inspection:

Certified Completion of Follow-Up Actions:

"I hereby certify that the follow-up/corrective actions identified in the inspection performed on _____ (DATE) have been completed and any required maintenance deficiencies have been adequately corrected."

Inspector/Operator: _____ Date: _____

Disconnection & Sheetflow Stormwater Management Practices Level 1 Inspection Checklist

SMP ID #		**SMP Owner**		☐ Private ☐ Public
SMP Location (Address; Latitude & Longitude)				
	Latitude		**Longitude**	

Party Responsible for Maintenance	**System Type**		**Type of Site**
☐ Same as SMP Owner ☐ Other _____	☐ Seasonal ☐ Continuous Use ☐ Other	☐ Above Ground ☐ Below Ground	☐ Commercial ☐ Industrial ☐ Residential ☐ State

Inspection Date		**Inspection Time**	
Inspector			
Date of Last Inspection			

Table 2.4.1 D&S Drainage Area

Visually inspect any surfaces in the drainage area.

Problem (Check if Present)	**Follow-Up Actions**
 ☐ Changes in flow; more runoff; runoff bypassing the practice	☐ For rooftop areas, make sure downspouts are still disconnected and conveying water into the treatment area. ☐ Look for and remove any “dams” of sediment and grass clippings that prevent water from entering the treatment area as sheet flow. ☐ Other:

Table 2.4.1 D&S Drainage Area

Visually inspect any surfaces in the drainage area.

Problem (Check if Present)	Follow-Up Actions
	☐ Kick-Out to Level 2 Inspection: Changes to drainage area size or amount of runoff due to construction, tillage, etc.
 ☐ For parking lots in the drainage area—sediment, grass clippings, or other debris has accumulated at pavement edge.	☐ For small, isolated amounts of debris, sweep up by hand and dispose properly so that it will not be exposed to runoff. ☐ Other: ☐ Kick-Out to Level 2 Inspection: Sediment is widespread and cannot be removed by manual sweeping.
 ☐ For parking lots in the drainage area—dips or damage at pavement edge caused flow to concentrate.	☐ Kick-Out to Level 2 Inspection: This will likely require special expertise to diagnose and fix pavement edge.

Table 2.4.2 D&S Level Spreader/Energy Dissipator

Inspect the energy dissipator closely, during a rain event if possible.

Problem (Check if Present)	Follow-Up Actions
 ☐ Debris and/or sediment accumulated behind or around the level spreader.	☐ Remove debris and sediment by hand and ensure that the area behind the level spreader is relatively flat. Too much debris and sediment can cause runoff to bypass the level spreader structure. ☐ Other:
 ☐ Sinking, cracking, sloughing, or other structural problem makes the energy dissipator no longer level.	☐ For stone/gravel spreaders, add new material or rake out as needed to make it even. ☐ Other: ☐ Kick-Out to Level 2 Inspection: Structural issues that cannot be easily fixed by hand

Table 2.4.3 D&S Treatment Area

Examine where flow enters the treatment area as well as the whole flow path. Look for signs of concentrated flow.

Problem (Check if Present)	Follow-Up Actions
☐ Trash and/or debris in the treatment area	☐ Collect trash/debris and dispose of properly.
 ☐ Grass filter strip has grown very tall, to the point that runoff cannot easily enter or is getting concentrated.	☐ Mow filter strip twice a year or more frequently in a residential yard.

Table 2.4.3 D&S Treatment Area

Examine where flow enters the treatment area as well as the whole flow path. Look for signs of concentrated flow.

Problem (Check if Present)	Follow-Up Actions
☐ Sparse vegetation or bare spots	☐ For grassy areas, add topsoil (as needed), grass seed, mulch, and water during the growing season to re-establish consistent vegetation cover. ☐ Other:
 ☐ Rills or gullies are forming in treatment area where flow has become concentrated	☐ For minor rills, fill in with soil, compact, and add seed and straw to establish vegetation. ☐ Other: ☐ Kick-Out to Level 2 Inspection: Rills are more than 2" to 3" deep and require more than just hand raking and re-seeding.

Additional Notes:

Inspector:_____ Date: _____

Complete the following if follow-up/corrective actions were identified during this inspection:

Certified Completion of Follow-Up Actions:

> "I hereby certify that the follow-up/corrective actions identified in the inspection performed on _____ (DATE) have been completed and any required maintenance deficiencies have been adequately corrected."

Inspector/Operator: _____ Date: _____

NEW YORK STATE OF OPPORTUNITY | Department of Environmental Conservation

Disconnection & Sheetflow Stormwater Management Practices Level 2 Inspection Checklist

SMP ID #		**SMP Owner**		☐ Private ☐ Public
SMP Location (Address; Latitude & Longitude)				
	Latitude		**Longitude**	

Party Responsible for Maintenance	**System Type**		**Type of Site**
☐ Same as SMP Owner ☐ Other _____	☐ Seasonal ☐ Continuous Use ☐ Other	☐ Above Ground ☐ Below Ground	☐ Commercial ☐ Industrial ☐ Residential ☐ State

Inspection Date		**Inspection Time**	
Inspector			
Date of Last Inspection			

Level 2 Inspection – DISCONNECTION AND SHEETFLOW	
Recommended Repairs	**Triggers for Level 3 Inspection**
Observed Condition: Significant sediment on pavement that drains to disconnection area (e.g., grass strip)	
☐ Condition 1: Sediment on parking lot is widespread Enlist a mechanical sweeper or vacuum sweeper to remove sediment across entire pavement surface. Pay special attention to downhill edges of pavement where more sediment may have accumulated.	• Sediment accumulation is so serious that it cannot be sufficiently removed with mechanical sweeper. May indicate a high sediment load from uphill in the drainage area that needs to be mitigated. ☐ Level 3 inspection necessary
Observed Condition: Pavement edge deteriorating	
☐ Condition 1: Dips or damage at pavement edge causing runoff to concentrate Determine whether the damaged edge is causing significant enough concentration of runoff to warrant repair or regrading of the pavement.	• Edge must be patched or re-paved to make secure and level. • Parking lot not draining properly to the energy dissipator and treatment area. ☐ Level 3 inspection necessary
Observed Condition: Level spreader/energy dissipator	
☐ Condition 1: Level spreader sinking or uneven If basic equipment can be used, prop up and secure any section of level spreader that is sinking. Regrade soil all around level spreader and add stone as necessary to prevent erosion and bypassing. ☐ Condition 2: Level spreader is broken These repairs can be simple for small, residential-scale practices, such as at a downspout. Ensure the level spreader is level across, keyed in to soil at the edges, and made of durable material that can withstand the flow of water running across it. Larger or more complicated level spreaders (e.g., concrete) will likely require specialized skill and equipment.	• Level spreader requires specialized equipment, regrading, or large amount of material to make level again. • Level spreader needs to be re-designed and replaced. ☐ Level 3 inspection necessary

Level 2 Inspection – DISCONNECTION AND SHEETFLOW	
Recommended Repairs	**Triggers for Level 3 Inspection**
Observed Condition: Erosion in treatment area	
☐ Condition 1: Rills from concentrated flow Inspect energy dissipator to see whether it needs to be improved to better spread out incoming flow. Regrade flow path to ensure that it is relatively flat (if minor). If major re-grading is needed, the treatment area may need to be redesigned and fixed with specialized equipment.	• Major rills and gullies • Treatment area needs to be re-designed and major grading needed. ☐ Level 3 inspection necessary

Notes:

Inspector:_____ Date: _____

Complete the following if follow-up/corrective actions were identified during this inspection:

Certified Completion of Follow-Up Actions:

> "I hereby certify that the follow-up/corrective actions identified in the inspection performed on _____ (DATE) have been completed and any required maintenance deficiencies have been adequately corrected."

Inspector/Operator: _____ Date: _____

NEW YORK STATE OF OPPORTUNITY | Department of Environmental Conservation

Green Roof Stormwater Management Practices Level 1 Inspection Checklist

SMP ID #		**SMP Owner**		☐ Private ☐ Public
SMP Location (Address; Latitude & Longitude)				
	Latitude		**Longitude**	

Party Responsible for Maintenance	**System Type**		**Type of Site**
☐ Same as SMP Owner ☐ Other _____	☐ Seasonal ☐ Continuous Use ☐ Other	☐ Above Ground ☐ Below Ground	☐ Commercial ☐ Industrial ☐ Residential ☐ State

Inspection Date		**Inspection Time**	
Inspector			
Date of Last Inspection			

GR Vegetation and Surface

Visually inspect the surface and vegetation of the practice.

Problem (Check if Present)	**Follow-Up Actions**
☐ Wilting or nutrient-deprived vegetation; bare areas developing on the roof	☐ Water or irrigate. ☐ Prune or remove dead or dying vegetation. ☐ Other:

GR Vegetation and Surface

Visually inspect the surface and vegetation of the practice.

Problem (Check if Present)	Follow-Up Actions
	☐ Kick-Out to Level 2 Inspection: Greater than 20% plant dieoff or wilting, even after rainy periods. May require new vegetation or indicate a problem with the soil medium. ☐ Kick-Out to Level 2 Inspection: Yellowing vegetation may indicate a need for fertilizer, but do not fertilize unless explicitly included in the management plan or with a Level 2 Inspection. ☐ Kick-Out to Level 2 Inspection: Bare areas with no vegetation growing. These may become weed problems in the future.
 ☐ Weeds or moss	☐ Remove weeds by hand. ☐ Apply lime to kill moss. ☐ Other: ☐ Kick-Out to Level 2 Inspection: Weeds cover more than 25% of the surface, or the original planting plan has been compromised.
☐ Ponding between storm events	☐ Kick-Out to Level 2 Inspection: Surface ponding more than 24 hours after a storm event presents a hazard and needs to be addressed immediately.

GR Overflows and Drains

Review the specific maintenance plan for this practice to determine where inspection ports are. Remove the cover and inspect the port.

Problem (Check if Present)	Follow-Up Actions
☐ Inspection port for roof drainage (can be clogged with debris)	☐ Remove debris by hand or flush through with a hose. ☐ Other: ☐ Kick-Out to Level 2 Inspection: Debris cannot be removed, or it appears that debris has accumulated in the underdrains.
☐ Damage to other roof drainage structures (e.g., roof scuppers)	☐ Call contractor or individual in charge of regular building maintenance. This is a building maintenance issue. ☐ Other:

Additional Notes:

Inspector:_____ Date: _____

Complete the following if follow-up/corrective actions were identified during this inspection:

Certified Completion of Follow-Up Actions:

"I hereby certify that the follow-up/corrective actions identified in the inspection performed on _____ (DATE) have been completed and any required maintenance deficiencies have been adequately corrected."

Inspector/Operator: _____ Date: _____

NEW YORK STATE OF OPPORTUNITY | Department of Environmental Conservation

Green Roof Stormwater Management Practices Level 2 Inspection Checklist

SMP ID #		**SMP Owner**		☐ Private ☐ Public
SMP Location (Address; Latitude & Longitude)				
	Latitude		**Longitude**	

Party Responsible for Maintenance	**System Type**		**Type of Site**
☐ Same as SMP Owner ☐ Other _____	☐ Seasonal ☐ Continuous Use ☐ Other	☐ Above Ground ☐ Below Ground	☐ Commercial ☐ Industrial ☐ Residential ☐ State

Inspection Date		**Inspection Time**	
Inspector			
Date of Last Inspection			

Level 2 Inspection: GREEN ROOF

Recommended Repairs and Required Skills	Triggers for Level 3 Inspection
Observed Condition: Unhealthy or Dying Vegetation	
☐ Condition 1: Large number of plants dying from wilt If this is a one-time occurrence, review weather and landscaping records to see whether the die off seems reasonable. If so, deeply water immediately, and plant reinforcements in the spring. ☐ Condition 2: Vegetation is dying and yellowing For yellowing vegetation, consider testing the media for pH, nutrient levels, and other factors that may affect growth. Problems identified would go to a Level 3 inspector (see note to right).	• More than 25% die off • Plants are unhealthy for a prolonged period of time or need to be replanted repeatedly, indicating that a new planting plan may be necessary, or the planting medium is not functioning properly. • pH or other media constituents are not conducive to plant growth, and the media needs to be amended (e.g., lime, fertilizer). This should be handled by a green roof vendor or green roof plant specialist. ☐ Level 3 inspection necessary
Observed Condition: Ponding Between Storm Events or Debris Accumulation	
☐ Condition 1: Further inspection shows debris is clogging the outflow drainpipe Remove debris by hand and revisit within 24 hours to see whether this action fixed the problem. ☐ Condition 2: Debris has backed up to include the underdrain Attempt to remove by hand or flush out with a hose.	• Ponding continues even after debris has been removed. This may indicate a problem with either the media or the underdrain system. ☐ Level 3 inspection necessary
Observed Condition: Structural Damage to Overflows	
☐ Condition: If the damage is minor, repair damage directly, per original design drawings	• Most instances of structural damage will need to be referred to the designer or a qualified green roof vendor. ☐ Level 3 inspection necessary
Observed Condition: Roof is Leaking or indication that the membrane has a leak	
☐ Condition: Roof is leaking	• Any leaks in the membrane trigger a Level 3 inspection or an inspection by the original installer or designer. ☐ Level 3 inspection necessary

Notes:

Inspector:_____ Date: _____

Complete the following if follow-up/corrective actions were identified during this inspection:

Certified Completion of Follow-Up Actions:

"I hereby certify that the follow-up/corrective actions identified in the inspection performed on _____ (DATE) have been completed and any required maintenance deficiencies have been adequately corrected."

Inspector/Operator: _____ Date: _____

Infiltration Stormwater Management Practices Level 1 Inspection Checklist

SMP ID #		**SMP Owner**		☐ Private ☐ Public
SMP Location (Address; Latitude & Longitude)				
	Latitude		**Longitude**	

Party Responsible for Maintenance	**System Type**		**Type of Site**
☐ Same as SMP Owner ☐ Other _____	☐ Seasonal ☐ Continuous Use ☐ Other	☐ Above Ground ☐ Below Ground	☐ Commercial ☐ Industrial ☐ Residential ☐ State

Inspection Date		**Inspection Time**	
Inspector			
Date of Last Inspection			

IN Drainage Area

Look for both pervious and impervious areas that are uphill from the Infiltration cell.

Problem (Check if Present)		**Follow-Up Actions**
	☐ Bare soil, erosion of the ground (rills washing out the dirt)	☐ Seed and straw areas of bare soil to establish vegetation. ☐ Fill in erosion areas with soil, compact, and seed and straw to get vegetation established. ☐ If a rill or small channel is forming, try to redirect water flowing to this area by creating a small berm or adding topsoil to areas that are heavily compacted. ☐ Other:

IN Drainage Area

Look for both pervious and impervious areas that are uphill from the Infiltration cell.

Problem (Check if Present)		Follow-Up Actions
		☐ Kick-Out to Level 2 Inspection: Large areas of soil have been eroded, or larger channels are forming. May require rerouting of flow paths.
☐ For Dry Wells: Leaves, sticks, or other debris in gutters and downspouts		☐ Remove all debris by hand. ☐ Other:
	☐ Piles of grass clippings, mulch, dirt, salt, or other materials	☐ Remove or cover piles of grass clippings, mulch, dirt, etc. ☐ Other:
	☐ Open containers of oil, grease, paint, or other substances	☐ Cover or properly dispose of materials; consult your local solid waste authority for guidance on materials that may be toxic or hazardous. ☐ Other:

IN Inlets

Look for all the places where water flows into the Infiltration practice.

Problem (Check if Present)	Follow-Up Actions
 ☐ Inlets are collecting grit and debris or grass/weeds are growing. Some water may not be getting into the Infiltration practice.	☐ Use a flat shovel to remove grit and debris (especially at curb inlets or openings). Parking lots generate fine grit that will accumulate at these spots. ☐ Pull out clumps of growing grass or weeds and scoop out the soil or grit that the plants are growing in. ☐ Remove any grass clippings, leaves, sticks, and other debris that is collecting at inlets. ☐ For pipes and ditches, remove sediment and debris that is partially blocking the pipe or ditch opening where it enters the Infiltration practice. ☐ Dispose of all material properly in an area where it will not re-enter the practice. ☐ Other: ☐ Kick-Out to Level 2 Inspection: Inlets are blocked to the extent that most of the water does not seem to be entering the Infiltration practice.
☐ Some or all of the inlets are eroding so that rills, gullies, and other erosion is present, or there is bare dirt that is washing into the Infiltration practice.	☐ For small areas of erosion, smooth out the eroded part and apply rock or stone (e.g., river cobble) to prevent further erosion. Usually, filter fabric is placed under the rock or stone. ☐ In some cases, reseeding and applying erosion-control matting can be used to prevent further erosion. Some of these materials may be available at a garden center, but it may be best to consult a landscape contractor. ☐ Other: ☐ Kick-Out to Level 2 Inspection: Erosion is occurring at most of the inlets and it looks like there is too much water that is concentrating at these points. The inlet design may have to be modified.

IN Infiltration Area

Examine the surface of the infiltration area and the observation well. Note: The following Problem and Follow-Up Actions apply to infiltration practice pretreatment areas also.

Problem (Check if Present)	Follow-Up Actions
 ☐ For grass-covered Infiltration practices: grass has grown very tall, *Photo credit: Stormwater Maintenance, LLC*	☐ Mow infiltration area at least twice per year. ☐ Other:
 ☐ For grass-covered Infiltration practices: sparse vegetation cover or bare spots	☐ Add topsoil (as needed), grass seed, straw, and water during the growing season to re-establish consistent grass coverage. ☐ Other: ☐ Kick-Out to Level 2 Inspection: Sparse vegetation cover can be a sign that the infiltration area is not infiltrating at the proper rate and water is standing too long after a storm. The surface may be saturated or squishy, and the conditions do not enable grass to grow. This situation should be evaluated by a Level 2 Inspection and likely corrected by a qualified contractor.
☐ Minor areas of sediment, grit, trash, or other debris are accumulating on the surface.	☐ Use a shovel to scoop out minor areas of sediment or grit, especially in the spring after winter sanding materials may wash in and accumulate. Dispose of the material where it cannot re-enter the Infiltration practice. ☐ If removing the material creates a hole or low area, rake the surface smooth and level. ☐ Remove trash, debris, and other undesirable materials. ☐ Other: ☐ Kick-Out to Level 2 Inspection: Sediment has accumulated more than 2-inches deep and covers 25% or more of the surface of the Infiltration area.

IN Infiltration Area

Examine the surface of the infiltration area and the observation well. Note: The following Problem and Follow-Up Actions apply to infiltration practice pretreatment areas also.

Problem (Check if Present)	Follow-Up Actions
 ☐ There is erosion on the surface; water seems to be carving out rills as it flows across the surface of the Infiltration area or sinkholes are forming in certain areas.	☐ For minor areas of erosion, try filling the eroded areas with clean topsoil, sand, or stone (whatever the existing cover is). ☐ If the problem recurs, you may have to use larger stone (e.g., river cobble) to fill in problem areas. ☐ Other: ☐ Kick-Out to Level 2 Inspection: The problem persists or the erosion is more than 3-inches deep and seems to be an issue with how water enters and moves through the infiltration area. ☐ Kick-Out to Level 2 Inspection: The problem does not seem to be caused by flowing water but a collapse or sinking of the surface (e.g., “sinkhole”) due to some underground problem.
 ☐ Observation well is damaged or cap is missing	☐ Kick-Out to Level 2 Inspection: Requires replacing pipes or caps.

IN Infiltration Area

Examine the surface of the infiltration area and the observation well. Note: The following Problem and Follow-Up Actions apply to infiltration practice pretreatment areas also.

Problem (Check if Present)	Follow-Up Actions
 ☐ Water still visible in the observation well more than 72 hours after a rain storm. The Infiltration practice does not appear to be draining properly.	☐ Kick-Out to Level 2 Inspection: This is generally a serious problem, and it will be necessary to activate a Level 2 Inspection.

IN Outlets

Locate and inspect all outlets.

Problem (Check if Present)	Follow-Up Actions
 ☐ Outlet obstructed with sediment, debris, trash, etc.	☐ Remove the debris and dispose of it where it cannot re-enter the infiltration area. ☐ Other:
	☐ Kick-Out to Level 2 Inspection: Outlet is completely obstructed; there is too much material to remove by hand or with simple hand tools.
☐ Rills or gullies are forming at outlet.	☐ For minor rills, fill in with soil, compact, and seed and straw to establish vegetation. ☐ Other:
	☐ Kick-Out to Level 2 Inspection: Rills are more than 2" to 3" deep and require more than just hand raking and re-seeding.

Additional Notes:

Inspector:_____ Date: _____

Complete the following if follow-up/corrective actions were identified during this inspection:

Certified Completion of Follow-Up Actions:

"I hereby certify that the follow-up/corrective actions identified in the inspection performed on _____ (DATE) have been completed and any required maintenance deficiencies have been adequately corrected."

Inspector/Operator: _____ Date: _____

NEW YORK STATE OF OPPORTUNITY | Department of Environmental Conservation

Infiltration Stormwater Management Practices Level 2 Inspection Checklist

SMP ID #		**SMP Owner**		☐ Private ☐ Public
SMP Location (Address; Latitude & Longitude)				
	Latitude		**Longitude**	

Party Responsible for Maintenance	**System Type**		**Type of Site**
☐ Same as SMP Owner ☐ Other _____	☐ Seasonal ☐ Continuous Use ☐ Other	☐ Above Ground ☐ Below Ground	☐ Commercial ☐ Industrial ☐ Residential ☐ State

Inspection Date		**Inspection Time**	
Inspector			
Date of Last Inspection			

Level 2 Inspection: INFILTRATION

Recommended Repairs	Triggers for Level 3 Inspection
Observed Condition: Water Stands on Surface for More than 72 Hours after Storm	
☐ Condition 1: Small pockets of standing water For infiltration basins with soil, use a soil probe or auger to examine the soil profile. For gravel infiltration trenches or basins, use a shovel to dig into the gravel layer where the problem is occurring. If isolated areas have accumulated grit, fine silt, or vegetative debris or have bad soil or clogged gravel, try removing and replacing with clean material. If the practice is supposed to have grass cover, it will likely be necessary to replant once the problem is resolved. ☐ Condition 2: Standing water is widespread or covers entire surface Look in the observation well (if it exists) and use a tape measure to estimate the depth of water standing in the soil or gravel. Requires diagnosis and resolution of problem: • Too much sediment/grit washing in from drainage area? • Too much ponding depth? • Improper infiltration media? • Underlying soil not suitable for infiltration? As above, the resolution will likely require replanting and re-establishment of good grass cover if this is part of the design.	• Infiltration media is clogged and problem cannot be diagnosed from Level 2 inspection. • Level 2 inspection identifies problem, but it cannot be resolved easily or it is associated with the original design of the practice. ☐ Level 3 Inspection necessary
Observed Condition: Severe erosion of infiltration bed, inlets, or around outlets	
☐ Condition 1: Erosion at inlets The lining (e.g., grass, matting, stone, rock) may not be adequate for the actual flow velocities coming through the inlets. First line of defense is to try a less erosive lining and/or extending the lining further down to where inlet slopes meet the infiltration surface. If problem persists, analysis by a Qualified Professional is warranted. ☐ Condition 2: Erosion of infiltration bed This is often caused by “preferential flow paths” along the surface. The source of flow should be analyzed and methods employed to dissipate energy and disperse the flow (e.g., check dams, rock splash pads).	• Erosion (rills, gullies) is more than 12 inches deep • The issue is not caused by moving water but some sort of subsurface defect, which may manifest as a sinkhole or linear depression and be associated with problems with the underlying stone or soil. ☐ Level 3 Inspection necessary

Notes:

Inspector:_____ Date: _____

Complete the following if follow-up/corrective actions were identified during this inspection:

Certified Completion of Follow-Up Actions:

"I hereby certify that the follow-up/corrective actions identified in the inspection performed on _____ (DATE) have been completed and any required maintenance deficiencies have been adequately corrected."

Inspector/Operator: _____ Date: _____

NEW YORK STATE OF OPPORTUNITY | Department of Environmental Conservation

Permeable Pavement Stormwater Management Practices Level 1 Inspection Checklist

SMP ID #		**SMP Owner**		☐ Private ☐ Public
SMP Location (Address; Latitude & Longitude)				
	Latitude		**Longitude**	

Party Responsible for Maintenance	**System Type**		**Type of Site**
☐ Same as SMP Owner ☐ Other _____	☐ Seasonal ☐ Continuous Use ☐ Other	☐ Above Ground ☐ Below Ground	☐ Commercial ☐ Industrial ☐ Residential ☐ State

Inspection Date		**Inspection Time**	
Inspector			
Date of Last Inspection			

PP Drainage Area

Look for areas that are uphill from the Permeable pavement.

Problem (Check if Present)		**Follow-Up Actions**
	☐ Bare soil, erosion of the ground (rills washing out the dirt)	☐ Seed and straw areas of bare soil to establish vegetation. ☐ Fill in erosion areas with soil, compact, and seed and straw to establish vegetation. ☐ If a rill or small channel is forming, try to redirect water flowing to this area by creating a small berm or adding topsoil to areas that are heavily compacted. ☐ Other:

PP Drainage Area

Look for areas that are uphill from the Permeable pavement.

Problem (Check if Present)		Follow-Up Actions
		☐ Kick-Out to Level 2 Inspection: Large areas of soil have been eroded, or larger channels are forming. May require rerouting of flow paths.
	☐ Piles of grass clippings, mulch, dirt, salt, or other materials	☐ Remove or cover piles of grass clippings, mulch, dirt, etc. ☐ Other:
	☐ Open containers of oil, grease, paint, or other substances	☐ Cover or properly dispose of materials; consult your local solid waste authority for guidance on materials that may be toxic or hazardous. ☐ Other:

PP Surface

Examine the entire permeable pavement surface.

Problem (Check if Present)	Follow-Up Actions
 ☐ Dirt and grit accumulating on pavement surface	☐ For small areas (e.g., driveways, patios), try a leaf blower or sweep the area to remove the dirt/grit from the Permeable pavement and properly dispose of the material. ☐ If dirt/grit remain in the joint areas between paver blocks, agitate with a rough brush and vacuum the surface with a wet/dry vac. ☐ Remove and replace clogged blocks in segmented pavers. ☐ For larger areas (e.g., parking lots, courtyards), hire a vacuum sweeper to restore the surface to a cleaner condition. ☐ Other: ☐ Kick-Out to Level 2 Inspection: Grit is widespread and cannot be removed by manual sweeping.
 ☐ Grass and weeds are growing on the permeable pavement surface (applies only to pavement types that are not intended to be covered in vegetation).	☐ If paver type is not intended to be covered in vegetation, remove the grass/weeds either mechanically (pulling, by hand or with a flame weeder) or with a herbicide approved for use in or near water (consult your local Extension Office for suggestions). ☐ Follow the actions listed above for removing dirt/grit from the pavement surface. ☐ Other: ☐ Kick-Out to Level 2 Inspection: Grass/weeds cover more than 25% of surface area.
 ☐ Slumping, sinking, cracking, or breaking of the pavement surface *(Source: CSN, 2013)*	☐ For small areas (e.g., patios, small driveway), it may be possible to remove the damaged pavers, check and fill in the underlying gravel, and replace with new materials. ☐ Other: ☐ Kick-Out to Level 2 Inspection: Problem affects more than a small, isolated area. Will typically require a qualified contractor to fix it. ☐ Problem recurs or occurs in multiple small locations.
 ☐ Water stands on Permeable pavement for days after a rainstorm; the Permeable pavement is clogged and doesn't let water through. *(Source: CSN, 2013)*	☐ Kick-Out to Level 2 Inspection: This is generally a serious problem, and it will be necessary to activate a Level 2 Inspection.

Additional Notes:

Inspector:_____ Date: _____

Complete the following if follow-up/corrective actions were identified during this inspection:

Certified Completion of Follow-Up Actions:

"I hereby certify that the follow-up/corrective actions identified in the inspection performed on _____ (DATE) have been completed and any required maintenance deficiencies have been adequately corrected."

Inspector/Operator: _____ Date: _____

Permeable Pavement Stormwater Management Practices Level 2 Inspection Checklist

SMP ID #		**SMP Owner**		☐ Private ☐ Public
SMP Location (Address; Latitude & Longitude)				
	Latitude		**Longitude**	

Party Responsible for Maintenance	**System Type**		**Type of Site**
☐ Same as SMP Owner ☐ Other _____	☐ Seasonal ☐ Continuous Use ☐ Other	☐ Above Ground ☐ Below Ground	☐ Commercial ☐ Industrial ☐ Residential ☐ State

Inspection Date		**Inspection Time**	
Inspector			
Date of Last Inspection			

Level 2 Inspection: PERMEABLE PAVEMENT

Recommended Repairs and Required Skills	Triggers for Level 3 Inspection
Observed Condition: Bare Soil or Erosion in the Drainage Area	
☐ Condition 1: Extensive problem spots, but no channels or rills forming Reseed problem areas. If problem persists or grass does not take, consider hiring a landscape contractor. ☐ Condition 2: Problem is extensive, and rills/channels are beginning to form May be necessary to divert or redirect water that is causing the erosion problem. If it appears that simple regrading—such as installing a berm or leveling a low spot–will fix the problem, make repairs and check to ensure that the problem is repaired after the next storm.	• Large rills or gullies are forming in the drainage area. • An attempt to regrade the drainage area has been unsuccessful • Fixing the problem would require major regrading (i.e., redirecting more than a 100-square-foot area. • It is not clear why the problem is occurring. ☐ Level 3 inspection necessary
Observed Condition: Dirt or Grit Accumulating, or Grass Growing on Pavement Surface	
☐ Condition 1: Grit beginning to form but is isolated to a small area or does not fill the joints between paver blocks Try to agitate and sweep by hand, or hire a contractor with a vacuum sweeper. Also investigate the drainage area for potential sediment sources. If no obvious sources are found, discuss winter sanding and salting operations with the property owner to identify whether this could be the source. ☐ Condition 2: Grit is forming and cannot be removed with agitation and hand sweeping Hire a vendor with a regenerative air vacuum sweeper, maximum power 2,500 rpm; avoid sweepers that use water.	• More than 2 inches of sand/dirt/grit are on some of the pavement surface. • More than 25% of the pavement surface is covered with sand/dirt/grit to the extent that joints between paver blocks are filled. • Regenerative air sweeper cannot remove grit. ☐ Level 3 inspection necessary

Level 2 Inspection: PERMEABLE PAVEMENT

Recommended Repairs and Required Skills	Triggers for Level 3 Inspection
Observed Condition: Structural Damage	
☐ Condition 1: Portions of porous asphalt or permeable pavers are damaged, and the cause is known to be at the surface. If the damage is from a single event such as heavy equipment or heavy fallen objects, or the surface has been damaged by wear over time, hire a contractor experienced in permeable pavement installation to repair the damaged areas. ☐ Condition 2: Damage to other structures, such as drainage infrastructure If possible, repair or replace damaged items, or hire a contractor with permeable pavement experience if the damaged infrastructure is within the pavement surface.	• More than 25% of the surface needs to be repaired or replaced. • It appears that the underlying material has "caved in," indicating an underlying water conveyance or soil stabilization issue. • Problem is repaired but recurs within less than five years. ☐ Level 3 inspection necessary
Observed Condition: Ponding on the Pavement Surface	
☐ Condition 1: Underdrains (if present) may be clogged Check to see whether underdrains are clogged by inspecting cleanouts (if present) or catch basins and looking for debris. If underdrains appear clogged, it may be necessary to hire a router service to ream out the underdrains. ☐ Condition 2: At time of Level 2 inspection, water is not ponded, and there is no obvious clogging of the surface. Conduct a flood test to determine whether the ponding is an ongoing problem.	• Water stands on the pavement surface more than 72 hours after a storm, and the problem cannot be resolved by unclogging underdrains. • More than 25% of the pavement surface is covered with sand/dirt/grit to the extent that joints between paver blocks are filled. ☐ Level 3 inspection necessary

Notes:

Inspector:_____ Date: _____

Complete the following if follow-up/corrective actions were identified during this inspection:

Certified Completion of Follow-Up Actions:

"I hereby certify that the follow-up/corrective actions identified in the inspection performed on _____ (DATE) have been completed and any required maintenance deficiencies have been adequately corrected."

Inspector/Operator: _____ Date: _____

NEW YORK STATE OF OPPORTUNITY | Department of Environmental Conservation

Pond and Wetland Stormwater Management Practices Level 1 Inspection Checklist

SMP ID #		**SMP Owner**		☐ Private ☐ Public
SMP Location (Address; Latitude & Longitude)				
	Latitude		**Longitude**	

Party Responsible for Maintenance	**System Type**		**Type of Site**
☐ Same as SMP Owner ☐ Other _____	☐ Seasonal ☐ Continuous Use ☐ Other	☐ Above Ground ☐ Below Ground	☐ Commercial ☐ Industrial ☐ Residential ☐ State

Inspection Date		**Inspection Time**	
Inspector			
Date of Last Inspection			

PW Drainage Area

Look for areas that are uphill from the pond.

Problem (Check if Present)	**Follow-Up Actions**
☐ Bare soil, erosion of the ground (rills washing out the dirt)	☐ Seed and straw areas of bare soil to establish vegetation. ☐ Fill in eroded areas with soil, compact, seed and mulch with straw to establish vegetation. ☐ Other:

☐ Bare soil, erosion of the ground (rills washing out the dirt)	☐ Kick-Out to Level 2 Inspection: If a rill or small channel is forming, try to redirect water flowing to this area by creating a small berm or adding topsoil to areas that are heavily compacted. ☐ If large areas of soil have been eroded or larger channels are forming, this may require rerouting of flow paths or use of an erosion-control seed mat or blanket to reestablish acceptable ground cover or anchor sod where it is practical.
 ☐ Piles of grass clippings, mulch, dirt, salt, or other materials	☐ Remove or cover piles of grass clippings, mulch, dirt, etc. ☐ Remove excessive vegetation or woody debris that can block drainage systems. ☐ Other:
 ☐ Open containers of oil, grease, paint, or other substances exposed to rain in the drainage area	☐ Cover or properly dispose of materials; consult your local solid waste authority for guidance on materials that may be toxic or hazardous. ☐ Other:

Pond Inlets

Look for all areas where water flows into the pond during storms. Note that there may be multiple points of inflow and types of structures (e.g., pipes, open ditches, etc.).

Problem (Check if Present)	Follow-Up Actions
 ☐ Inlets are buried, covered or filled with silt, debris, or trash, or blocked by excessive vegetation.	☐ If the problem can be remedied with hand tools and done in a safe manner, remove vegetation, trash, woody debris, etc. from blocking inlet structures. ☐ Other: ☐ Kick-Out to Level 2 or 3 Inspection: If the amount of material is too large to handle OR there are ANY safety concerns about working in standing water, soft sediment, etc., the work will likely have to be performed by a qualified contractor.

Pond Inlets

Look for all areas where water flows into the pond during storms. Note that there may be multiple points of inflow and types of structures (e.g., pipes, open ditches, etc.).

Problem (Check if Present)		Follow-Up Actions
	☐ Inlets are buried, covered or filled with silt, debris, or trash, or blocked by excessive vegetation.	☐ Kick-Out to Level 2 or 3 Inspection: If the amount of material is too large to handle OR there are ANY safety concerns about working in standing water, soft sediment, etc., the work will likely have to be performed by a qualified contractor.
	☐ Inlets are broken, and, with pieces of pipe or concrete falling into the pond, there is erosion around the inlet, there is open space under the pipe, or there is erosion where the inlet meets the pond	☐ Kick-Out to Level 2 Inspection: These types of structural or erosion problems are more serious and will require a qualified contractor to repair.

PW Pond Area and Embankments

Examine both interior and exterior pond banks as well as the pond body. Observe from the inlet pipes to the outfall structure and emergency overflow.

Problem (Check if Present)		Follow-Up Actions
	☐ The pretreatment area(s) or forebay(s) are filled with sediment, trash, vegetation, or other debris.	☐ If the problem can be remedied with hand tools and done in a safe manner, use a flat shovel or other equipment to remove small amounts of sediment. ☐ Remove trash and excessive vegetation from forebays if this can be done in a safe manner. ☐ Other:

PW Pond Area and Embankments

Examine both interior and exterior pond banks as well as the pond body. Observe from the inlet pipes to the outfall structure and emergency overflow.

Problem (Check if Present)		Follow-Up Actions
	☐ The pretreatment area(s) or forebay(s) are filled with sediment, trash, vegetation, or other debris.	☐ Kick-Out to Level 2 Inspection: Large amounts of sediment or debris will have to be removed by a qualified contractor. ANY condition that poses a safety concern for working in standing water or soft sediments should be referred to a Level 2 Inspection or qualified contractor.
	☐ The pond area itself has accumulated sediment, trash, debris, or excessive vegetation that is choking the flow of the water, OR the pond area is covered with algae or aquatic plants.	☐ Level 1 includes handling only small amounts of material that can be removed by hand, or with rakes or other hand tools. Do not attempt any repair that poses a safety issue. ☐ Other: ☐ Kick-Out to Level 2 Inspection: Most cases will call for a Level 2 Inspection and/or a qualified contractor. ☐ You are not sure what type and amount of vegetation is supposed to be in the pond. ☐ The algae or aquatic plants should be identified so that proper control techniques can be applied.
	☐ The side slopes of the pond are unstable, eroding, and have areas of bare dirt.	☐ If there are only minor areas, try filling in small rills or gullies with topsoil, compacting, and seeding and mulching all bare dirt areas with an appropriate seed. Alternatively, try using herbaceous plugs to get vegetation established in tricky areas, such as steep slopes. ☐ Other: ☐ Kick-Out to Level 2 Inspection: Erosion and many bare dirt areas on steep side slopes will require a Level 2 Inspection and repair by a qualified contractor.

PW Pond Area and Embankments

Examine both interior and exterior pond banks as well as the pond body. Observe from the inlet pipes to the outfall structure and emergency overflow.

Problem (Check if Present)		Follow-Up Actions
 	☐ The riser structure is clogged with trash, debris, sediment, vegetation, etc., OR is open, unlocked, or has a steep drop and poses a safety concern. The pond level may have dropped below its "normal" level.	☐ If you can safely access the riser on foot or with a small boat, clear minor amounts of debris and remove it from the pond area for safe disposal. ☐ Other: ☐ Kick-Out to Level 2 Inspection: The riser cannot be accessed safely, the amount of debris is substantial, or the riser seems to be completely clogged and the water level has risen too high. ☐ There are safety issues with the riser and concern about access to pipes, drops, or any other life safety concern. ☐ The riser is leaning, broken, settling or slumping, corroded, eroded or any other structural problem.
	☐ The dam/embankment is slumping, sinking, settling, eroding, or has medium or large trees growing on it.	☐ If there are small isolated areas, try to fix them by adding clean material (clay and topsoil) and seeding and mulching. ☐ Periodically mow embankments to enable inspection of the banks and to minimize establishment of woody vegetation. ☐ Remove any woody vegetation that has already established on embankments. ☐ Other: ☐ Kick-Out to Level 2 Inspection: Most of these situations will require a Level 2 Inspection or evaluation and repair by a qualified contractor. Seepage through the dam or problems with the pipe through the dam can be a serious issue that should be addressed to avoid possible dam failure.

PW Pond Area and Embankments

Examine both interior and exterior pond banks as well as the pond body. Observe from the inlet pipes to the outfall structure and emergency overflow.

Problem (Check if Present)		Follow-Up Actions
	☐ The emergency spillway or outfall (if it exists) has ☐ Erosion, settlement, or loss of material. Rock-lined spillways have excessive debris or vegetation.	☐ Clear light debris and vegetation. ☐ Other: ☐ Kick-Out to Level 2 Inspection: Displacement of rock lining, excessive vegetation and erosion/settlement may warrant review and decision by Level 2 Inspector to check against original plan. ☐ Any uncertainty about the integrity of the emergency spillway should be referred to a Level 2 Inspector. ☐ Erosion or settlement such that design has been compromised should be reviewed by an engineer.

PW Pond Outlet

Examine the outlet of the pipe on the downstream side of the dam/embankment where it empties into a stream, channel, or drainage system.

Problem (Check if Present)	Follow-Up Actions
 ☐ The pond outlet is clogged with sediment, trash, debris, vegetation, or is eroding, caving in, slumping, or falling apart.	☐ If there is a minor blockage, remove the debris or vegetation to allow free flow of water. ☐ Remove any accumulated trash at the outlet. ☐ Outlet: ☐ Kick-Out to Level 2 Inspection: ☐ If the area at the outlet cannot be easily accessed or if the blockage is substantial, a Level 2 Inspection is warranted. ☐ Erosion at and downstream of the outfall should be evaluated by a qualified professional. ☐ Any structural problems, such as broken pipes, structures falling into the stream, or holes or tunnels around the outfall pipe, should be evaluated by a Level 2 Inspector and will require repair by a qualified contractor. ☐ The pool of water at the outlet pipe is discolored, has an odor, or has excessive algae or vegetative growth.

Additional Notes:

Inspector:_____ Date: _____

Complete the following if follow-up/corrective actions were identified during this inspection:

Certified Completion of Follow-Up Actions:

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Inspector/Operator: _____ Date: _____

NEW YORK STATE OF OPPORTUNITY | Department of Environmental Conservation

Pond and Wetland Stormwater Management Practices Level 2 Inspection Checklist

SMP ID #		**SMP Owner**		☐ Private ☐ Public
SMP Location (Address; Latitude & Longitude)				
	Latitude		**Longitude**	

Party Responsible for Maintenance	**System Type**		**Type of Site**
☐ Same as SMP Owner ☐ Other _____	☐ Seasonal ☐ Continuous Use ☐ Other	☐ Above Ground ☐ Below Ground	☐ Commercial ☐ Industrial ☐ Residential ☐ State

Inspection Date		**Inspection Time**	
Inspector			
Date of Last Inspection			

Level 2 Inspection: PONDS and WETLANDS

Recommended Repairs and Required Skills	Triggers for Level 3 Inspection
Observed Condition: Bare Soil or Erosion in the Drainage Area	
☐ Condition 1: Extensive problem spots, but no channels or rills forming Reseed problem areas. If problem persists or grass does not take, consider hiring a landscape contractor. ☐ Condition 2: Problem is extensive, and rills/channels are beginning to form May be necessary to divert or redirect water that is causing the erosion problem. If it appears that simple regrading—such as installing a berm or leveling a low spot–will fix the problem, make repairs and ensure that the problem is repaired after the next storm.	• Large rills or gullies are forming in the drainage area. • An attempt to regrade the drainage area has been unsuccessful. • Fixing the problem would require major regrading (i.e., redirecting more than a 100-square-foot area. • It is not clear why the problem is occurring. ☐ Level 3 inspection necessary
Observed Condition: Manholes or Inlet Pipe Buried or Covered with Vegetation	
☐ Condition 1: Nearest manhole and inlet pipe not found Consult as-built drawings to get to closest suspected location and use metal detector to search for metal manhole cover. If unsuccessful, identify nearest drain inlets and approximate pipe direction to locate next manhole. ☐ Condition 2: Manhole located and inspected Never enter a manhole, except by following confined-space entry protocols. If outlet pipe is not visible or greater than 25% full of sediment/debris or trash, it will typically require a qualified contractor to flush, clean and clear blockages. ☐ Condition 3: Inlet pipe not found at pond Clear vegetation and brush that may be covering the inlet pipe. Buried inlet pipes may be found through use of a metal probe. ☐ Condition 4: Inlet pipe buried in sediment or blocked by vegetation Once located, the pipe path can be cleared of vegetation with brush hook or other brush tools. Light digging may clear sediment from the end of the pipe.	• To locate buried manholes and lost storm lines, it is sometimes necessary to hire a pipeline inspection contractor with televising equipment or ground-penetrating radar and enter at the closest upstream access point. • Locating a buried inlet pipe may require wading in the edge of the pond and using a metal probe and brush axe to find and expose the pipe. • If other than light digging is necessary to remove accumulated sediment, a contractor with heavy equipment may be required. ☐ Level 3 inspection necessary

Level 2 Inspection: PONDS and WETLANDS	
Recommended Repairs and Required Skills	**Triggers for Level 3 Inspection**
Observed Condition: Pipe or Headwall Settlement, Erosion, Corrosion or Failure	
☐ Condition 1: Pipe or headwall settlement or failure Severe sinkholes, settlement or corrosion should be kicked out to Level 3 Inspection. ☐ Condition 2: Flow not confined to pipe and visible outside pipe wall With flashlight, observe the inside of the pipe and note its condition. Take photographs. Look for sinkholes developing that indicate pipe failure beneath the surface. Kick out to Level 3 inspection.	• Where blockages are visible, a decision is needed on whether to clear them or leave in place. If a third of the pipe is full of sediment, it should be removed by a contractor with pipe-cleaning equipment. • Corrosion of inlet pipes that allows flow around the pipe exterior is a structural concern because it can lead to settlement, sinkholes and undermining pond embankment. Evidence of this type of failure may require specialized pipe-inspection equipment and investigation by an engineer. ☐ Level 3 inspection necessary
Observed Condition: Pond Conditions	
☐ Condition 1: Pond pre-treatment zone is full of sediment or not constructed as shown on as-built drawings. ☐ Condition 2: Excessive buildup of sediment or overgrowth If the pre-treatment area or pond pool is overgrown or filled with sediment so that the original design is compromised, corrective measures are required. If plants have died, then replanting is necessary. If none of the original design exists due to alteration or sediment, kick out to Level 3 inspection.	• It may require inspection by an engineer to determine next steps for clearing, replanting or reconstruction. • Erosion or settlement such that design has been compromised should be reviewed by an engineer. Recurring erosion may require redesign and/or regrading to direct flow away from eroding area. • If sediment has filled more than 50% of the pond's capacity, dredging is likely needed and should be evaluated by a qualified contractor. • Removal or control of excessive algae or aquatic plants can be assessed by a qualified pond maintenance company. ☐ Level 3 inspection necessary

Notes:

Inspector:_____ Date: _____

Complete the following if follow-up/corrective actions were identified during this inspection:

Certified Completion of Follow-Up Actions:

"I hereby certify that the follow-up/corrective actions identified in the inspection performed on _____ (DATE) have been completed and any required maintenance deficiencies have been adequately corrected."

Inspector/Operator: _____ Date: _____

Rainwater Harvesting Stormwater Management Practices Level 1 Inspection Checklist

SMP ID #		**SMP Owner**		☐ Private ☐ Public
SMP Location (Address; Latitude & Longitude)				
	Latitude		**Longitude**	

Party Responsible for Maintenance	**System Type**		**Type of Site**
☐ Same as SMP Owner ☐ Other _____	☐ Seasonal ☐ Continuous Use ☐ Other	☐ Above Ground ☐ Below Ground	☐ Commercial ☐ Industrial ☐ Residential ☐ State

Inspection Date		**Inspection Time**	
Inspector			
Date of Last Inspection			

RWH Conveyance System and Filter

Inspect any gutters, downspouts, drainage pipes, and filters connected to the Rainwater Harvesting System.

Problem (Check if Present)	**Follow-Up Actions**
☐ Leaves, sticks, or other debris in gutters and downspouts	☐ Remove all debris by hand. ☐ Other:
☐ Leaves, sticks, or other debris in filter(s)	☐ Clean out all debris and organic matter buildup by hand or by spraying with a hose. ☐ Other:

RWH Conveyance System and Filter

Inspect any gutters, downspouts, drainage pipes, and filters connected to the Rainwater Harvesting System.

Problem (Check if Present)	Follow-Up Actions
	☐ Kick-Out to Level 2 Inspection: Filter (first-flush diverter or vortex filter outside the tank) does not seem to be operating, is completely clogged, or does not appear to be trapping any debris.
☐ Loose or disconnected junctions between gutters, pipes, or filters	☐ Secure any loose junctions or parts and make sure they are properly sealed to prevent leaks, ☐ Other:

RWH Storage Tank

Inspect for any leaks or blockages when tank is full. Drain tank to visually inspect interior without breaking the plane of the opening with any part of the body. This is a confined space that should only be entered by those with special training.

Problem (Check if Present)	Follow-Up Actions
☐ Tank is above ground and not freeze proof.	**Winterize the tank by performing the following steps:** ☐ Drain down water level in the tank before winter to avoid damage from freezing temperatures. ☐ Drain water from pipes and pumps. ☐ Disconnect conveyance pipes from the tank to enable roof runoff to bypass the tank during winter.
☐ Mosquito larvae or other insects present in the water	☐ Add mosquito dunks to water. ☐ Ensure that insect screens are installed on all openings and are properly sealed (inlet and outlets). ☐ Other:
☐ Debris, algae, or organic matter accumulated in tank	☐ Remove as much as possible, by hand. ☐ Other: ☐ Kick-Out to Level 2 Inspection: For large tanks that cannot easily be accessed for inspection and/or cleaning, defer to Level 2 Inspection.
☐ Tank does not appear to fill fully even during large rains, or water level drops quickly after filling.	☐ Kick-Out to Level 2 Inspection: Water is bypassing the tank and/or there are leaks in the tank wall. This will likely require special expertise to diagnose and fix.
☐ Problems with pumps, filters, or other mechanical components	☐ Kick-Out to Level 2 Inspection: This will likely require special expertise to diagnose and fix.

RWH Outlets

Examine the outlet pipe(s) and the point at which it overflows onto the ground.

Problem (Check if Present)	Follow-Up Actions
☐ Slow flow from outlet caused by faulty or clogged valve	☐ If clogging seems to be the problem, ream out sediment from valve if this can be done from exterior. ☐ Other: ☐ Kick-Out to Level 2 Inspection: Valve needs to be replaced or cannot be cleaned out from outside of tank.
☐ Flow from outlet is backing up toward building foundation.	☐ Add flexible pipe to end of outlet pipe to divert flow further away and downhill from building.
☐ Erosion or drainage issues at outlet	☐ Add a gravel and/or stone pad to reduce the impact from the water flowing out of the outlet pipe during storms. ☐ Other: ☐ Kick-Out to Level 2 Inspection: Rills have formed, erosion or drainage problems are more severe or cannot be resolved, or there is discoloration or other unusual conditions around the outlet.

Additional Notes:

Inspector:_____ Date: _____

Complete the following if follow-up/corrective actions were identified during this inspection:

Certified Completion of Follow-Up Actions:

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Inspector/Operator: _____ Date: _____

Rainwater Harvesting Stormwater Management Practices Level 2 Inspection Checklist

SMP ID #		**SMP Owner**		☐ Private ☐ Public
SMP Location (Address; Latitude & Longitude)				
	Latitude		**Longitude**	

Party Responsible for Maintenance	**System Type**		**Type of Site**
☐ Same as SMP Owner ☐ Other _____	☐ Seasonal ☐ Continuous Use ☐ Other	☐ Above Ground ☐ Below Ground	☐ Commercial ☐ Industrial ☐ Residential ☐ State

Inspection Date		**Inspection Time**	
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Date of Last Inspection			

Level 2 Inspection – RAINWATER HARVESTING

Recommended Repairs	Triggers for Level 3 Inspection
Observed Condition: Tank is not filling properly or water level drops quickly	
☐ Condition 1: Tank is not filling properly Look for signs of water bypassing the tank. Inspect the conveyance system and filters to make sure that all parts are properly connected and not leaking. Observe the system during a rainstorm to make sure that water is not backing up and spilling out of the gutters or getting excessively diverted by the filter. Adjust angles and placement of filter as needed. ☐ Condition 2: Water level drops quickly after filling Requires diagnosis and resolution of problem: • Leaking valve or spigot? • Crack in tank wall? • Pump turning on unnecessarily?	• Gutters, pipes, and/or filter appear to be undersized or not properly designed. • Structural or mechanical problem requires special expertise in rainwater harvesting systems. ☐ Level 3 Inspection necessary
Observed Condition: Tank is sinking, leaning, or at risk of collapse	
☐ Condition 1: Foundation is not stable This repair may need specialized equipment and skill, depending on the size and type of tank. For smaller tanks (like rain barrels), drain and disconnect the tank to move it aside. Compact the underlying soil and create a solid, level base for the tank with concrete blocks or gravel. Seek professional help for larger tanks. ☐ Condition 2: Other structural problem Seek professional help.	• Tanks cannot be easily adjusted or fixed by hand. ☐ Level 3 Inspection necessary
Observed Condition: Severe erosion at outlet	
☐ Condition 1: Erosion gets worse even after re-seeding or adding stone There are several potential solutions to this continued erosion. Add geotextile fabric below the stone to protect the soil. Dig out a pit at the outfall and fill with gravel or stone to absorb the velocity of the water spilling out the tank. If the outlet flows onto a steep slope, consider extending the pipe length to a flatter area. Some of these actions may require help from a contractor.	• Erosion control cannot easily be installed by hand. • Erosion recurs after previous repairs. • Downstream drainage concerns ☐ Level 3 Inspection necessary

Notes:

Inspector:_____ Date: _____

Complete the following if follow-up/corrective actions were identified during this inspection:

Certified Completion of Follow-Up Actions:

"I hereby certify that the follow-up/corrective actions identified in the inspection performed on _____ (DATE) have been completed and any required maintenance deficiencies have been adequately corrected."

Inspector/Operator: _____ Date: _____

Sand and Organic Filter Stormwater Management Practices Level 1 Inspection Checklist

SMP ID #		**SMP Owner**		☐ Private ☐ Public
SMP Location (Address; Latitude & Longitude)				
	Latitude		**Longitude**	

Party Responsible for Maintenance	**System Type**		**Type of Site**
☐ Same as SMP Owner ☐ Other _____	☐ Seasonal ☐ Continuous Use ☐ Other	☐ Above Ground ☐ Below Ground	☐ Commercial ☐ Industrial ☐ Residential ☐ State

Inspection Date		**Inspection Time**	
Inspector			
Date of Last Inspection			

SF Drainage Area

Look for both pervious and impervious areas that are uphill from the filter.

Problem (Check if Present)	**Follow-Up Actions**
☐ Bare soil, erosion of the ground (rills washing out the dirt; reference below)	☐ Seed and straw areas of bare soil to get vegetation established. ☐ Fill in erosion areas with soil, compact, and seed and straw to establish vegetation. ☐ If a rill or small channel is forming, try to redirect water flowing to this area by creating a small berm or adding topsoil to areas that are heavily compacted. ☐ Other:

SF Drainage Area

Look for both pervious and impervious areas that are uphill from the filter.

Problem (Check if Present)	Follow-Up Actions
 ☐ Bare soil, erosion of the ground (rills washing out the dirt)	☐ Kick-Out to Level 2 Inspection: Large areas of soil have been eroded, or larger channels are forming. May require rerouting of flow paths.
 ☐ Piles of grass clippings, mulch, dirt, salt, or other materials	☐ Remove or cover piles of grass clippings, mulch, dirt, etc. ☐ Other:
 ☐ Open containers of oil, grease, paint, or other substances	☐ Cover or properly dispose of materials; consult your local solid waste authority for guidance on materials that may be toxic or hazardous. ☐ Other:

SF Inlets

Look for all the places where water flows into the filter practice.

Problem (Check if Present)	Follow-Up Actions
 ☐ Inlets are collecting grit and debris or grass/weeds growing. Some water may not be getting into the filter practice.	☐ Use a flat shovel to remove grit and debris (especially at curb inlets or openings). Parking lots generate fine grit that accumulates at these spots. ☐ Pull out clumps of growing grass or weeds and scoop out the soil or grit that the plants are growing in. ☐ Remove any grass clippings, leaves, sticks, and other debris that is collecting at inlets. ☐ For pipes and ditches, remove sediment and debris that is partially blocking the pipe or ditch opening where it enters the Filter practice. ☐ Dispose of all material properly in an area where it will not re-enter the practice. ☐ Other: ☐ Kick-Out to Level 2 Inspection: Inlets are blocked to the extent that most of the water does not seem to be entering the filter practice.
 ☐ Some or all of the inlets are eroding so that rills, gullies, and other erosion are present, or there is dirt washing into the filter practice.	☐ For small areas of erosion, smooth out the eroded part and apply rock or stone (e.g., river cobble) to prevent further erosion. Usually, filter fabric is placed under the rock or stone. ☐ In some cases, reseeding and applying erosion-control matting can be used to prevent further erosion. Some of these materials may be available at a garden center, but it may be best to consult a landscape contractor. ☐ Other: ☐ Kick-Out to Level 2 Inspection: Erosion is occurring at most of the inlets and it looks like there is too much water concentrating at these points. The inlet design may have to be modified.
 ☐ For an underground filter, water is ponding and doesn't seem to be getting through the filter.	☐ Kick-Out to Level 2 Inspection: This is generally a more serious problem and should be referred for a Level 2 Inspection because it will require opening up the filter vault to check for clogging.

SF Filter Area (for Surface Sand Filters)

Examine the surface of the filter and the observation well, if present.

Problem (Check if Present)	Follow-Up Actions
 ☐ Filter has grass and vegetation growing on more than 25% of the filter bed, threatening to clog the filter.	☐ Vegetation growing in the filter bed should be removed either manually or with a water-safe herbicide (e.g., glysophate without surfactants). ☐ Other: ☐ Kick-Out to Level 2 Inspection: The filter seems clogged, or vegetation and weeds have proliferated past the point where the Level 1 person can manage it.
☐ Minor amounts of sediment, grit, trash, or other debris are accumulating on the surface.	☐ Use a shovel to scoop out minor amounts of sediment or grit, especially in the spring after winter sanding materials wash in and accumulate. Dispose of the material where it cannot re-enter the filter. ☐ If removing the material creates a hole or low area, rake the surface smooth and level. ☐ Remove trash, debris, and other undesirable materials. ☐ Other: ☐ Kick-Out to Level 2 Inspection: Sediment (other than sand) has accumulated more than 2-inches deep and covers 25% or more of the surface of the filter area.
 ☐ There is erosion on the surface; water seems to be carving out rills as it flows across the filter surface, or sinkholes are forming in certain areas.	☐ For minor areas of erosion, try filling the eroded areas with clean, coarse construction sand. ☐ Other: ☐ Kick-Out to Level 2 Inspection: The problem persists or the erosion is more than 3-inches deep and seems to be an issue with how water enters and moves through the filter area. ☐ Kick-Out to Level 2 Inspection: The problem does not seem to be caused by flowing water but by a collapse or sinking of the surface (e.g., “sinkhole”) due to some underground problem.

SF Filter Area (for Surface Sand Filters)

Examine the surface of the filter and the observation well, if present.

Problem (Check if Present)	Follow-Up Actions
 ☐ Water is still visible on the surface and/or the standpipe (if present) more than 72 hours after a rainstorm. The filter practice drains very slowly or is completely clogged.	☐ Kick-Out to Level 2 Inspection: This is generally a serious problem, and it will be necessary to activate a Level 2 Inspection.

Additional Notes:

Inspector:_____ Date: _____

Complete the following if follow-up/corrective actions were identified during this inspection:

Certified Completion of Follow-Up Actions:

"I hereby certify that the follow-up/corrective actions identified in the inspection performed on _____ (DATE) have been completed and any required maintenance deficiencies have been adequately corrected."

Inspector/Operator: _____ Date: _____

Sand and Organic Filter Stormwater Management Practices Level 2 Inspection Checklist

SMP ID #		**SMP Owner**		☐ Private ☐ Public
SMP Location (Address; Latitude & Longitude)				
	Latitude		**Longitude**	

Party Responsible for Maintenance	**System Type**		**Type of Site**
☐ Same as SMP Owner ☐ Other _____	☐ Seasonal ☐ Continuous Use ☐ Other	☐ Above Ground ☐ Below Ground	☐ Commercial ☐ Industrial ☐ Residential ☐ State

Inspection Date		**Inspection Time**	
Inspector			
Date of Last Inspection			

Table 3.12.1 Level 2 Inspection: SAND AND ORGANIC FILTERS

Recommended Repairs	Triggers for Level 3 Inspection
Observed Condition: Water Stands on Surface for More than 72 Hours after Storm	
☐ Condition 1: Small pockets of standing water Use a soil probe or auger to examine the sand or filter profile. If isolated areas have accumulated grit, fine silt, vegetative debris, oily sludge or bad sand media, try scraping off top 3 inches of media and replacing with clean, coarse construction sand. ☐ Condition 2: Standing water is widespread or covers entire surface Look in the underdrain cleanout (if present) and use a tape measure to estimate the depth of water standing in the sand layer. Requires diagnosis and resolution of problem: • Clogged underdrain • Filter fabric between the sand layer and underdrain gravel OR on top of the sand filter layer (usually held in place by a thin layer of gravel) • Too much sediment/grit/vegetative debris/oily sludge washing in from drainage area • Too much ponding depth • Improper sand media	• Sand or organic media is clogged, but problem was not evident from Level 2 inspection. • Level 2 inspection identifies problem, but it cannot be resolved easily or is associated with the original design of the practice. • The problem seems to be filter fabric placement, but this is specified in the original design. • The entire filter media layer or filter cartridges need to be replaced. • The problem is associated with improper configuration of underdrain pipes or outlet structures. ☐ Level 3 Inspection necessary

Notes:

Inspector:_____ Date: _____

Complete the following if follow-up/corrective actions were identified during this inspection:

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Inspector/Operator: _____ Date: _____

Swale Stormwater Management Practices Level 1 Inspection Checklist

SMP ID #		**SMP Owner**		☐ Private ☐ Public
SMP Location (Address; Latitude & Longitude)				
	Latitude		**Longitude**	

Party Responsible for Maintenance	**System Type**		**Type of Site**
☐ Same as SMP Owner ☐ Other _____	☐ Seasonal ☐ Continuous Use ☐ Other	☐ Above Ground ☐ Below Ground	☐ Commercial ☐ Industrial ☐ Residential ☐ State

Inspection Date		**Inspection Time**	
Inspector			
Date of Last Inspection			

SW Drainage Area

Look at areas that are uphill from the swale.

Problem (Check if Present)	Follow-Up Actions
 ☐ Bare soil, erosion of the ground (rills washing out the dirt)	☐ Seed and mulch or sod areas of bare soil to establish vegetation. ☐ Fill in erosion areas with soil, compact, and add seed and straw to establish vegetation. ☐ If a rill or small channel is forming, try to redirect water flowing to this area by creating a small berm or adding topsoil to areas that are heavily compacted. ☐ Other: ☐ Kick-Out to Level 2 Inspection: Large areas of soil have been eroded, or larger channels are forming. May require rerouting of flow paths
 ☐ Piles of grass clippings, mulch, dirt, salt, or other materials	☐ Remove or cover piles of grass clippings, mulch, dirt, etc. ☐ Other:
 ☐ Open containers of oil, grease, paint, or other substances	☐ Cover or properly dispose of materials; consult your local solid waste authority for guidance on materials that may be toxic or hazardous.
☐ Grass dying at edge of road	☐ Seed and mulch; add topsoil or compost if needed. ☐ Other: ☐ Kick-Out to Level 2 Inspection: Grass on edge of pavement continues to die off for unknown reasons. Swale edge may need to be replaced with other materials (e.g., stone diaphragm).

SW Inlets

Stand in the swale and look for all the places where water flows in.

Problem (Check if Present)	Follow-Up Actions
☐ Inlets or the swale edge are collecting grit, grass clippings, or debris or have grass/weeds growing. Some water may not be getting into the swale. The objective is to have a clear pathway for water to flow into the swale.	☐ Use a flat shovel to remove grit and debris (especially at curb inlets or opening). Parking lots will generate fine grit that will accumulate at these spots. ☐ Pull out clumps of growing grass or weeds, and scoop out the soil or grit that the plants are growing in. ☐ Remove any grass clippings, leaves, sticks, and other debris that is collecting at inlets or along the edge of the swale where water is supposed to enter. ☐ For pipes and ditches, remove sediment and debris that is partially blocking the pipe or ditch opening where it enters the swale. ☐ Dispose of all material properly in an area where it will not re-enter the swale. ☐ Other:
	☐ Kick-Out to Level 2 Inspection: Inlets are blocked to the extent that most of the water does not seem to be entering the swale.
 ☐ Some or all of the inlets are eroding so that rills, gullies, and other erosion are present, or there is bare dirt that is washing into the swale.	☐ For small areas of erosion, smooth out the eroded part and apply rock or stone (e.g., river cobble) to prevent further erosion. Usually, filter fabric is placed under the rock or stone. ☐ In some cases, reseeding and applying an erosion control matting can be used to prevent further erosion. Some of these materials may be available at a garden center, but it may be best to consult a landscape contractor. ☐ Other:
	☐ Level 2 Inspection: Erosion is occurring at most of the inlets or along much of the swale edge. The inlet design may have to be modified.

SW Surface Area

Examine the entire swale surface and side slopes.

Problem (Check if Present)	Follow-Up Actions
☐ Minor areas of sediment, grit, trash, or other debris are accumulating in the swale.	☐ Use a shovel to scoop out minor areas of sediment or grit, especially in the spring after winter sanding materials may wash in and accumulate. Dispose of the material where it cannot re-enter the swale. ☐ If removing the material creates a hole or low area, fill with good topsoil and add seed and straw to re-vegetate. ☐ Remove trash, vegetative debris, and other undesirable materials. ☐ If the swale is densely vegetated, it may be difficult to do the maintenance; check for excessive ponding or other issues described in this section to see if the accumulated material is causing a problem. ☐ Other: ☐ Kick-Out to Level 2 Inspection: Sediment has accumulated more than 3 inches deep and covers 25% or more of the swale surface. ☐ The source of sediment is unknown or cannot be controlled with simple measures.
 ☐ There is erosion in the bottom or on the side slopes. Water seems to be carving out rills as it flows through the swale or on the slopes.	☐ Try filling the eroded areas with clean topsoil, and then seed and mulch to establish vegetation. ☐ If the problem recurs, you may have to use some type of matting, stone (e.g., river cobble), or other material to fill in eroded areas. ☐ If the erosion is on a side slope, fill with soil and cover with erosion-control matting or at least straw mulch after re-seeding. ☐ Kick-Out to Level 2 Inspection: The problem persists or the erosion is more than 3 inches deep and seems to be an issue with how water enters and moves through the swale. ☐ Kick-Out to Level 2 Inspection: The problem does not seem to be caused by flowing water, but a collapse or sinking of the surface (e.g., “sinkhole”) due to some underground problem.
☐ Water does not flow evenly down the length of the swale, but ponds in certain areas for long periods of time (e.g., 72 hours after a storm). The swale does not seem to have “positive drainage.” Check during or immediately after a rain storm.	☐ If the problem is minor (just small, isolated areas), try using a metal rake or other tools to create a more even flow path; remove excessive vegetative growth, sediment, or other debris that may be blocking the flow. ☐ Other: ☐ Kick-Out to Level 2 Inspection: Water ponds in more than 25% of the swale for three days or more after a storm. The issue may be with the underlying soil or the grade of the swale. ☐ Water ponds behind check dams for three days or more after a storm. Check dams may be clogged or not functioning properly.

SW Surface Area

Examine the entire swale surface and side slopes.

Problem (Check if Present)	Follow-Up Actions
 ☐ Check dams (if present): water is flowing around the edges of check dams, creating erosion or sinkholes on the uphill or downhill side, or the check dams are breaking apart or breaching .	☐ If the problem is isolated to just a few check dams, try simple repairs. ☐ It is very important for the center of each check dam (where most of the water flows) to be lower (by at least several inches) than the edges of the check dams where they meet the side slopes. Also, the check dams should be keyed into side slopes so water does not flow between the check dam and side slope. ☐ Use a level to check the right check-dam configuration, as noted above. Repair by moving around stone, filling and compacting soil, or adding new material so that water will be directed to the center of the check dam instead of the edges. ☐ Other: ☐ Kick-Out to Level 2 Inspection: Many check dams are impacted and/or the problem seems to be a design issue with height, spacing, shape, or materials used to construct them.

SW Vegetation

Assess the swale vegetation.

Problem (Check if Present)	Follow-Up Actions
 ☐ Vegetation is too overgrown to access swale for maintenance activities	☐ Mow or bush-hog the path. ☐ Other:

SW Vegetation

Assess the swale vegetation.

Problem (Check if Present)	Follow-Up Actions
 ☐ Vegetation requires regular maintenance: pulling weeds, removing dead and diseased plants, adding plants to fill in areas that are not well vegetated, etc.	☐ If you can identify which plants are weeds or not intended to be part of the planting plan, eliminate these, preferably by hand pulling. ☐ If weeds are widespread, check with the local stormwater authority and/or Extension Office about proper use of herbicides for areas connected with the flow of water. ☐ Even vegetation that is intended to be present can become large, overgrown, block flow, and/or crowd out surrounding plants. Prune and thin accordingly. ☐ If weeds or invasive plants have overtaken the whole swale, bush-hog the entire area before seed heads form in the spring. It will be necessary to remove the root mat manually or with appropriate herbicides, as noted above. ☐ Replant with species that are aesthetically pleasing and seem to be doing well in the swale. ☐ Other: ☐ Kick-Out to Level 2 Inspection: You are unsure of the original planting design or the vegetation maintenance task is beyond your capabilities of time, expertise, or resources. If you are unsure of the health of the vegetation (e.g. salt damage, invasives, which plants are undesirable) or the appropriate season to conduct vegetation management, consult a landscape professional before undertaking any cutting, pruning, mowing, or brush hogging.
☐ Vegetation is too thin, is not healthy, and there are many spots that are not well vegetated.	☐ The original plants are likely not suited for the actual conditions within the swale. If you are knowledgeable about plants, select and plant more appropriate vegetation (preferably native plants) so that almost the entire surface area will be covered by the end of the second growing season. ☐ Other: ☐ Kick-Out to Level 2 Inspection: For all but small practices (e.g., in residential yards), this task will likely require a landscape design professional or horticulturalist.

SW Outlets

Examine outlets that release water out of the swale.

Problem (Check if Present)	Follow-Up Actions
☐ Outlet is obstructed with mulch, sediment, debris, trash, etc.	☐ Remove the debris and dispose of it where it cannot re-enter the swale. ☐ Other: ☐ Kick-Out to Level 2 Inspection: Outlet is completely clogged or obstructed; there is too much material to remove by hand or with simple hand tools.

Additional Notes:

Inspector:_____ Date: _____

Complete the following if follow-up/corrective actions were identified during this inspection:

Certified Completion of Follow-Up Actions:

"I hereby certify that the follow-up/corrective actions identified in the inspection performed on _____ (DATE) have been completed and any required maintenance deficiencies have been adequately corrected."

Inspector/Operator: _____ Date: _____

NEW YORK STATE OF OPPORTUNITY | Department of Environmental Conservation

Swale Stormwater Management Practices Level 2 Inspection Checklist

SMP ID #		**SMP Owner**		☐ Private ☐ Public
SMP Location (Address; Latitude & Longitude)				
	Latitude		**Longitude**	

Party Responsible for Maintenance	**System Type**		**Type of Site**
☐ Same as SMP Owner ☐ Other _____	☐ Seasonal ☐ Continuous Use ☐ Other	☐ Above Ground ☐ Below Ground	☐ Commercial ☐ Industrial ☐ Residential ☐ State

Inspection Date		**Inspection Time**	
Inspector			
Date of Last Inspection			

Level 2 Inspection: SWALE	
Recommended Repairs	**Triggers for Level 3 Inspection**
Observed Condition: Water Stands on Surface for More than 72 Hours after Storm	
☐ Condition 1: Small pockets of standing water Use a soil probe or auger to examine the soil profile. If isolated areas have accumulated grit, fines, or vegetative debris or have compacted soil, try scraping off top 3 to 6 inches of soil and replacing with clean material. Also check to see that surface is level and water is not ponding selectively in certain areas. ☐ Condition 2: Standing water is widespread or covers entire surface Requires diagnosis and resolution of problem: • Bad or compacted soil • Filter fabric on the swale bottom • Too much sediment/grit washing in from drainage area? • Too much ponding depth? • Longitudinal slope is too flat?	• Soil is overly compacted or clogged and problem is not evident from Level 2 inspection. • Level 2 inspection identifies problem, but it cannot be resolved easily or is associated with the original design of the practice (e.g., not enough slope down through the swale). ☐ Level 3 inspection necessary
Observed Condition: Vegetation is predominantly weeds and invasive species	
For a small area, weed and dig up invasive plants. Replant with natives or plants from original planting plan. If longer than 100 feet, develop a new planting plan and have it professionally reviewed.	• Vegetation deviates significantly from original planting plan; swale has been neglected and suffered from deferred maintenance. • Owner/responsible party does not know how to maintain the practice. • For large area, hire a professional to develop a grading plan and develop a planting plan. ☐ Level 3 inspection necessary

Notes:

Inspector:_____ Date: _____

Complete the following if follow-up/corrective actions were identified during this inspection:

Certified Completion of Follow-Up Actions:

> "I hereby certify that the follow-up/corrective actions identified in the inspection performed on _____ (DATE) have been completed and any required maintenance deficiencies have been adequately corrected."

Inspector/Operator: _____ Date: _____

NEW YORK STATE OF OPPORTUNITY | Department of Environmental Conservation

Tree Planting Stormwater Management Practices Level 1 Inspection Checklist

SMP ID #		**SMP Owner**		☐ Private ☐ Public
SMP Location (Address; Latitude & Longitude)				
	Latitude		**Longitude**	

Party Responsible for Maintenance	**System Type**		**Type of Site**
☐ Same as SMP Owner ☐ Other _____	☐ Seasonal ☐ Continuous Use ☐ Other	☐ Above Ground ☐ Below Ground	☐ Commercial ☐ Industrial ☐ Residential ☐ State

Inspection Date		**Inspection Time**	
Inspector			
Date of Last Inspection			

TP Watering

Inspect the trees to determine whether they need watering.

Problem (Check if Present)	**Follow-Up Actions**
☐ Soil is not moist to the touch and/or it has not rained in a week, and leaves/needles are starting to appear wilted/dry.	☐ Water trees deeply and slowly near the base. Soaker hoses and drip irrigation work best for deep watering of trees and shrubs. ☐ Other:

TP Mulch

Mulch should be applied in the late spring and during leaf fall. Check the depth of mulch regularly. Rake the old mulch to break up any matted layers and to refresh the appearance.

Problem (Check if Present)	Follow-Up Actions
☐ Mulch is too thin or thick (should be approximately 3" deep) or does not extend to tree canopy (or 5' radius if tree has a larger than 10' canopy reach).	☐ Add or remove mulch around tree canopy to maximum 5' radius but not within 3" of the bark. ☐ If mulch is against the stems or tree trunks, pull it back several inches to expose the base of the trunk and root crown. ☐ Other:

TP Pruning

Examine the branches and tree shape.

Problem (Check if Present)	Follow-Up Actions
☐ Presence of suckers, dead or diseased branches, branches that interfere with pedestrian traffic	☐ Selective cutting ☐ Prune to make the tree more aesthetically pleasing and remove disease. ☐ Other:
	☐ Kick-Out to Level 2 Inspection: Use an arborist or landscaper for more extensive pruning jobs.

Additional Notes:

Inspector:_____ Date: _____

Complete the following if follow-up/corrective actions were identified during this inspection:

Certified Completion of Follow-Up Actions:

> "I hereby certify that the follow-up/corrective actions identified in the inspection performed on _____ (DATE) have been completed and any required maintenance deficiencies have been adequately corrected."

Inspector/Operator: _____ Date: _____

NEW YORK STATE OF OPPORTUNITY | Department of Environmental Conservation

Tree Planting Stormwater Management Practices
Level 2 Inspection Checklist

SMP ID #		**SMP Owner**		☐ Private ☐ Public
SMP Location (Address; Latitude & Longitude)				
	Latitude		**Longitude**	

Party Responsible for Maintenance	**System Type**		**Type of Site**
☐ Same as SMP Owner ☐ Other _____	☐ Seasonal ☐ Continuous Use ☐ Other	☐ Above Ground ☐ Below Ground	☐ Commercial ☐ Industrial ☐ Residential ☐ State

Inspection Date		**Inspection Time**	
Inspector			
Date of Last Inspection			

Level 2 Inspection: TREE PLANTING	
Recommended Repairs	**Triggers for Level 3 Inspection**
Observed Condition: Appearance of fungus or pest damage	
☐ Condition 1: Fungus, discoloration, browning leaves or holes in leaves Check with arborist or other tree professional about the best way to proceed. This requires a Level 3 inspection. ☐ Condition 2: Burrowing insects, holes Check with arborist or other tree professional about the best way to proceed. This requires a Level 3 inspection.	• Any concerns about how to address infestation or disease ☐ Level 3 inspection necessary

Notes:

Inspector:_____ Date: _____

Complete the following if follow-up/corrective actions were identified during this inspection:

Certified Completion of Follow-Up Actions:

"I hereby certify that the follow-up/corrective actions identified in the inspection performed on _____ (DATE) have been completed and any required maintenance deficiencies have been adequately corrected."

Inspector/Operator: _____ Date: _____

ATTACHMENT 16

POLLUTION PREVENTION AND GOOD HOUSEKEEPING PUBLICATION

Stormwater Best Management Practice

Municipal Employee Training and Education

Minimum Measure: Pollution Prevention/Good Housekeeping for Municipal Operations
Subcategory: Education

Description

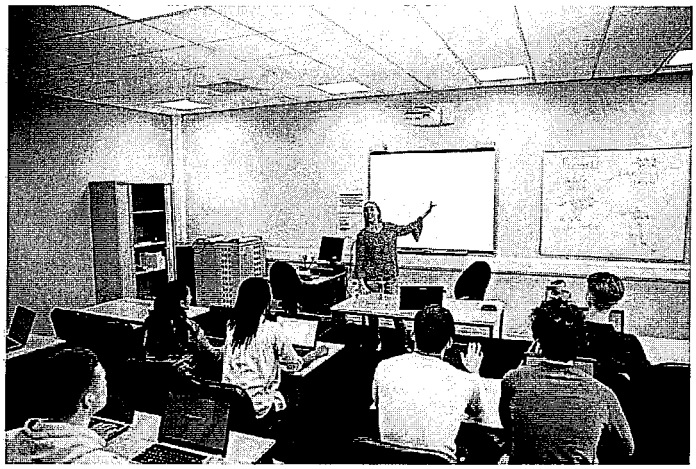
Employee training and education is critical to the proper implementation of pollution prevention and good housekeeping measures, which limit stormwater pollution associated with regular municipal activities. A municipality should design its employee training programs to teach staff about potential sources of stormwater contamination and ways to minimize the water quality impact of municipal activities, such as park and open space maintenance, fleet and building maintenance, construction and land disturbances, and storm drain system maintenance. Employee training and education also serves to create awareness of Phase II minimum control measures, including public education and outreach, public participation/involvement, illicit discharge detection and elimination, and runoff controls for construction and post-construction sites. A key factor in the success of training and education programs is training all employees and associated contractor personnel to incorporate pollution prevention/good housekeeping practices into their everyday activities.

Applicability

Municipal employees who are directly involved in potentially polluting activities should receive both general stormwater and practice-specific training tailored to their responsibilities. These employees may include municipal staff, contractors, and even temporary or seasonal staff. Proper training helps protect storm drain systems and the receiving waters they discharge to from accidental spills, illicit discharges, and improperly managed stormwater discharges from poorly planned construction and development activities and incomplete or improper housekeeping practices.

Implementation

Municipal training and education can take many forms and cover a wide range of content. It is important for municipal staff to design a training and education program around the specific needs of their municipality.



Routine stormwater training for all municipal employees and contractors is a crucial component of operating a successful stormwater program.

General stormwater awareness training is a good way to convey the importance of pollution prevention/good housekeeping practices, as demonstrated by this training from the New Castle County Department of Public Works.

Training and Education Content

Training and education program content should begin with general material, including a general stormwater awareness message, an overview of applicable stormwater regulations, and an overview of NPDES Phase II minimum control measures. It is important that this content draw direct links between municipal employees' daily activities and the potential for impacts to a community's local water resources.

As well, a municipality should design program content around specific operations. For example, the Center for Water Protection's (CWP's) *Municipal Pollution Prevention/Good Housekeeping Practices* manual lists major municipal operations that may affect water quality, including:

- Hotspot facility management
- Construction project management
- Street repair and maintenance
- Street sweeping
- Storm drain maintenance
- Stormwater hotline response
- Park and landscape maintenance
- Residential stewardship
- Stormwater management practice maintenance

The CWP manual also provides a helpful, step-by-step guide for identifying, evaluating, and prioritizing municipal operations for incorporation into a custom training program.

Training and Education Methods

Training on stormwater issues can take several forms, including in-house training programs, on-the-job training, videos or online content, general awareness and educational materials, and workshops or conferences. For all content types, it is important to keep records to document participation and progress.

Typically, in-house training formats include annual, formal classroom style programs as well as more frequent, informal "tailgate" meetings. Tailgate meetings—usually held frequently such as on a weekly basis—update staff on current issues and tasks but often incorporate short training sessions as well. Municipalities usually conduct more comprehensive training when hiring or promoting employees. Any of these training formats can include basic information and details about pollution prevention and stormwater treatment practices. Whenever possible, a municipality should provide additional in-field (i.e., hands-on) training to demonstrate proper implementation of operation and maintenance and good housekeeping measures.

Videos and online trainings are also useful tools. EPA and many other state and local agencies have developed their own online resources. Examples include:

- EPA's posters, fact sheets, guidebooks and other tools
- The North Central Texas Council of Governments' video "Preventing Stormwater Pollution: What We Can Do," with an accompanying series of training modules on stormwater pollution prevention
- The Minnesota Pollution Control Agency's "Parks Maintenance and Stormwater Protection Employee Training" video
- The New Jersey Department of Environmental Protection's series of NJPDES Municipal Stormwater Regulation Program employee training videos

Some municipalities provide general stormwater awareness information in new employee training. Paycheck inserts or email notices with information about household practices to reduce stormwater impacts or ways to recognize an illicit discharge can increase overall awareness. Stormwater posters or displays in common areas of municipal buildings educate both employees and members of the community.

Many federal agencies, state agencies, and professional and nonprofit organizations offer workshops and conferences about pollution prevention and stormwater controls and stormwater management best management practices (BMPs). For example, EPA sponsors workshops and conferences on a variety of stormwater topics, and many states provide local stormwater trainings. Employees can learn how to comply with the latest stormwater management regulations, how to develop required stormwater pollution prevention plans, which controls or BMPs to use at a particular facility or site, and methods for collecting and handling samples. By attending these outside events, municipal staff can keep up to date on current stormwater controls and stormwater management approaches while networking with other municipal employees and representatives from industry and regulatory agencies.

Training and Education Follow-Up

After initial training, it is helpful for managers to periodically check employees' work practices. Periodic, unscheduled inspections of facilities and maintenance activities will allow managers to gauge what employees have learned and where they could improve. Posting reminders—such as markers above drains prohibiting discharges of vehicle fluids and wastes, or signs above faucets to not use water to clean up spills—will remind employees of proper procedures. Municipalities can place stickers that list important information and contact numbers for reporting illicit discharges, dumping or spills on all their vehicles. Stenciling or marking all storm drains at municipal facilities will prompt employees to be conscientious of discharges. Facility stormwater pollution prevention plans and stormwater BMP guidance documents should be available to all employees as a reference to use after trainings.

Limitations

Limited staff time, employee turnover, funding constraints or lack of commitment from management can hamper comprehensive stormwater training. Often exacerbating these limitations is a lack of refresher trainings, as well as a lack of training course content updates to account for changes in regulations and best practices. To combat these problems, municipalities can incorporate stormwater training into their existing training programs. In doing so, they can draw on the many training materials and stormwater BMP guidance documents available online and free of charge.

Cost Considerations

Costs for in-house employee training programs are related to labor and associated overhead costs. Trainers can reduce direct costs by using free educational materials or training tools that are already developed. CWP estimates a municipality would need 200 to 400 staff hours to improve employee training and education by following the step-by-step guidance in its *Municipal Pollution Prevention/Good Housekeeping Practices* manual (CWP, 2008).

Many private companies and groups offer training for a fee. Online searches can bring up an extensive range of training options: webinars, in-person courses and guidebooks for on-site stormwater practices, as well as information on developing stormwater management plans and examples of training that already exists.

Additional Information

Additional information on related practices and the Phase II MS4 program can be found at EPA's National Menu of Best Management Practices (BMPs) for Stormwater website

Disclaimer

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Stormwater Best Management Practice

Deicing Material Application and Storage

Minimum Measure: Pollution Prevention/Good Housekeeping for Municipal Operations
Subcategory: Municipal Activities

Description

In areas where snow and ice are common during winter months, municipalities and transportation authorities apply deicing materials—most commonly salts, gravel or sand—to sidewalks, parking lots, and roadways to reduce ice buildup and improve traction for pedestrians and vehicles. Salts help lower the melting point of ice, allowing sidewalks, parking lots, and roadways to stay free of ice buildup during cold winters. But they are also soluble, can be toxic to some biota and environmentally persistent: applying and storing them can cause them to mix with stormwater, leading to water quality problems. Problems range from aquatic life impacts in downstream waters to contamination of drinking water supplies (Fay & Shi, 2012; Labashosky, 2015).

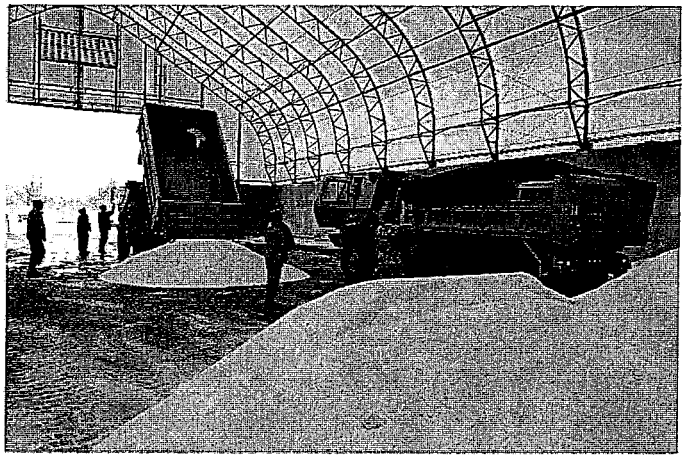
For more information on alternative deicers, see Terry et al.'s (2020) "Alternative Deicers for Winter Road Maintenance—A Review" and the comprehensive Transportation Research Board (2007) report *Guidelines for the Selection of Snow and Ice Control Materials to Mitigate Environmental Impacts.*

Applicability

Deicing materials are applied and stored in areas that receive heavier snowfalls. Municipalities in these areas should use techniques to ensure proper storage and application for equipment and materials.

Deicing Materials Management Program Considerations

During deicing materials application, certain best management practices can limit potential environmental impacts. Roadway managers and others generally outline these practices in a deicing materials management program or plan, which can help improve the efficiency of deicing efforts. Such a program plan should account for local considerations, as well as the general ones described below.



Keeping salt stored inside protects water quality and reduces salt loss from exposure to rain and snow.
Photo Credit: Staff Sgt. Jorge Intriago/Wikimedia

Material Selection

U.S. municipalities and transportation departments use sodium chloride for deicing more than any other material, due to its low cost and wide availability (Table 1). Sodium chloride has its drawbacks, including minimal effectiveness at temperatures less than 15°F, high potential for contamination of downstream waters, and high corrosivity. Because of these drawbacks, roadway managers have looked to other chemicals or materials including other salts (e.g., calcium chloride, magnesium chloride), organic compounds (e.g., acetate compounds, glycol) and biomass-based agricultural byproducts (Terry et al., 2020; Transportation Research Board, 2007). Most of these alternative products are more expensive than sodium chloride and each has its own strengths and weaknesses. For example, municipalities should consider less corrosive alternative deicing materials like glycol, urea, or calcium magnesium acetate (CMA) for bridge deicing.

Table 1 does not include sand and gravel—often referred to as "abrasives"—which can improve traction on ice-covered roadways but do not melt ice.

Table 1. Deicing Material Alternatives

Material	Annual Usage, North America (Tons)	Median Cost per Ton (2020 Dollars)[a]	Characteristics
Sodium chloride (NaCl)	4,773,000	$51	■ Low cost ■ Widely available ■ Moderately effective at temperatures between 15°F and 25°F, most effective at temperatures above 25°F
Calcium chloride ($CaCl_2$)	47,679	$171	■ Melts ice at temperatures below 25°F ■ If used as recommended, will not harm vegetation
Magnesium chloride ($MgCl_2$)	149,724	$135	■ Lowest practical temperature: 5°F ■ If used as recommended, will not harm vegetation; however, $MgCl_2$, on a percentage basis, contains 17–56% more chloride ion than other salt-type deicers
Calcium magnesium acetate (CaMgAc)	21,817	$1,820	■ Will work below 0°F ■ Low toxicity and biodegradable

Sources: Keating, 2004; Kelting & Laxson, 2010

[a] Cost data adjusted from 2009 to 2020 dollars using the Bureau of Labor Statistics CPI Inflation Calculator

Application

Before applying salt, it is important to blow, shovel or plow accumulated snow to ensure more effective melting (NHDES, 2016).

Roadway managers should set application rates that reflect site-specific characteristics such as pavement temperature, road width and design, traffic concentration, and proximity to surface waters. Application rates should be as low as possible while remaining effective. Application plans should specify alternative deicing materials for areas too sensitive for chemical use.

To apply deicing materials to roadways and parking lots, most municipalities use specialized dump trucks with spreaders. When possible, they should employ electronically controlled spreading equipment that can lock in specific application rates, preventing operators from using more salt than necessary (MDOT, 2019). Municipalities should also calibrate all deicing material spreading equipment before the start of a winter season and check it periodically during the season for accuracy.

Monitoring and Tracking

Keeping accurate records of application practices can help optimize deicing effectiveness and reduce harmful impacts. Roadway managers should develop a tracking system that maps application routes, logs application rates and notes areas of high accumulation of ice/snow. Benchmarking is also a good way to reduce salt use over time. For example, roadway managers can log application rates per degrees below 32°F or inch of snow and set reduction goals each year (MPCA, 2020).

Many DOTs are implementing road weather management strategies focusing on tools and technologies using real-time or archived road weather data from fixed and mobile road weather observations. In addition to vehicle location data from automatic vehicle location systems and radio communication between the driver and the maintenance center, mobile road weather observations can include more detailed maintenance vehicle information such as plow status and material usage, and/or road weather measurements such as pavement surface and air plus pavement temperatures. Survey data from the Federal Highway Administration (2017) reports that overall, 23 of the 40

States collect real-time field data from maintenance vehicles with plow status and material usage being the most common data collected.

Storage

Municipalities should store deicing material piles in covered areas, protected from weather throughout the year. Although covering stored deicing materials may be costly, the benefits are often far greater than the perceived costs. Properly storing deicing materials prevents it from lumping together, which makes it easier to load and apply. Covering deicing materials storage piles reduces loss, as exposed piles will slowly dissolve from rain and snow throughout the year and wash into downstream waterbodies. Municipalities often store deicing materials in barns, domes, silos or other permanent structures. These structures should be outside the 100-year floodplain for further protection against flooding and surface water contamination.

Training

Municipalities should regularly train their staff and contractors on proper storage and application practices. This training should stress the importance of using the smallest amount of material that will make roadways safe and passable (MDOT, 2019). Program managers should receive additional training on effective winter storm management, winter materials inventory management, the properties of salt and other winter deicing materials, and data collection and analysis.

Maintenance Considerations

Salt is highly corrosive, so application equipment and storage facilities need regular maintenance to maintain functionality and integrity. Importantly, maintenance activities should also help reduce salt export as much as possible.

As well as carrying out standard vehicle and equipment maintenance, staff should wash applicator vehicles down after every use. To prevent contamination of downstream waters, municipalities should capture, treat, or recycle the salt-containing wash water. Staff can reuse this water as brine for salt pre-wetting (MPCA, 2020). Installing a wash area adjacent to a storage area so that it can also collect any spilled brine from the storage area is a good way to eliminate another potential source of salt contamination and improve overall salt use efficiency.

Staff should routinely inspect storage structures. During active months, they should immediately collect any material spilled during loading or unloading operations and return it to the storage structure. During the off-season, they should identify and fix any leaks, weak points or corroded areas.

Limitations

Salt application requires specialized equipment that needs rigorous maintenance to limit corrosion from the salt. It also requires designated personnel and storage facilities that are generally only in use for a fraction of the year. Deicing becomes expensive at very cold temperatures: below 15°F, a community would typically need a prohibitive amount of sodium chloride, and suitable replacements are much more expensive (Kelting & Laxson, 2010).

Salt application also leads to long-term environmental impacts as well as infrastructure and automobile corrosion problems. Particularly across the northeast and Midwest, salt application has led to the designation of thousands of miles of streams and thousands of acres of lakes, reservoirs and ponds as threatened or impaired for chloride (U.S. EPA, 2020).

Cost Considerations

Costs associated with a deicing materials application program include both direct and indirect costs. Direct costs, including the cost of the deicing materials (see Table 1), application equipment, storage facilities and labor, will vary depending on the frequency and duration of deicing materials activities. Using a typical range of application rates for sodium chloride of 200 to 800 pounds per lane mile (Transportation Research Board, 2007) and the median cost from Table 1, material costs can range from $5.10 to $20.40 per lane mile.

Indirect or "hidden" costs, on the other hand, tend to accumulate over time and are harder to quantify. In a review of the literature, Dindorf and Fortin (2014) found estimates of damage to infrastructure, automobiles, vegetation, human health and the environment due to salt to range from $800 to more than $3,000 per ton of salt used.

Additional Information

Additional information on related practices and the Phase II MS4 program can be found at EPA's National Menu of Best Management Practices (BMPs) for Stormwater website

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Stormwater Best Management Practice

Municipal Landscaping

Minimum Measure: Pollution Prevention/Good Housekeeping for Municipal Operations
Subcategory: Municipal Activities

Description

Municipal landscaping involves a number of activities that can contribute to water quality impacts. Improper use of fertilizers and pesticides can lead to increased concentrations of nutrients and chemicals in stormwater, while poor grass and vegetation management can lead to export of soil and organic matter. Proper landscaping practices can reduce these impacts and can also provide water quality benefits.

There are many benefits to environmentally friendly landscape design. First, proper site planning can reduce maintenance requirements by using native species that often need less upkeep than non-native species. Soil analysis can prevent overfertilization by eliminating uncertainty regarding existing soil fertility. Minimizing turf area by replacing it with alternative ground cover, shrubs and trees increases infiltration and reduces mowing requirements, which subsequently reduces air, water and noise pollution. Mulches stabilize exposed soils, prevent growth of nuisance vegetation, and improve soil fertility through the slow release of nutrients from decomposition. Ensuring the proper application of pesticides and fertilizers and preventing overuse reduces the potential for contamination of downstream waterways. Finally, a diverse landscape can enhance a property's aesthetics.

Municipal landscaping programs also offer the opportunity to set a good example for residents. To reduce pesticide use and encourage the use of less-toxic alternatives by municipal crews, King County, Washington, and the City of Seattle began to phase out the use of dozens of pesticides in 1999 as part of an overall pesticide reduction strategy. The decision followed criticism that while the municipalities were urging residents to stop using weed killer and pesticides in yards to help endangered Chinook salmon, they were allowing municipal crews to apply herbicides in municipal parks and along roadsides (Johnson, 1999). Pesticide use and conversion of natural habitat to turfgrass also affects pollinators, which are vital to agricultural production. The Bee City USA program seeks to bolster pollinator habitat by increasing the abundance of native plants and reducing the use of harmful pesticides. Currently, over 100 cities are "Bee Cities," which means they commit to incorporating pollinator-friendly landscaping practices into their policies and plans.



Replacing turf with native species, trees and shrubs can reduce maintenance and fertilization requirements.
Photo Credit: Katrina Mueller/U.S. Fish & Wildlife Service

Applicability

Turf or other vegetation can cover a significant percentage of the land a municipality owns—and it often needs regular maintenance. Municipalities can use environmentally friendly lawn and garden practices on their properties, and they can encourage residents to use the same practices in their yards. Such practices include landscape planning, integrated pest management, planting indigenous species, soil testing, and the reduction or elimination of fertilizers and pesticides. Planting drought-resistant plants and using water conservation practices can be especially useful in areas of low rainfall. Areas of high rainfall experience more erosion, so protecting exposed soils with vegetation and mulches is of particular importance in these areas.

Siting and Design Considerations

The following guidelines describe ways in which municipalities can promote environmentally friendly landscaping techniques.

Planning and design. It is important to develop a landscape plan that recognizes the property's natural conditions including drainage patterns, soils, existing vegetation and climate. The plan should group plants together according to their water needs. It should also consider the site's intended use. A thoughtful landscape plan will promote natural vegetation growth and minimize water loss and contamination. Alternatively, water-smart landscaping, similar to xeriscaping, uses drought-tolerant vegetation along with non-vegetation components such as gravel, rocks or mulch that can add aesthetic appeal, maintain infiltration rates and reduce irrigation requirements (EPA, 2013). Residents and municipal staff can partner with local nurseries and irrigation and lawn services to determine appropriate landscape designs for a specific site or facility. Planners can also incorporate green infrastructure into landscape designs (see the box to the right) to provide further stormwater benefits.

Several EPA resources are available to help municipalities identify ways to incorporate green infrastructure into existing municipal landscaping, including:

- *Green Infrastructure in Parks* guide
- *Green Infrastructure Operations That Arise During Municipal Operations*
- *Green Infrastructure Operations and Maintenance*

Soil analysis and improvements. Soil testing every 3 to 4 years by residents and municipal staff can help determine the amount of nutrients necessary to maintain healthy vegetation and can prevent overfertilization. Municipalities can encourage home and garden centers to market and sell soil test kits so that property owners can perform such tests on their own. Local extension offices or universities can often perform soil tests and are a good source of information on fertilization and watering rates that are appropriate for local soils and vegetation.

Vegetation selection. Vegetation selection is a critical component of good landscaping practices. It dictates water use, fertilizer and pesticide use, maintenance requirements and site stormwater discharge characteristics. Property owners and municipal crews should use local or regional plants, which are generally more water efficient and disease resistant. Furthermore, exotic plants can potentially invade surrounding natural areas and local waterways. Local nurseries can assist in choosing appropriate regional plant species.

Turf areas. Property owners and municipal crews should plant non-turf areas, where possible, because turf typically needs more water and maintenance than wildflowers, shrubs and trees. If they do use turf, they should choose a type of turf grass that can withstand drought and that becomes dormant in hot, dry seasons. Local nurseries can help property owners and municipal crews choose grass types. In addition, when maintaining lawns, crew should not cut the grass shorter than 3 to 4 inches. They should leave clippings—which carry important nutrients—on the lawn and keep them from ending up in streets and sidewalks. This allows the grass to absorb nutrients as natural fertilizer and prevents those nutrients from reaching downstream waterways, where they can cause eutrophication.

Efficient irrigation. Irrigation requirements vary by climate, soil and vegetation type. Maintenance crews should follow an irrigation schedule that is appropriate for their site and an irrigation rate that is water efficient. Applying water too quickly causes it to run off, along with the top layers of soil. To prevent this, it is important to encourage the use of low-volume watering approaches such as drip-type or low volume sprinkler systems. In addition, overwatering can actually discourage plants from developing deeper roots, which makes them less resistant to drought. Automated irrigation controllers are a good way to provide regular irrigation, and to reduce irrigation rates when it rains to prevent over-irrigation and excessive stormwater discharge.

Use of mulches. Mulches help retain water, reduce weed growth, prevent erosion and improve the soil for plant growth. Mulches usually contain wood bark chips, wood grindings, pine straws, nut shells, small gravel or shredded landscape clippings. Municipalities should consider mulch use and encourage property owners to use mulches and inform them of the benefits of these materials. Additionally, municipalities can start programs

to collect plant materials from municipal maintenance activities as well as yard waste from property owners. They can then convert these materials to mulch and use them at their own properties or redistribute them to property owners.

Fertilizers. Municipalities should discourage property owners and municipal crews from using fertilizers—or, if they do use them, from over-applying them. Municipalities should consider less-toxic alternatives to commercial fertilizers, such as composted organic material.

Municipalities can also recommend practices to reduce the amount of fertilizer entering stormwater. For example, slow-release fertilizers are less likely to enter stormwater. Application techniques, such as tilling fertilizers into moist soil to move the chemicals directly into the root zone, reduce the likelihood that the chemicals will mobilize in stormwater. Timing is also important: property owners should fertilize warm season grasses in the summer (in frequent and small doses) and cool season grasses in the fall. They should not apply fertilizer on a windy day or immediately before a heavy rain. Municipalities can recommend that municipal crews and property owners apply fertilizer at rates at or below those recommended on the packaging—or based on the needs of the soil, as determined by a soil test. Municipalities should also encourage safe disposal of excess fertilizer and containers.

Municipal crews and property owners should change fertilization rates if they use reclaimed water, or "purple pipe" water, for irrigation. Reclaimed water contains important nutrients like nitrogen and phosphorus in concentrations that are often high enough to completely eliminate the need for supplemental fertilizer. Local extension offices or environmental departments can help determine the amount of nutrients in reclaimed water and can help calculate revised fertilization rates.

Pesticides. Municipal crews and property owners should use pesticides (like fertilizer) on lawns and gardens only when necessary. They can avoid pesticide use by choosing hearty plants that are native to the area and by keeping them healthy. If they need to use chemical pesticides, they should choose the least toxic pesticide that targets the specific pest in question (boric acid, garlic, insects, etc.). A pesticide labeled "caution" is less toxic than one labeled "warning," which in turn is less toxic than one labeled "danger/poison."

It is important to follow the label directions on the pesticide product. Property owners and municipal crews should read and follow all safety precautions listed on pesticide labels, including wearing of personal protective equipment, using recommended application methods, and washing hands and face before smoking or eating. They should always rinse tools or equipment used for applying or incorporating pesticides in a bucket and handle the rinse water as if it were full-strength pesticide. They can save any unused pesticide and dispose of it at a hazardous waste collection location.

The following websites provide education and information on safe pesticide use:

- University of Nebraska's pesticide education resources
- Pennsylvania State University Extension's information on insects, pests and diseases
- Washington State University's Urban integrated pest management and pesticide safety courses
- Beyond Pesticides
- Cornell University's Pesticide Management Education Program
- National Pesticide Safety Education Center
- Californians for Alternatives to Toxics

Ordinances. Pollution due to the improper use or overuse of fertilizers and pesticides is a problem in places around the country. Fertilizer and pesticide ordinances are a way municipalities can reduce or even eliminate fertilizer and pesticide use. The following resources provide information on states or municipalities that have implemented fertilizer or pesticide ordinances, including integrated pest management programs that have become models for other communities:

- The State of Maine's Municipal Pesticide Ordinances Web page provides examples of communities throughout the state that have implemented ordinances specific to their locations and the pesticides of concern.
- The City of Portland, Oregon's Invasive Plant and Integrated Pest Management Program has become a model for communities throughout the Pacific Northwest.

- Fertilizer ordinances in Florida that reduce or completely ban fertilizer applications have become increasingly common to protect local surface water and groundwater quality. Florida state statute encourages every county and municipal government to adopt and enforce a model ordinance or the equivalent, and even requires it in watersheds that have existing nutrient impairments.

Limitations

There are virtually no limitations for implementing environmentally friendly lawn, garden, and landscaping practices. Some practices are more applicable in certain climates (for example, there is little need for irrigation in areas of very high rainfall), but they are generally low cost and relatively easy to implement. With guidance from a local environmental agency, extension service or nursery, municipality and property owners can make proper decisions about which practices are best.

Effectiveness

Proper landscaping techniques benefit the environment by reducing water use; decreasing energy use (by decreasing the need for water pumping and treatment); maximizing infiltration of storm and irrigation water; minimizing transport of soils, fertilizers and pesticides; and creating more habitat for plants and wildlife.

Conventional landscaping requires considerable amounts of water. Although municipal water use varies, about 30 percent of the average household's water consumption is for outdoor uses like irrigation (Mayer et al., 1999). In warmer areas, irrigation can exceed 60 percent of total household use (Haley et al., 2007). Xeriscape practices, including reducing turfgrass coverage, can reduce this water consumption (U.S. EPA, 2013, 2017). A study in Colorado Springs compared water use between a traditionally landscaped area and two xeriscaped areas and found xeriscaping to provide water savings of 22 to 63 percent over traditional turfgrass (Colorado WaterWise, 2010).

Good landscaping practices can reduce fertilizer and pesticide export from landscaped areas through better application, ordinances that restrict their use, or conversion to ground covers that do not require their use. A U.S. Geological Survey study of suburban lawns found that stormwater flow from unfertilized lawns had half as much phosphorus as discharge from regularly fertilized lawns (Garn, 2002). Similarly, a comparison of surface water quality data before and after Ann Arbor, Michigan's implementation of a phosphorus fertilizer ordinance found statistically significant reductions in phosphorus concentrations (Lehman et al., 2009). Xeriscape practices can help reduce export of both fertilizers and pesticides by incorporating ground covers that need neither to thrive.

Low-maintenance landscaping can also have positive effects on habitat and biodiversity. Landscaping requiring more maintenance like frequent mowing and pesticide use can lead to reduced vegetation diversity (Bertoncini et al., 2012), which in turn leads to lower biodiversity. In a study of 18 suburban lawns, Lerman et al. (2018) found that less frequent mowing allowed for greater abundance of bees and pollinators owing to greater abundance and diversity of the small weeds and wildflowers they rely on.

Cost Considerations

Proper landscape activities can be very cost effective. Promoting the growth of healthy plants that need less fertilizer and pesticide minimizes labor and maintenance costs of lawn and garden care. Using water, pesticides, and fertilizers only when necessary and replacing store-bought fertilizers with compost material can increase the savings for a property owner as well as benefit the environment. Reducing turfgrass cover reduces labor and equipment costs associated with regular mowing. Actual cost savings will depend on how much existing labor, maintenance and equipment costs can be reduced.

Costs associated with alternative practices vary widely depending on the features that are incorporated. Features may include vegetation (e.g., wildflowers, grass, shrubs, trees), irrigation systems (drip, sprinkler or none), and "hardscape" features (e.g., rocks, pavers, gravel). The Colorado WaterWise *Guidebook of Best Practices* provides costs for different levels of implementation, which range from $3–$4 per square foot for simple plantings and no hardscape to $20 per square foot for elaborate installations featuring an array of plantings, drip irrigation and hardscape features (Colorado WaterWise, 2010).

Additional Information

Additional information on related practices and the Phase II MS4 program can be found at EPA's National Menu of Best Management Practices (BMPs) for Stormwater website

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Stormwater Best Management Practice

Municipal Vehicle Fueling

Minimum Measure: Pollution Prevention/Good Housekeeping for Municipal Operations
Subcategory: Municipal Activities

Description

Fueling fleets of municipal vehicles can generate spills and leaks of fuel (gasoline and diesel fuel) and heavy metals—disproportionately toxic compounds that, if stormwater washes them into the storm drain system, can seriously impair the quality of nearby waterbodies. To prevent such discharges, municipal staff can employ practices that involve site design, regular maintenance and inspection, and focusing on pollution prevention during routine operations.

Applicability

Municipalities use a variety of vehicles and equipment, such as transit buses, fire trucks, police cruisers, school buses, and public works and maintenance vehicles. The practices discussed below can apply to any location where fueling operations take place.

Siting and Design Considerations

Municipal staff should design fueling areas to prevent spills and the contamination of stormwater discharges. Because spills can still occur, they should also incorporate features that contain spilled fuel. For example, the California Stormwater Quality Association recommends that designers pave fuel-dispensing areas with cement, concrete or an equivalent impervious surface (for asphalt paving, municipal staff should apply a suitable sealant); incorporate a 2 to 4 percent slope to prevent ponding, and separate the area from the rest of the site with a grade break or berm that keeps away stormwater (CASQA, 2003). Similarly, the City of Seattle requires that spill containment berms be at least 4 inches tall to both contain spilled liquids and keep stormwater away (City of Seattle, 2017).

Designers should cover fuel-dispensing areas, and the cover's minimum dimensions should be equal to or greater than the area within the grade break or the fuel-dispensing area. The cover should not drain onto the fuel-dispensing area. Designers can use a perimeter drain or sloped pavement to direct stormwater inward to a blind sump. Site conditions or local regulations may require the installation of an oil control device in catch basins that receive stormwater flow from the fueling area.



Fueling areas can be covered to reduce exposure to stormwater.

Vapor recovery nozzles can help control drips as well as reducing air pollution (CASQA, 2011). Fuel-dispensing nozzles should have "hold-open latches" (automatic shutoff) except where local fire departments prohibit them. Signs at the fuel dispenser or island should warn vehicle owners/operators against "topping off" vehicle fuel tanks.

For any facility where a mobile fuel truck fuels equipment, municipal staff should consider designating a fueling area and using temporary containment measures. Staff can place temporary cap seals over nearby catch basins or manhole covers to prevent any spills from entering the storm drain. Staff can also use a secondary containment device, such as an absorbent sock, when transferring fuel from a tank truck to a vehicle's fuel tank.

Facilities with fueling areas should have spill prevention plans and necessary spill kits nearby. A spill prevention

plan specifies material handling procedures and storage requirements and identifies spill cleanup procedures for areas and processes in which spills may occur. The plan standardizes operating procedures and training of employees and contractors to minimize accidental pollutant releases that could contaminate stormwater. (Consult the Spill Response and Prevention fact sheet for more information.)

Operation and Maintenance Considerations

Regular operation and maintenance practices are just as important as proper facility design in preventing and containing spills. Municipal staff should routinely implement the following example measures:

- Check for external corrosion, leaks and structural failure in aboveground storage tanks.
- Check for spills and overfills due to operator error, including dried residue that may be evidence of past spills.
- Check for failure of any pumping, piping or dispensing systems.
- Check for leaks or spills during pumping of liquids or gases from a truck or rail car to a storage facility or vice versa.
- Visually inspect new tank or container installations for loose fittings, poor welds, and improper or poorly fitted gaskets.
- Inspect tank foundations, connections, coatings, tank walls and piping systems. Look for corrosion, leaks, cracks, scratches and other physical damage that may weaken the tank or container system.
- Periodically enlist a qualified professional to test the integrity of aboveground storage tanks.
- Ensure there is clear tagging or labeling on all fuel valves.

In the event of a spill, municipal staff should use dry cleanup methods. These include sweeping to remove litter and debris and using rags and adsorbents for leaks and spills. Staff should not use water to wash these areas. During routine cleaning, staff should use damp cloths on the pumps and damp mops on the pavement, rather than spraying with hoses.

Municipalities should provide written procedures that describe these practices to all employees who will be using fueling systems.

Limitations

Municipalities often lack the funding for proper vehicle fueling practices. Old, outdated equipment and facilities can limit the implementation of appropriate practices. Many municipal fueling areas have no covering, have improper designs (e.g., no impervious surfaces), are in bad locations, have poor drainage (e.g., near downstream waterbodies), or use equipment prone to leaking or spills. It can be costly to retrofit existing facilities or build new fueling islands that provide better stormwater protection. Regularly training staff and inspecting facilities also requires funding that may not be available.

Effectiveness

Vehicle fueling stations are well-known stormwater hot spots, with the potential to discharge hydrocarbons and heavy metals in concentrations far greater than those from surrounding land (Schueler & Shepp, 1995). As such, the potential environmental harm from accidental fuel spills can be significant. Although it is difficult to quantify the effectiveness of vehicle fueling practices, experience has shown that they make spills less likely to reach receiving waters. Additionally, studies have shown that certain treatment devices, such as oil-water separators or sand filters, can reduce the harmful effects of contaminated stormwater (Robbins, 2000; Schueler & Shepp, 1995).

Municipalities may develop metrics to assess relative progress against baseline conditions. Resources to help municipalities develop these metrics are available from California's State Water Resources Control Board.

Cost Considerations

The costs of vehicle fueling pollution prevention practices are highly variable, as they depend on the need for new or retrofitted facilities, the condition of existing facilities, and ongoing maintenance requirements.

To reduce future maintenance costs, municipalities can design new facilities with high-quality features such as designated fueling areas with proper impermeable surfaces, protection from wet weather and sufficient containment structures. They should also consider staff time for training new hires, along with staff time for periodic retraining of other employees.

Municipalities should purchase spill kits and make them available at each fueling area and on each mobile fueling truck. Based on a review of current commercial supply companies, spill kits capable of cleaning up 5 to 6 gallons of spilled liquid range in cost from $25 to $100. These kits include standard items like absorbent socks, pads, gloves, one or more disposal bags, and a watertight container.

Additional Information

Additional information on related practices and the Phase II MS4 program can be found at EPA's National Menu of Best Management Practices (BMPs) for Stormwater website

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Stormwater Best Management Practice

Municipal Vehicle and Equipment Maintenance

Minimum Measure: Pollution Prevention/Good Housekeeping for Municipal Operations
Subcategory: Municipal Activities

Description

Municipal vehicle and equipment maintenance activities can generate a number of hazardous materials and wastes. If improperly managed, these materials can cause pollutant contributions to stormwater discharges and significant impacts to downstream water quality. This means that vehicle and equipment maintenance facilities might also be considered stormwater hot spots: areas that generate significant loads of hydrocarbons, trace metals and other pollutants that can affect the quality of stormwater discharges.

Vehicle maintenance facilities can generate wastes such as:

- Solvents (e.g., degreasers, paint thinners)
- Antifreeze
- Brake fluid and brake pad dust
- Battery acid
- Motor oil
- Fuel (gasoline, diesel, kerosene)
- Lubricating grease

Municipal staff who properly store automotive fluids, do maintenance in protected areas and thoroughly clean up spills can help reduce the effects of automotive maintenance practices on stormwater discharges and, consequently, local water resources.

Applicability

Municipal activities require the use of various vehicles and equipment across many departments, such as public works operation and maintenance vehicles, police cars, fire trucks, and school and public transit buses. Because of this, a single community may have many maintenance facilities. Maintaining this equipment requires changing various parts and fluids, activities that can contribute to stormwater pollution through accidental spills or negligent practices. For example, in the United States about 350 million gallons of used engine oil each year is improperly disposed (DOE, 2006). Although governments often regulate stormwater discharges from most municipal facilities because of the "hot spot" nature of these activities, it is important to routinely implement best practices such as those outlined below.



A police car being maintained inside a municipal maintenance facility.

Photo Credit: U.S. Air Force photo/Senior Airman Nathanael Callon

Siting and Design Considerations

The most effective way to minimize wastes generated by automotive maintenance activities is to prevent that waste's production in the first place.

For wastes a facility cannot avoid producing, "dry shop" techniques are a helpful way to reduce the potential for stormwater contamination from liquid discharges. Dry shop techniques limit comingling of waste materials with stormwater or wash water, which can wash pollutants into storm drains. Dry shop techniques include doing all maintenance activities inside or under cover and cleaning up spills immediately without water whenever possible. In addition, for activities that use solvents and generate a lot of waste liquids, a facility can hire a solvent service to supply parts and cleaning materials and to collect spent solvent.

In addition to dry shop practices, various structural and non-structural practices can further reduce pollutant discharges from vehicle maintenance facilities. The following list is not comprehensive; all facilities are different and should develop their own, specific targeted practices. Still, the following practices can serve as a starting point and as examples for a custom pollution prevention program.

For more information on related good housekeeping practices, see the following fact sheets:

- Materials Management
- Municipal Facilities Management
- Municipal Vehicle and Equipment Washing
- Municipal Employee Training and Education
- Municipal Vehicle Fueling
- Spill Response and Prevention
- Hazardous Materials Storage

Structural Practices Examples

- Seal all floor drains.
- Label drains, wash sinks and other entry points to indicate outfall location (e.g., internal collection container, sanitary sewer, storm sewer).
- Install berms or other measures to contain spills and prevent surface drainage from entering storm drains.
- Locate work areas on impermeable surfaces (i.e., not on grass or gravel).
- If indoor storage space is limited, build covered hazardous material storage areas that include raised platforms for items like waste drums or corrodible containers.

Waste Reduction Examples

- Keep the number of solvents used to a minimum. It makes recycling easier and reduces hazardous waste management costs.
- Perform all liquid cleaning at a centralized station to ensure that solvents and residues stay in one area.
- Locate drip pans and draining boards to direct solvents back into a solvent sink or holding tank for reuse.
- Reuse or recycle products on-site or through coordination with local recycling companies.

Use of Safer Alternatives Examples

- Use non-hazardous cleaners instead of organic solvent degreasers when possible. Non-hazardous cleaners generally include detergent-based or water-based solutions.
- Replace chlorinated organic solvents like trichloroethylene (TCE) with non-chlorinated ones like kerosene or mineral spirits.
- Purchase recycled products, such as engines, oil, transmission fluid, antifreeze and hydraulic fluid, to help support the recycled products market.
- Steam clean or pressure wash parts (ensuring to collect and properly dispose of rinse water) instead of using solvents.

Spill Containment and Cleanup Examples

- Update facility schematics to accurately reflect all plumbing and drainage connections.
- Use as little water as possible to clean spills, leaks and drips.
- Follow the spill prevention plan.
- Keep a supply of spill response materials appropriate for the activities performed on-site.
- In the event of a spill, cover drains with drain mats.

Good Housekeeping Examples

- Store hazardous materials indoors or in covered areas.
- Conduct employee training and public outreach to reinforce proper disposal practices.
- Clearly label storage and disposal containers to prevent cross-contamination and accidental misuse.
- Closely monitor parked vehicles for leaks and place drip pans under any leaks to collect the fluids for proper disposal or recycling.
- Immediately remove fluids from wrecked vehicles to prevent leakage while in storage.
- Promptly transfer used fluids to recycling drums or hazardous waste containers.
- Dispose of liquid waste properly and regularly.
- Store cracked batteries in leakproof secondary containers.

Even with good housekeeping practices, local pretreatment requirements from the local sewer authority

or specific containment requirements for wellheads or water supply protection areas may direct facilities that discharge to sanitary sewer systems to treat their wastewater before releasing it. This is due to the sensitivity of most biological wastewater treatment processes to hazardous substances. Facilities often use structural pretreatment devices for this treatment. For example, they can use oil/water separators, settling chambers or filtration devices to remove solids, oil and grease. All drainage systems and wastewater treatment plants are different, however, and it is important for all maintenance facilities to follow all state and local requirements.

Limitations

There are a number of limitations to implementing best practices at vehicle and equipment maintenance facilities. Space and time constraints may rule out indoor work. Containing spills from vehicles brought on-site after working hours may be impossible. Installing structural treatment devices for pretreatment of wastewater discharges can be expensive. Recycled materials and fluids may cost more than non-recycled materials, and municipalities may face a lack of recycled materials providers. They may also encounter an absence of businesses that provide hazardous waste removal, solvent recycling or other services.

Maintenance Considerations

Routine maintenance is key to keeping best practices effective. Regular training of employees on current best practices should also be part of that maintenance program.

Staff should regularly inspect outdoor areas, especially parking areas for vehicles awaiting repair, for drips, spills and improperly stored materials (e.g., unlabeled containers, auto parts that might contain grease or fluids).

The proper functioning of structural practices is an important maintenance consideration for facilities that pretreat their wastewater before discharge. Systems like oil/water separators need routine cleanout of oil, grease and any other accumulated deposits—usually at least once a month, and more often during periods of heavy rainfall so that pollutants do not bypass the system altogether. For any structural treatment system, it is important to follow the manufacturer's recommended maintenance schedule.

Effectiveness

It's difficult to quantify the effectiveness of vehicle and equipment maintenance best management practices at removing pollutants. However, some studies have evaluated individual practices with some success. In a review of a study of two auto recycler facilities, Robbins (2000) notes that structural and non-structural practices were measurably effective at reducing oil and grease concentrations as well as biological toxicity of stormwater discharge. The first site, evaluated over 10 years, incrementally implemented practices including draining vehicle fluids before stripping, sending stormwater through a multi-chambered oil-water separator, and building a roof over the dismantling area. The cumulative effect of all practices was a reduction in acute toxicity from 100 percent to 14 percent and a steady decline in discharged oil and grease concentrations. At another facility, an oil-water separator and an aeration-flocculation treatment system (more advanced and effective than a passive oil/water separator) together lowered lead and oil and grease concentrations by nearly 90 percent.

Municipalities may develop their own measurable performance standards to assess relative progress against baseline conditions. Keeping track of spill frequencies, documenting the volume of fluids recycled, and monitoring the use of chemical cleaning supplies are all ways to increase the efficiency of existing operations and motivate employees to implement best practices.

Cost Considerations[1]

Purchase of new equipment or modification of existing facilities can be expensive. An oil/water separator can cost anywhere from several thousand dollars for a simple, single tank, above-ground version to nearly $200,000 for a professionally installed underground unit (RSMeans, 2020). Oil/water separators also need regular cleaning and maintenance, though other practices that reduce the total pollutant load to the system can lessen maintenance intervals.

Replacement or modification of existing equipment may be a more affordable option. For instance, installation of water-based cleaning equipment to replace solvent cleaning stations can cost between $700 and $17,000 depending on equipment type (EBMUD, 2004).

Many educational and non-structural measures cost little or nothing. Installing signage, improving labeling systems, adjusting storage and work areas, incorporating routine inspections and improving recordkeeping practices can be quick and relatively inexpensive practices.

Good housekeeping practices during vehicle and equipment maintenance can have additional cost benefits beyond waterway protection. For example, proper management of hazardous materials reduces employee exposure and potential work disruptions due to illness or injury. Pollution prevention efforts, meanwhile, reduce an organization's risk of enforcement action, private legal claims and damage to reputation.

[1] Prices updated to reflect inflation and reported in 2020 dollars. Inflation data obtained from the Bureau of Labor Statistics CPI Inflation Calculator website: https://data.bls.gov/cgi-bin/cpicalc.pl

Additional Information

Additional information on related practices and the Phase II MS4 program can be found at EPA's National Menu of Best Management Practices (BMPs) for Stormwater website

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Stormwater Best Management Practice

Municipal Vehicle and Equipment Washing

Minimum Measure: Pollution Prevention/Good Housekeeping for Municipal Operations
Subcategory: Municipal Activities

Description

Municipal vehicle and equipment washing can generate dry weather discharges contaminated with sediment, detergents, oils, grease and heavy metals. Both commercial and residential vehicle wash water can contain contaminants from vehicle fluid leaks, typical vehicle wear and the cleaning process itself. A study in a single city in Washington (City of Federal Way, 2009) estimated that vehicle washing had an annual contribution of:

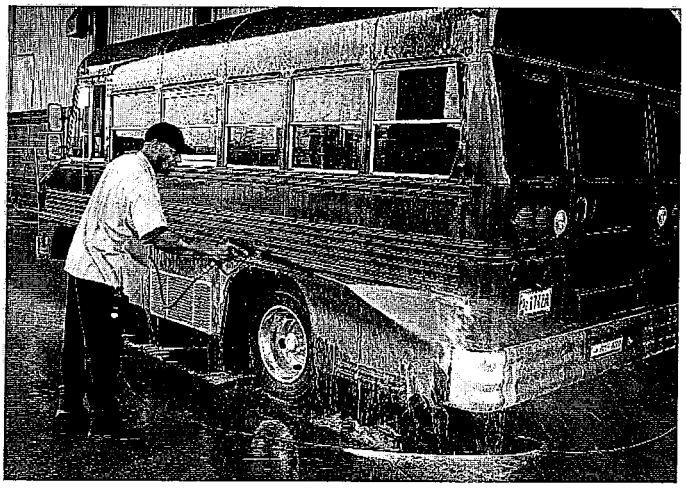
- 190 gallons of gasoline, diesel and motor oil
- 14 pounds of dissolved copper
- 400 pounds of phosphorus and nitrogen
- 60 pounds of ammonia
- 2,200 pounds of surfactants
- 3,000 pounds of solids

The impacts of these constituents discharging to downstream waterbodies can include increased toxicity to living organisms, increased eutrophication and reduced oxygen levels. Therefore, properly addressing these non-stormwater sources using pollution prevention/good housekeeping and other practices is an important component of a stormwater program to eliminate the impacts of these discharges.

Properly implemented vehicle and equipment washing practices can reduce wash water impacts by minimizing or preventing contaminated wash water discharges to downstream waters. They can also help municipalities meet general sustainability goals. For instance, incorporating water recycling systems reduces overall water usage—especially important in dry areas or during periods of drought.

Applicability

Municipalities typically operate fleets of vehicles (e.g., public works trucks, fire trucks, ambulances, police cars, school buses) that they regularly wash and maintain. Municipalities with large fleets might operate their own washing facilities, while municipalities with small fleets might find it more economical to contract with commercial car washes.



Vehicle and equipment washing can contribute significant amounts of pollutants to stormwater if washwater is not properly captured and treated.
Photo Credit: Margo Wright/U.S. Air Force

In addition to the general washing practices discussed here, there are a number of related activities that other fact sheets discuss in more detail that may be helpful for municipally owned/operated vehicles/equipment or to share with contractors who manage such vehicles/equipment:

- For municipalities that own and operate concrete trucks, see the Concrete Washout fact sheet for more information on proper washout techniques.
- For municipalities that own and operate salt spreading equipment, see the Deicing Material Application and Storage fact sheet for more information on proper maintenance and storage of equipment.
- For municipalities looking to reduce the impacts of vehicle washing by the general public, see the fact sheets for Residential Car Washing and Developing Outreach Strategies for Residents and Businesses on the BMPs for Stormwater-Public Education page.

Siting, Design and Operational Considerations

To limit impacts to downstream waters, municipalities should contain, treat or reuse vehicle and equipment wash water.

- For containment, a municipality can build drainage features that direct wash water to containers, sumps or a treatment system.
- Treatment systems (which regulations often require if a facility discharges wash water to sanitary sewers and subsequently municipal treatment plants) generally include oil/water separators or some type of filtration.
- Sometimes a facility can use more advanced treatment practices if it intends to reuse wash water on-site—a practice that not only limits discharge impacts but also reduces water consumption.

For all practices, municipalities should consider local regulatory requirements. These may include pretreatment requirements from the local sewer authority or specific containment requirements for wash areas in wellheads or water supply protection areas.

Wash Areas

Wash areas (sometimes called wash racks) are designated areas—gratings, raised platforms, bermed areas, etc.—that incorporate drainage systems of some type to allow for containment and collection of wash water. When installing a wash area, a municipality should use paving to minimize loss of wash water and a berm or sloping to contain and direct wash water to a sump. It may connect the sump to the sanitary sewer or to a holding tank, process treatment system, or enclosed recycling system. For a sanitary sewer connection, the municipality would seek the permission of the sewer authority before discharging (because wash water may have special treatment requirements). Alternately, the municipality could design the wash area to recycle wash water, thereby eliminating pretreatment costs and discharges.

If municipal staff need to wash a vehicle outside a facility plumbed to the sanitary sewer, they should avoid direct discharges to storm drain systems. For a small job, they can use a bermed wash area and capture the wash water with a wet/dry vacuum for discharge to a sanitary sewer. For a larger job, they can use a combination of berms and a vacuum truck (such as those used to clean storm and sanitary sewer systems) to capture and safely dispose of wash water. If they use detergents, they should clean pavement to avoid discharging those detergents during the next storm event. Green infrastructure practices like bioretention systems, vegetated filter strips or stormwater wetlands can also help reduce stormwater impacts from wash area overflows. For wash areas that drain directly to storm drains, catch basin modifications can be a low-cost way to contain wash water without replumbing entire drainage systems.

Non-Structural Considerations

The following examples of good housekeeping practices can minimize the risk of contamination from vehicle wash water discharges (adapted from CASQA, 2003):

- Wash all vehicles in areas designed to collect and hold wash water before its discharge to the sanitary sewer system.
- Clearly mark the designated wash area.
- Cover the wash area when not in use to keep out rainwater.
- Perform cleaning activities over an impermeable ground surface (e.g., concrete or asphalt).
- Avoid detergents whenever possible. If detergents are necessary, use phosphate-free, non-toxic, biodegradable soap. If you are using an oil/water separator for pretreatment before discharge to the sanitary sewer, source quick-break degreasers and monitor the oil/water separator output for effectiveness.
- Use a high-pressure hose nozzle to reduce the need for soaps and detergents.
- Municipal facilities that store vehicles should stencil their storm drains to remind employees to wash vehicles within designated wash areas. They can also post signage with this message.
- Mount spill kits with absorbent containment materials and instructions near wash racks. Immediately contain and clean up all spills.
- Train employees in proper vehicle washing and water management procedures; make sure they get regular refresher training.
- In some regions, the dry weather season (lowest stream flows) coincides with fish spawning, when aquatic populations are especially sensitive (EPI, 2007). If possible, schedule outdoor equipment washing and other potential contamination-causing work outside the highest-risk months for the area.

Commercial Car Washes

Municipalities can negotiate with commercial car washes and steam cleaning businesses to handle their fleet vehicle washing. This option eliminates the cost of building and the liability of operating a wash facility. It may only be available for smaller vehicles, since many car washes do not have bays large enough to handle buses, fire trucks, ambulances and other large vehicles.

Maintenance Considerations

Municipal staff should periodically inspect and clean a wash rack's paved surfaces and sump to remove buildups of particulate matter or other pollutants. Plumbing, recycling and pretreatment systems also need periodic inspection and maintenance. Staff should visually inspect the area surrounding the wash rack for leaks, overspray or other signs of ineffective containment due to faulty design or physical damage to berms. They should correct any defects.

Limitations

If the appropriate facilities are available, vehicle washing measures are relatively inexpensive. However, if a municipality needs to build new facilities, implement new structural practices or use outside services, funding can be a limitation. Building a new wash rack can be expensive, and facilities that cannot recycle their wash water might face significant costs for pretreating wash water before discharge to the sanitary sewer. For municipalities using off-site commercial vehicle washing facilities, the employee and equipment time lost during travel to and from approved locations and wait times at wash locations may also be a limitation (CTC & Associates, 2016).

Effectiveness

Although direct measurement of the effectiveness of good housekeeping practices is not common, studies have shown that certain related practices can address common contaminants in vehicle wash water. Combined with good housekeeping practices discussed above, several green infrastructure practices can greatly reduce stormwater impacts. Rain gardens can effectively remove or degrade surfactants—a common constituent of soap—and remove more than 90 percent of total suspended solids (Bakacs et al., 2013). Stormwater wetlands can also effectively remove contaminants like sediments, nutrients and heavy metals (Clary et al., 2017).

Using designated washing facilities can also result in significant water savings. A commercial car wash uses up to 60 percent less water in its entire wash cycle than just the final rinse step of residential hand washing (MASSDEP, n.d.).

For both pollutant reduction and water savings reasons, communities that establish municipal washing facilities or even commercial car washes for the public can reduce impacts to their local water resources. For example, the community of St. Albans, West Virginia, constructed a charity car wash station to reduce residential washing impacts and serve as a model for communities throughout the state. The station directs wash water into permeable pavers and adjacent rain gardens and vegetated areas (WVDEP, 2016). Not only does the facility reduce stormwater impacts, it provides an opportunity to educate the public on local stormwater problems and solutions.

Cost Considerations[1]

As discussed above, a range of non-structural and structural practices are available for vehicle and equipment washing. Costs vary widely, from low-cost, non-structural practices like proper employee training and chemical storage to high-cost, capital improvement projects such as installing new wash areas.

[1] Prices updated to reflect inflation; reported in 2020 dollars. Inflation data obtained from the Bureau of Labor Statistics CPI Inflation Calculator website: https://data.bls.gov/cgi-bin/cpicalc.pl

Non-structural Practices

Adopting "green" cleaning chemicals (biodegradable, non-corrosive, non-toxic) is a low-cost way to reduce discharge of hazardous chemicals. These more environmentally friendly chemicals may also be less corrosive to both vehicles and wash area equipment, providing further savings for long-term maintenance. In addition, regular maintenance and inspections by municipal staff in vehicle washing work areas can identify water or chemical leaks, which may save on operating costs or potential fines.

Structural Practices

The cost of structural practices depends on site needs and constraints as well as system scale and design. The table below provides ranges of various practices.

Practice	Cost Range	Factors That Affect Cost	Source
Berm construction	$700 to $6,000	Wash area size, berm height	CASQA, 2003; MPCA, 2009
Drainage retrofits	$7,000 to $35,000	Drain line type, size, depth and length	CASQA, 2003; MPCA, 2009
New fleet washing facility (installation)	$25,000 to $2,500,000	Fleet size, fleet type, targeted pollutant	CTC & Associates, 2016
Treatment or recycling system (installation)	$40,000 to $250,000	Wash area size, targeted pollutant	CASQA, 2003; MPCA, 2009
Wash bay (annual operating costs)	$3,000 to $5,500	Wash area size, equipment age and type	CTC & Associates, 2016
Commercial car wash (contract rate)	$13 to $55 per truck	Truck type, location	CTC & Associates, 2016

Additional Information

Additional information on related practices and the Phase II MS4 program can be found at EPA's National Menu of Best Management Practices (BMPs) for Stormwater website

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Stormwater Best Management Practice

Parking Lot and Street Sweeping

Minimum Measure: Pollution Prevention/Good Housekeeping for Municipal Operations
Subcategory: Municipal Activities

Description

Streets, roads, highways and parking lots accumulate pollutants that, when combined with stormwater, can lead to water quality impacts. Street sweeping can minimize some of these pollutants, including sediment, debris, yard waste, trash, deicing materials and trace metals. It can also improve the aesthetics of municipal roadways, control dust and reduce the frequency of catch basin or storm drain cleaning. An effective municipal street sweeping program can meet regulatory requirements, assess street sweeping effectiveness, and minimize pollutants in roadways.

Applicability

Most urban areas sweep their streets, often as an aesthetic practice to remove trash, built-up sediment and large debris from curb gutters and increasingly as a water quality practice to reduce stormwater pollutant loadings. Effective street sweeping programs can remove several tons of debris a year from city streets (Franklin Soil and Water Conservation District, 2017) minimizing pollutants in stormwater. In colder climates, street sweeping during the spring snowmelt can reduce pollutants in stormwater from deicing materials, sand and grit.

Implementation

A municipality should account for several factors when designing and implementing an effective municipal street sweeping program.

Schedule and Reporting

Creating (and following) a schedule can increase the efficiency of a street sweeping program. A successful program should be flexible to accommodate climate conditions and areas of concern. Municipalities should base their identification of areas of concern on traffic volume, land use, field observations of sediment and trash accumulation, and proximity to surface waters (MPCA, 2017). They should develop up-to-date maps and impervious surface inventories to help find and designate these areas. They may want to increase street sweeping and amend schedules for areas of concern. Schedules should include sweeping at least once a year. In cold climates prone to snowfall, the Connecticut Department of Energy and Environmental Protection recommends, municipalities should conduct street sweeping as soon as possible after the snow melts (DEEP, 2007). Removal of the accumulated sand, grit and debris from roads after the snow melts reduces the amount of pollutants that subsequent storms can mobilize.



Street sweepers, such as the one shown above, can be used to clean roadways on a regular schedule.
Photo Credit: Mark Mauno/Wikimedia

To evaluate the effectiveness of their street sweeping programs, municipalities should keep accurate logs of the number of curb-miles they sweep and the amount of waste they collect. They can measure monthly or yearly intakes (per ton) per district, road, season or mile. This information can inform a written plan, schedule and periodic re-evaluation that would target the following (Curtis, 2002):

- Roadways with contributing land uses (high imperviousness, high industrial activity) indicating high pollutant concentrations.

- Roadways that have consistently accumulated more materials (in pounds per mile swept) between sweeps.

Municipalities can present gross intake amounts to regulatory agencies and finance directors to measure performance. The City of Dana Point, California, reported a monthly debris intake of 23 tons when it conducted sweeping twice a month. Dana Point then moved to weekly sweeping and the monthly total increased to between 45 and 80 tons of debris (Franklin Soil and Water Conservation District, 2017). Some municipalities also try to estimate the types of trash typically swept to tailor other aspects of their stormwater programs, including the public education and outreach component.

Parking Lots

Parking lot cleaning is similar to standard street sweeping with a few important exceptions. Like streets, parking lots need regular inspections and maintenance to identify specific areas of concern or times of high activity (e.g., fairs, farmers markets, special events). For privately owned parking lots, property owners and municipal staff should coordinate to limit pollutant discharge to public storm drains. In many cases, property owners can contact their municipal public works departments or private street sweeping companies to coordinate regular cleanings (Pace Partners, 2018).

Street Sweepers

There are three common types of street sweepers available to municipalities: mechanical, regenerative air and vacuum. Each type of street sweeper has its advantages and disadvantages involving pollutant removal effectiveness, traveling speed and noise. Each targets large debris, though regenerative air and vacuum cleaners are much more effective at removing particles down to 10 microns in diameter (also known as PM_{10}). The three types differ in price, noise and maintenance requirements. A municipality should choose the most appropriate type according to its budget, local climate, street type, noise ordinances and major pollutants of concern. It may find it best to have a complement of each type of street sweeper in its fleet (CASQA, 2003).

Mechanical broom sweepers are typically the least expensive and are well suited to picking up large-grained sediment particles and cleaning wet surfaces. They tend to create more dust, however, potentially increasing atmospheric emissions as well as the amount of fine sediment that travels to surface waters. Some newer models can use water to suppress dust (Kuehl et al., 2008). Regenerative air and vacuum sweepers are more efficient, particularly with respect to fine-grained sediment, but are more expensive. Using a mechanical sweeper for large particles followed by a regenerative air cleaner can be an effective strategy (MPCA, 2017).

Street Sweepings Storage, Disposal and Reuse

Street sweeping material often includes sand, deicing materials, leaves and miscellaneous debris. Often, the collected sweepings contain pollutants and the municipality should test them before disposal or reuse to determine if they are hazardous. Miller et al. (2016) provides a comprehensive review of studies that have analyzed pollutants of concern (heavy metals and petroleum hydrocarbons) in sweepings. Municipalities should adhere to all federal and state regulations that apply to the disposal and reuse of sweepings.

Municipalities should develop comprehensive management plans for the handling of sweepings. A critical aspect of a management plan is choosing a location for storing and processing street sweepings. Storage locations should have secondary containment and possibly overhead coverage to prevent stormwater from contacting the piles of sweeper tailings. It is also best to cover the piles of sweepings with tarps to prevent the generation of excessive dust. Storage locations should be large enough to completely contain the disposed sweepings.

To reduce disposal costs and prevent the landfilling of reusable material, some state and local regulations may allow the reuse of sweepings for general fill, parks, road shoulders and other applications. To reduce the chance of human or environmental exposure to pollutants, some states require municipalities to assess sweepings heavy metals and petroleum compounds before reuse; other states do not require assessment of materials that are not visibly contaminated (Miller et al., 2016). Municipalities should find beneficial reuse opportunities for street sweeping material and should follow all applicable local, state or federal regulations.

Parking Policies

Parking policies can increase the effectiveness of street sweeping programs. They often have the following components:

- Restriction of parking in problematic areas during periods of street sweeping.
- Posting of permanent street sweeping signs (or temporary signs, if installing permanent ones is infeasible) in problematic areas.
- Inclusion in community newsletters or posting flyers on nearby poles notifying residents of upcoming street sweeping schedules.
- Municipalities can set parking policies as city ordinances.

Operation and Maintenance Program

A municipality should dedicate time for daily and weekly equipment maintenance. Regular maintenance and daily startup inspections ensure that street sweepers are in good working condition. It is vital for municipalities to inventory and properly stock parts to prevent downtime and decreased productivity. They should also replace old sweepers with new, more advanced sweepers, preferably modern versions that maximize pollutant removal (CASQA, 2003). Installing an automatic greasing system on sweepers can decrease maintenance time and reduce wear on critical parts, which can keep the sweeper on the job longer with fewer unscheduled maintenance hassles. Maintaining surfaces through more frequent sweeping may also reduce the frequency necessary for catch basin cleaning (MPCA, 2017).

Cost Considerations

Staffing and equipment are the largest expenditures associated with street sweeping programs (CASQA, 2003). The capital cost for a conventional street sweeper can range from $60,000 for a small mechanical sweeper to more than $250,000 for a newer vacuum or regenerative air sweeper, with make, model and specifications all affecting cost (Kuehl et al., 2008; MPCA, 2017). Street sweepers have an average life span of 4 to 8 years (though more modern street sweepers sometimes last longer). Municipal programs should budget for capital expenditures on equipment replacement depending on expected life spans. Municipalities can save costs by acquiring equipment with multiple uses. For example, the City of Jordan, Minnesota, purchased a sweeper that converts to a sander and snowplow in the winter (MCPA, 2017).

The following tables show street cleaning program cost estimates from nine surveyed cities.

Table 1. Spending and staffing for street cleaning: eight surveyed cities and San Francisco, fiscal year 2016-17.

City	Population	Area (Square Miles, Land)	Street Cleaning Spending [a]	Spending per Capita	Street Cleaning FTE Count
Chicago	2,704,958	227.3	$8,548,428	$3.16	71
Long Beach	470,130	50.3	$5,313,421	$11.30	15
Minneapolis	413,651	54.9	$8,800,000	$21.27	54
Portland	639,863	133.0	$7,461,034	$11.66	30
Sacramento	501,334	97.9	$936,292	$1.87	7
San Diego	1,406,630	325.2	$3,282,000	$2.33	40
San Jose	1,015,785	177.5	$6,320,000	$6.22	18
Seattle	713,700	83.9	N/A	N/A	N/A
Median	**639,863**	**97.9**	**$ 8,004,731**	**$8.76**	**40**
San Francisco	864,816	46.9	$34,988,059	$40.46	302

Source: Adapted from City and County of San Francisco, 2018

[a] Figures do not include overhead costs for cities.

Table 2. Curb miles swept and expenditures per curb mile, seven surveyed cities and San Francisco, FY 2016-17.

City	Curb Miles Swept	Street Sweeping Expenditures [a]	$ per Curb Mile Swept
Chicago	251,429	$7,005,120	$27.86
Long Beach	141,132	N/A	N/A
Portland	14,780	$2,973,149	$201.16
Sacramento	150,000	$936,292	$6.24
San Diego	106,000	N/A	N/A
San Jose	67,295	$3,520,000	$52.31
Seattle	27,360	$2,588,400	$94.61
Median	**120,333**	**$3,744,878**	**$52.31**
San Francisco	158,974	$6,367,200	$40.05

Source: Adapted from City and County of San Francisco, 2018

[a] Figures do not include overhead costs for cities.

Effectiveness

Street sweeping can be an effective way to reduce sediment loadings to downstream waterbodies. This can be important, not just because of sediment export concerns, but because sweepings can have variable and sometimes high concentrations of heavy metals, petroleum hydrocarbons and nutrients. For example, Miller et al. (2016) compiled results from a literature review and an online survey of municipal street sweeping programs and found reported concentrations of lead and heavier petroleum hydrocarbons (e.g., motor oil) that were sometimes in excess of Ohio beneficial reuse standards.

The effectiveness of street sweeping varies considerably depending on geographic location, sweeping frequency and equipment used:

- In a survey of three towns in Ohio, Miller et al. (2016) found that over 3 years, collection rates (influenced by type of sweeper, traffic counts, precipitation, frequency, surrounding land use) varied from 44 to 7,550 pounds per mile, with median rates ranging from 332 to 938 pounds per mile. A similar study in Maryland found that for a program that swept about 14,373 miles of roadway, the overall collection rate was 343 pounds per mile (Curtis, 2002).
- Sweeper type is an important factor, especially when pollutant removal (as opposed to bulk sediment and debris removal) is the goal. Many studies are finding that pollutants are predominantly associated with finer particles (Miller et al., 2016) and that mechanical sweepers not only cannot effectively remove fines but often dislodge fines in cracks and crevices, resulting in minimal and sometimes negative removal rates for target pollutants (Miller et al., 2016; Schueler et al., 2016). Vacuum and regenerative air sweepers are more effective. Using a combination of previously published collection data and modeling, Schueler et al. (2016) found that for sweeping frequencies of six to 100 passes per year, removal efficiencies were 4–21 percent for total suspended solids, 0.7–4 percent for total nitrogen and 2–10 percent for total phosphorus.
- Traffic counts and surrounding land use (industrialized areas) are also important factors influencing elevated concentrations of total petroleum hydrocarbons (TPH), polycyclic aromatic hydrocarbons (PAHs) and heavy metals in sweepings. In urban areas with high traffic counts, higher concentrations of heavy metals, TPH, and PAHs are expected in collected sweepings (Washington Department of Ecology, 2005). Irvine, et al, 2009 confirmed that heavy metals concentrations are elevated in street sweepings collected from urban roads with high traffic counts

and in industrialized areas. Both zinc and copper concentrations were higher in areas with high traffic counts, while manganese and iron concentrations were higher in industrialized Final Report 5 areas (Irvine, et al, 2009). Depree, 2008 found that PAH concentrations in street sweepings collected from arterial streets were approximately two times higher than those collected from non-arterial roads, while copper and lead concentrations were three times higher on high traffic volume roads than low traffic volume roads (Depree, 2008).

A street sweeping program can be an effective tool for municipalities for pollutant removal and good housekeeping. Using modern efficient street sweepers may reduce the need for other structural stormwater controls. Municipal stormwater managers should compare potential benefits and costs of street sweeping, especially in more urbanized areas with greater areas of pavement.

Additional Information

Additional information on related practices and the Phase II MS4 program can be found at EPA's National Menu of Best Management Practices (BMPs) for Stormwater website

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Stormwater Best Management Practice

Roadway and Bridge Maintenance

Minimum Measure: Pollution Prevention/Good Housekeeping for Municipal Operations
Subcategory: Municipal Activities

Description

Daily roadway and bridge use, along with scheduled repairs, can generate substantial amounts of sediment and pollutants. The most common contaminants in highway discharges are heavy metals, inorganic salts, polycyclic aromatic hydrocarbons, and suspended solids. Salting and sanding practices, for example, leave concentrations of chloride, sodium and calcium on the roadway surface. Through ordinary operation and wear and tear, vehicles release metals, hydrocarbons, rubber particles and other solid materials on highway surfaces. Rain and melting snow often wash these materials off the highway and into adjacent waterways (FHWA, 1999).

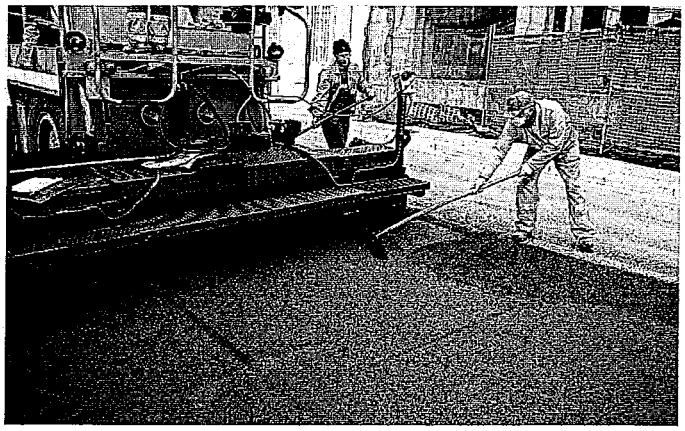
Roadway and bridge maintenance pollution prevention practices can reduce pollutant loadings from existing road surfaces as part of a larger operation and maintenance program. These practices include routine maintenance activities such as sweeping, vegetation maintenance, and cleaning of stormwater discharge control structures. They can also include modification of existing practices such as roadway resurfacing or deicing.

Applicability

Roadway systems make up a large part of urban infrastructure. Because of traffic use and weathering, they need regular repairs and maintenance. The amount of pollutants found on roads and bridges varies, due to climate, traffic volume, and other factors including surrounding land use, the bridge or roadway's design, the presence of roadside vegetation, insecticide use, and the frequency of vehicle accidents and chemical spills. In colder climates, deicing materials applied to roadways can also influence pollutant levels in roadway discharges, thereby affecting local water quality.

Siting and Design Considerations

Proper planning for road and bridge resurfacing is a simple but effective pollution control method. A municipality should schedule roadway inspections throughout the year, and should make sure each inspection includes a careful examination of the function and physical condition of roadway assets and systems including roadway surfaces, drainage structures, vegetation, guardrails and bridges. Municipalities should also map their inspection locations, paying special attention to places that may need extra attention and maintenance (Washington County DLUT, 2017).



Paving operations should be conducted in dry weather.

To prevent stormwater contamination during resurfacing, municipalities should only perform paving operations in dry weather. They should use proper staging techniques to reduce the spillage of paving materials during the repair of potholes and worn pavement. These techniques can include covering storm drain inlets and manholes during paving operations; using erosion and sediment controls to decrease discharges from repair sites; and using drip pans, absorbent materials and other pollution prevention materials to limit leaks of paving materials and fluids from paving machines. Lastly, using porous asphalt for shoulder repair can reduce the amount of stormwater generated from roadway systems. For more information on permeable materials, see the Permeable Pavement fact sheet.

Sweeping and vacuuming heavily traveled roadways to remove sediment and debris can reduce the amount of pollutants in stormwater (see the Parking Lot and Street Sweeping fact sheet). Regular cleaning of stormwater control structures, such as catch basins, can help reduce

sediment loads in discharges that will end up in local waterways (see the Stormwater Inlet BMPs and Storm Drain System Cleaning fact sheets).

Proper application of deicing materials on roadways also limits stormwater pollution. By routinely calibrating spreaders, a program manager can prevent the over-application of deicing materials. Besides reducing these materials' effects on the aquatic environment, this practice can save money through more efficient material use. Training transportation employees in proper deicer application techniques, timing and type will also help reduce impacts on water quality and aquatic habitat. See the Deicing Material Application and Storage fact sheet for more information.

Maintenance practices for roadside vegetation can improve its stormwater treatment performance. Restricting the use of herbicides and pesticides on roadside vegetation, and training employees on the proper handling and application of pesticides and other chemicals, can help prevent contamination of stormwater. Choosing roadside vegetation with higher salt tolerances will also help to maintain the health of practices such as vegetated swales and biofilters. For more information on roadside vegetated stormwater practices, see the Vegetated Filter Strip and Bioretention fact sheet.

The EPA's National Management Measures to Control Nonpoint Source Pollution from Urban Areas provides more information on how bridge and highway design and maintenance practices can address stormwater pollution.

Besides the roadway practices listed above, improved bridge siting, design and maintenance practices can help reduce water quality impacts. Several studies have shown that scupper drainage that directly enters adjacent waters can result in localized increases of metal concentrations in sediments and in aquatic biota (Transportation Research Board, 2002). Avoiding scupper drains in new bridges and routinely cleaning existing ones to prevent sediment and debris buildup can help. Program managers should also consider retrofitting scupper drains with catch basins or closed pipe systems to redirect stormwater to vegetated areas or other stormwater treatment practices. Other techniques to help reduce pollutant discharges to receiving waters include using suspended tarps, booms or vacuums to capture paint, solvents, rust, paint chips and other pollutants generated by regular bridge maintenance. Additionally, sodium chloride, a common deicer, corrodes metal bridge supports, not only increasing maintenance costs but often leaving corroded material in local waterways. Municipalities should consider less corrosive alternative deicing materials like glycol, urea or calcium magnesium acetate (CMA) for bridge deicing.

Limitations

Pollution prevention practices for road and bridge maintenance come with costs for equipment, maintenance and training. However, since all communities already need to maintain roadways and bridges, they usually have staff and may not need to change their practices or add staffing or administrative labor.

A new bridge's location may be a limitation. If it is near sensitive waters, it may need a better design to adequately treat stormwater. Community requirements may restrict the size of paved areas to limit impervious surface; this can affect roadway and shoulder widths.

Cost Considerations

Most community public works or transportation departments allocate considerable funding to the maintenance of local roads and bridges and the cost of incorporating pollutant reduction strategies will likely be insignificant relative to existing expenditures. New York state, for example, spent $3.6 billion on roadways and bridges in 2018, and more than a third of that went to maintenance and preservation (CBCNY, 2019). These costs attributed to stormwater-related maintenance and generally involve the training and equipment required to apply new stormwater practices.

Strategic planning may also help offset implementation costs. For example, incorporation of road and bridge pollution prevention practices by a community's transportation department may benefit the environmental or stormwater department. Communities working to address metal or sediment impairments through the Total Maximum Daily Load (TMDL) program may be able to gain credit for road and bridge practices that demonstrate a reduction in these pollutant loadings. Similarly, scupper retrofits that redirect stormwater to an approved treatment practice may help offset municipal treatment requirements.

Additional Information

Additional information on related practices and the Phase II MS4 program can be found at EPA's National Menu of Best Management Practices (BMPs) for Stormwater website

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Stormwater Best Management Practice

Storm Drain System Cleaning

Minimum Measure: Pollution Prevention/Good Housekeeping for Municipal Operations
Subcategory: Municipal Activities

Description

Municipal stormwater commonly flows through storm drains and from there, sometimes without treatment, into waterbodies. A storm drain consists of one or more conduits (closed pipes or open channels or ditches) connecting one or more inlets. If not routinely cleaned and maintained, these systems can accumulate large amounts of debris and pollutants, which can lead to clogging, flooding and water quality problems. The specifics depend on the type and amount of pollutant involved, but problems can include foul odors, excessive sediment export and reduced dissolved oxygen in receiving waters.

Some common pollutants found in storm drains include:

- Trash and debris
- Sediments
- Oil and grease
- Antifreeze
- Paints
- Cleaners and solvents
- Pesticides
- Fertilizers
- Animal waste
- Deicing materials
- Detergents



Debris from storm drains and catch basins should be collected and disposed of according to best practices and local regulations.

Photo Credit: Airman 1st Class Milton Hamilton/U.S. Air Force

Implementation

Cleaning Programs

Like all infrastructure, storm drain systems need regular inspection and cleaning. Municipal or contracted professional personnel should do this work, and they should have training on applicable regulations and cleaning and disposal procedures. Many municipalities have standard operating procedures for cleaning their storm drain systems, which include training, methods, equipment and frequencies for cleaning. For example, the Brighton, Colorado, utilities department has developed storm sewer cleaning guidelines. They recommend cleaning the storm drain systems every 5 years—in practice, this means that the city cleans 20 percent of the system every year (City of Brighton, 2018).

To increase the effectiveness of any cleaning program, a municipality can establish a pre-inspection program that maps and creates an asset inventory of all storm drains and conveyances. This makes it possible to identify and prioritize problem areas, and thus to set a more efficient cleaning schedule that takes into account storm drain accessibility, cleaning routes and any seasonal patterns. (For example, a system might need more frequent cleanouts during the fall when leaf litter increases. Another example could include a system in a high traffic area that is identified as a priority system to clean out more frequently.)

Cleaning Methods

There are two main methods of storm drain system cleaning, dry cleaning and wet cleaning. The dry method—which should be performed first—involves direct removal by hand or using vacuums or shovels. The wet method typically involves jetting and flushing

(City of Brighton, 2018). For larger systems, municipalities tend to use vactor trucks (often called vacuum or jet trucks) with either method.

Having removed the sediment and debris, a municipality should treat or discard it according to applicable solid waste and hazardous materials regulations. This includes rinse water from wet cleaning: it is important to contain, collect and properly dispose of this rinse water, whose sediment and debris content may qualify as hazardous waste. The municipality should identify temporary storage areas for debris and protect those areas from wind, rain and surface stormwater flow.

Accurate recordkeeping is important for any cleaning method. Field staff should document the staff, location, cleaning date, equipment used, frequency of waste disposal, and number of drainage structures cleaned. They should also record the amount of sediment or debris collected or removed.

Limitations

Several factors may limit the effectiveness of a storm drain cleaning program. For example, tree roots can clog storm drain systems, affecting overall structural integrity and making cleaning difficult. Storm drain systems may be in areas that are hard to access and clean. And municipalities often lack the resources to train employees or contractors, purchase the equipment they need, or actually do the cleaning. A targeted cleaning program (see the discussion of pre-inspection programs above) can at least help address known hot spots and help prioritize cleanings.

Cost Considerations

Including equipment and labor, a storm drain cleaning program can be expensive. Vactor trucks can cost $80,000 to $150,000 (City of Manhattan, 2018). For total cleaning costs, a 2005 survey of NPDES stormwater compliance costs in California found actual cleaning expenditures of $8 per linear foot of drain line and $170 per catch basin, with all storm drain cleaning activities making up 10–20 percent of all stormwater costs (California State University, Sacramento, 2005). Municipalities should also factor in costs for properly disposing of the collected sediment and debris.

Additional Information

Additional information on related practices and the Phase II MS4 program can be found at EPA's National Menu of Best Management Practices (BMPs) for Stormwater website

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Stormwater Best Management Practice

Hazardous Materials Storage

Minimum Measure: Pollution Prevention/Good Housekeeping for Municipal Operations
Subcategory: Municipal Facilities

Description

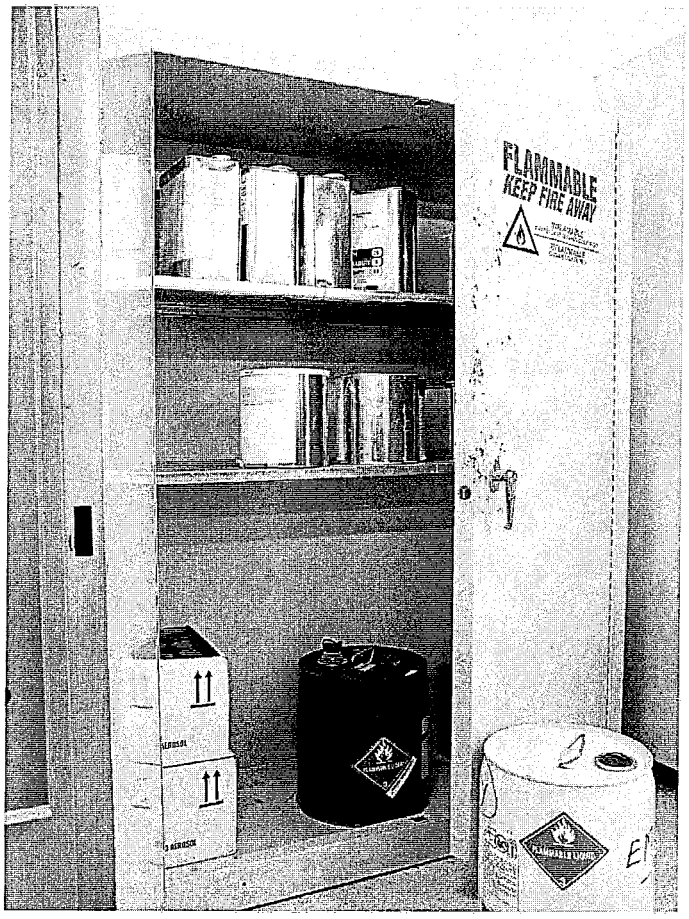
Generally, hazardous materials have properties that make them dangerous or capable of having a harmful effect on human health or the environment. Hazardous materials can be in many forms including liquids, solids or gases and sludges. They are often generated from common municipal activities, such as vehicle maintenance and fueling, firefighting, landscaping and park maintenance, roadway repairs and maintenance, and hazardous waste drop-off locations. Proper management, storage and handling of hazardous materials is critical for reducing the possibility of stormwater contamination through leakage and spills.

Applicability

Hazardous materials storage is relevant to both urban and rural settings in all geographic regions. Some common hazardous material sources are:

- Petroleum products
- Fuels
- Asphalt products
- Concrete curing compounds
- Pesticides
- Pharmaceutical products
- Acids (e.g., from batteries)
- Paints, stains, and solvents
- Septic wastes
- Wood preservatives

The effects of hazardous materials contamination may be more pronounced in geographic areas with heavier rainfall due to the greater volume of stormwater and potential for contribution of pollutants to stormwater discharges.



Hazardous materials should be stored appropriately for the type of material, such as in a flammables cabinet.

Siting and Design Considerations

Regulatory Requirements

Municipal staff should store, manage and dispose of hazardous materials in accordance with all applicable federal, state and local regulations. Two common requirements include general safety requirements of The Occupational Safety and Health Administration (OSHA 29 CFR 1910.176) and storage requirements from the National Fire Protection Association Code 30 (NFPA 30) for flammables and combustibles.

General Storage Considerations

Best practices for hazardous materials storage minimize the possibility of spills, weathering, leaks or improper handling from regular site activities. They include:

- Properly inspect, label and seal all containers.
- Segregate incompatible materials based on physical and chemical properties and secondary containment requirements (refer to Safety Data Sheets for useful information).
- Store all hazardous materials in areas that will not be subject to rain, flooding, or vandalism (under lock and key if necessary).
- For outdoor storage locations, provide proper ventilation, storage foundations (e.g., pallets or a concrete slab) and secondary containment as recommended by the manufacturer or required by regulation.
- Confine storage of hazardous materials to designated areas.
- Ensure enough aisle space to ease inspections and handling and minimize the chance of accidental spills.
- Store hazardous materials away from high-traffic areas.
- Perform loading and unloading operations in areas designed to contain potential spills.
- Make sure workers have easy access to spill cleanup materials.
- Use dry cleanup methods instead of wet (e.g., hosing areas down).
- Train employees on proper storage techniques.

A number of resources outline best practices for various contexts—see the box to the right for two of these.

Vehicle Maintenance and Washing

Vehicle and equipment fueling, maintenance and washing may involve hazardous materials. Municipal staff should confine these activities to designated areas that contain the discharge. They should also follow all federal, state and local disposal requirements for disposing of generated hazardous waste. For more information, refer to the Vehicle Equipment and Maintenance and Vehicle and Equipment Washing fact sheets.

Storage of Household Hazardous Materials

Residents waiting to dispose of their household hazardous materials should store them properly until their hazardous waste collection day. For example, they could:

- Put hazardous material—in its own, original container—into a plastic container with a lid (e.g., a 5-gallon bucket), filled halfway with unused cat litter.
- Fasten the bucket lid and clearly mark the contents of the container.
- Store the bucket away from children and anyone else who might ingest the stored hazardous material.
- Store the bucket off the ground to reduce the potential for corrosion.

Limitations

Hazardous materials storage containers, structures and buildings all have finite life spans. For example, tarpaulins and plastic sheets used for coverings on outdoor storage locations may not last very long in some climates—though a roof or other covered storage building structure would last much longer.

Some hazardous materials or generated waste products may have limitations on the volume and length of time that anyone may store them. Refer to EPA's Hazardous Waste Generator Regulatory Summary page for more on storage requirements for specific hazardous wastes.

Resources on hazardous material storage best practices and requirements for different contexts:

- The U.S. EPA's Multi-Sector General Permit for Stormwater Discharges associated with Industrial Activity
- The U.S. EPA's Construction General Permit for Stormwater Discharges from Construction Activities

Maintenance Considerations

Along with keeping storage areas neat, orderly and well lit, municipal staff should implement a regular inspection program. In particular, they should routinely inspect storage spaces and containers for leaks, signs of cracks or deterioration, or any other signs of leakage. They should immediately repair any leaks or containment weaknesses they find.

Cost Considerations

Costs for storing hazardous materials depends on the substance, the type of storage facility, and the frequency with which that facility's operators store, transport or dispose of the materials. Cleanup costs vary widely depending on the type and amount of substance that has leaked, as well as the surfaces or environments the substance has come in contact with. Municipal staff should immediately protect any spilled hazardous material from stormwater, clean all contaminated surfaces and dispose of the waste, regardless of the expense. To offset the cost of covering or enclosing hazardous materials, they might reconsider procurement, inventory and disposal practices to minimize the amount of materials stored on-site.

Additional Information

Additional information on related practices and the Phase II MS4 program can be found at EPA's National Menu of Best Management Practices (BMPs) for Stormwater website

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Stormwater Best Management Practice

Materials Management

Minimum Measure: Pollution Prevention/Good Housekeeping for Municipal Operations
Subcategory: Municipal Facilities

Description

Many municipal activities involve common chemicals such as fertilizers, solvents, paints, cleaners and automotive products. These materials, if improperly managed, can enter storm drains and lead to water quality impacts. Properly using, storing and disposing of them can limit the likelihood of these accidental spills or releases.

Applicability

Any municipal facility that might release harmful chemicals (through spills, leaks or otherwise) can use materials management practices to minimize or prevent releases. Such facilities or activities include:

- Municipal landscaping
- Municipal vehicle and equipment maintenance
- Municipal vehicle and equipment washing
- Municipal vehicle fueling
- Deicing material application and storage

(For more information on storing hazardous materials, refer to the Hazardous Materials Storage fact sheet.)

Implementation

In many cases, facilities can implement simple housekeeping practices to manage materials more effectively. Before establishing such a routine, however, municipal staff should generate a material inventory to familiarize employees with their presence and proper use. Some facilities—for example, facilities that use and store large quantities of chemicals—may need to implement structural and non-structural practices.

Material Inventory

Regular material inventories make hazardous material overstocking less likely, increase knowledge about what hazardous materials are present and what their storage requirements are, and document proper handling techniques. An inventory of hazardous materials has three major steps:



Keeping materials stored indoors and using controls such as drip pans can reduce the risk of a potential stormwater contamination.
Photo Credit: Kevin Stockton, U.S. EPA, 2020

- Identify all hazardous and nonhazardous substances by reviewing all purchase orders and walking through the facility. Obtain a Safety Data Sheet (SDS) for each substance present, as applicable.
- Label each container with the name of the chemical, unit number, expiration date, handling instructions, and health or environmental hazards. (The SDS will be the source of much of this information). Insufficient labeling can lead to improper handling or disposal of hazardous substances.
- Make special note of hazardous chemicals that need special handling, storage or disposal.

Routine Housekeeping

Routine housekeeping practices, drawing on the now-complete material inventory, can reduce worker exposure to potentially harmful chemicals and limit the potential for spills and accidental discharges. These practices include:

- Implement routine cleaning and inspection of facilities or areas that store or process materials.
- Maintain clean, organized workplaces.
- Minimize the amounts of materials used and the wastes that municipal activities generate.
- Use environmentally friendly alternatives to toxic chemicals whenever possible.
- Store materials away from storm drains.

Employee education and training is critical to good materials management practices.

To learn more about how to implement training programs, see the Municipal Employee Training and Education fact sheet.

- Dispose of old or outdated chemicals at approved disposal locations.
- Educate employees about the benefits of proper materials management practices (see box to the right).

Structural Controls

For facilities that store or handle large quantities of potentially harmful materials, structural controls can add a layer of protection against stormwater contamination. Structural controls include:

- Cover outdoor storage and handling areas to reduce exposure to precipitation, stormwater and wind.
- Build a designated, enclosed storage area.
- Install secondary containment structures surrounding material handling areas.

Cost Considerations

Except for structural controls, costs associated with materials management practices are mostly labor costs. The necessary education of municipal employees, local businesses and the public will take up an amount of staff hours that depends on the program's extent. Producing items to encourage proper practices, such as posters and bulletin boards, may also incur minor material costs.

The cost of structural controls will depend on the size of the material handling or storage area.

Additional Information

Additional information on related practices and the Phase II MS4 program can be found at EPA's National Menu of Best Management Practices (BMPs) for Stormwater website

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Stormwater Best Management Practice

Municipal Facilities Management

Minimum Measure: Pollution Prevention/Good Housekeeping for Municipal Operations
Subcategory: Municipal Facilities

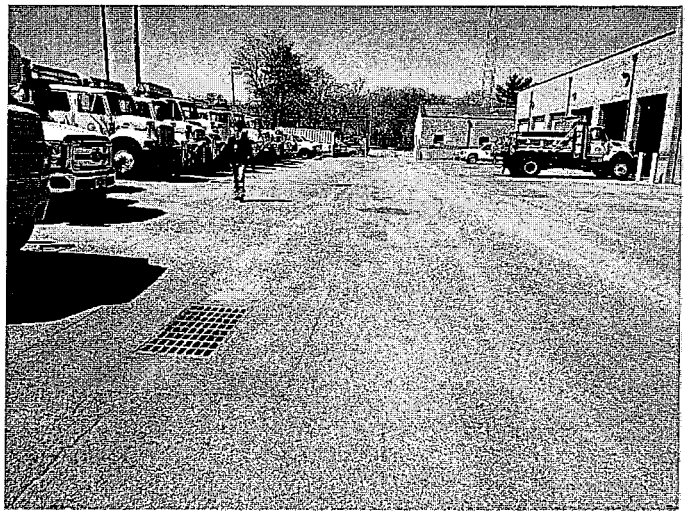
Description

Municipalities own and operate many facilities, including maintenance yards, parks, office buildings and schools. Some regular activities at these facilities can release pollution that enters storm drain systems or receiving waters. Among these activities are automobile maintenance, residential car washing, hazardous materials storage, materials management, sign painting, pest control, parking lot and street sweeping, and waste storage and disposal.

To effectively manage stormwater and thus prevent or reduce stormwater pollution, a municipality should inventory its facilities and associated activities to assess potential impacts on stormwater quality and revise activities or implement new measures as needed. It should describe these activities and control measures in a stormwater pollution prevention plan (SWPPP) or a similar document. It should also provide training on stormwater best management practices (BMPs), which include stormwater control measures and good housekeeping practices, to all municipal facilities maintenance staff, giving them clear guidance on how to use appropriate stormwater practices during typical maintenance operations and facility management activities.

Applicability

The Phase II rule establishes that permits should require the development and implementation of operation and maintenance programs that includes a training component and has the ultimate goal of preventing or reducing pollutant runoff from municipal operations. The program should include employee training to prevent or reduce stormwater pollution from activities such as park and open space maintenance, fleet and building maintenance, new construction and land disturbances, and storm water system maintenance. These programs should address, as applicable, areas such as municipal parking lots, maintenance and storage yards, fleet maintenance shops, deicing material storage locations, snow disposal areas, and waste transfer stations. The



Municipal facilities, such as an outdoor vehicle storage area, can be a source of stormwater pollution when not cleaned and maintained regularly.

Photo Credit: Anthony D'Angelo, taken for U.S. EPA

rule also requires that permits include storm water system maintenance. Programs often include procedures for properly disposing of waste removed from the separate storm sewers and areas listed above (such as dredge spoil, accumulated sediments, floatables and other debris). Municipal staff should also evaluate facilities that store chemicals, those with outdoor trash storage areas, and areas that store or dispose of potentially hazardous materials (e.g., animal shelters, hospitals, clinics) for pollution potential and need/opportunity for control practices.

Some municipalities should also have industrial stormwater permits covering the municipal facilities and activities they own and manage. If a municipal facility, such as a landfill or transportation facility, has activities included in one of the 11 categories of industrial activity described in 40 CFR 122.26(b)(14)(i)–(xi) that discharge stormwater, the operator may need coverage under a National Pollutant Discharge Elimination System (NPDES) industrial stormwater permit. For areas where EPA is the permitting authority (in some states, on Indian Country lands, and at some federal facilities), the Multi-Sector General Permit provides facility-specific

requirements for many types of industrial facilities in one permit. However, EPA has delegated and authorized most states to implement the NPDES stormwater program (click here for a list of authorized states) that have their own industrial stormwater permits.

Implementation

Municipal facilities each will have different activities and pollutants of concern. Facility managers should consider the good housekeeping practices and pollution prevention controls outlined in EPA's menu of BMPs and develop a pollution prevention program, such as a SWPPP, that outlines how they will implement the BMPs. If an industrial stormwater permit covers the facility, the development and implementation of a SWPPP is one of the permit requirements.

SWPPP development and implementation consists of five general phases to minimize or prevent pollutants from entering a storm drain system or receiving waters. SWPPPs are designed to include facility-specific BMPs which may include scheduling activities to reduce the potential for off-site migration of pollutants, such as not scheduling activities immediately before or during rainstorms; prohibiting certain practices, such as the outside storage and use of chemicals; requiring specific maintenance procedures; and other management practices to prevent or reduce stormwater pollutants. The five major phases of developing a pollution prevention plan include (U.S. EPA, 2009):

1. ***Planning and organization.*** Staff should designate a person or team who will be responsible for developing and implementing the SWPPP and other existing environmental facility plans, such as plans governing pesticide use or hazardous materials storage, to ensure consistency across departments. The municipality should build on relevant portions of other environmental plans as appropriate, although it is important that the SWPPP be a comprehensive, stand-alone document that is reflective of facility-specific conditions.

2. ***Assessment.*** Municipal staff should inspect facilities that might contribute pollutants to the storm drain system to identify possible pollution sources and BMP opportunities. It is helpful to create a map of the facility that identifies pollutant sources, storm drains, drainage ditches, BMPs requiring periodic maintenance, and areas suitable for new BMP implementation or retrofit. The municipality should also take an inventory of potentially polluting materials, evaluate past spills and leaks, identify and eliminate sources of non-stormwater discharges and illicit connections, collect and evaluate any existing stormwater quality data, and summarize the findings of the assessment.

3. ***BMP and stormwater control selection and plan design.*** In choosing stormwater controls and BMPs, the municipality should give special consideration to material handling or storage areas, outdoor processing areas, loading and unloading areas, and on-site waste management and disposal areas. Municipal staff should consider both structural and non-structural control measures as well as the site-specific pollutants to be reduced to select the proper controls. Structural control measures may include practices such as inlet controls, vegetated swales, rain gardens and wet detention systems. Examples of non-structural control measures include good housekeeping practices that focus on pollution prevention.

> EPA has adapted a table from California's *Stormwater Best Management Practice Handbook* that provides a helpful table listing of potential pollutants likely to be associated with specific municipal facilities.

4. ***Implementation.*** The municipality should implement the selected stormwater BMPs according to a schedule that reflects their priority level and funding/labor constraints. Also, all municipal employees should receive training to understand and carry out the goals of the SWPPP. Employee training and education is itself a control measure and is critical in informing employees about potential sources of stormwater contamination and ways to minimize water quality impacts.

5. ***Evaluation and site inspection.*** Facility staff should conduct regular site evaluations to demonstrate adherence to the SWPPP and gage the SWPPP's effectiveness. Evaluations should document BMP implementation, illicit discharge or spill incidents, employee training, inspections, and monitoring (if applicable). Keeping records of site evaluations and their findings is important for

supporting corrective actions, demonstrating compliance with facility permits (if applicable) and adapting to changes in facility activities. The municipality should revise the SWPPP if elements prove ineffective or if activities or conditions at the facility change.

Limitations

Developing and implementing an effective SWPPP requires time and commitment, not only from managers but also from staff and laborers. Lack of funding or staff time is therefore often a limitation. After development of the SWPPP, the facility should conduct regular inspections to detect leaks, spills or other pollution issues as soon as possible. Without the proper training, municipal employees can be unable or unwilling to conduct regular inspections and maintain the BMPs included in the SWPPP.

Cost Considerations

The costs of formalizing stormwater management at municipal facilities will vary by facility and by municipality. The majority of the costs involve the staff time to develop a SWPPP, train staff and inspect the facilities to ensure that selected BMPs are applicable and effective.

Additional Information

Additional information on related practices and the Phase II MS4 program can be found at EPA's National Menu of Best Management Practices (BMPs) for Stormwater website

References

U.S. Environmental Protection Agency (U.S. EPA). (2009). *Developing your stormwater pollution prevention plan: A guide for industrial operators.* EPA 833-B-09-002.

Stormwater Best Management Practice

Spill Response and Prevention

Minimum Measure: Pollution Prevention/Good Housekeeping for Municipal Operations
Subcategory: Municipal Facilities

Description

Accidental spills of hazardous materials, petroleum products or common chemicals/ can endanger public health or the environment if they reach waterways. Spill response and prevention practices can help to prevent spills from happening and can minimize impacts when a spill does occur. A key practice is creating and implementing a spill response and prevention plan, which should clearly state how to prevent spills, stop the source of a spill, how to contain and clean up a spill, how to dispose of contaminated materials, and how to train personnel to prevent and control future spills.

Applicability

See the Hazardous Materials Storage fact sheet and Materials Management fact sheet for more information on storing and managing hazardous materials.

Spill response and prevention practices apply to any facility that uses or stores hazardous materials. Hazardous materials include petroleum products, pesticides, paints, cleaners, fertilizers and solvents. Applicable facilities may include manufacturing areas, warehouses, service stations, roadways and parking lots. These facilities may be on public or private property, so municipal spill response and prevention practices pertain to both municipal activities on public properties and spill response procedures for private properties.

Implementation

A municipality may implement spill response and prevention practices individually, within a stormwater management plan, or within a spill prevention and control plan. Being proactive to implement practices to prevent spills in the first place is pivotal. Instituting effective and coordinated response measures is key to responding quickly to prevent or limit any impacts that could occur from a spill.

Prevention Practices

Municipalities should define material handling procedures and storage requirements and take actions to reduce the potential for spills. They can achieve this by:



Spills should be responded to swiftly and according to established response plans.
Photo Credit: Mark Herlihy/U.S. Air Force

- Recycling, reclaiming or reusing process materials, thereby reducing the amount of process materials they bring into facilities.
- Installing leak detection devices, overflow controls and diversion berms.
- Disconnecting drains from processing areas that lead to the storm sewer.
- Performing preventative maintenance on storm tanks, valves, pumps, pipes and other equipment.
- Using material transfer or filling procedures that minimize spills from tanks and other equipment.
- Replacing toxic materials with less or non-toxic products.

Spill Response Plan

When a spill happens, it is critical to have a detailed plan in place. The plan should be clear and concise and should outline step-by-step instructions for spill containment, material cleanup and disposal, documentation, reporting, and follow-up procedures. The spill response plan can be in the form of a procedural handbook or a sign and should include the following components (EPA, 2007):

- Identification of potential spill or source areas such as loading and unloading, storage, and processing areas and areas designated for waste disposal.

- Identification of individuals responsible for implementing the plan.
- Description of safety measures to take with each kind of waste.
- Procedures for notifying appropriate authorities, such as police and fire departments, hospitals, or publicly owned treatment works.
- Procedures for containing, diverting, isolating and cleaning up the spill.
- Description of spill response equipment that staff should use, including safety and cleanup equipment.
- Storage of spill response supplies in easily accessible locations and in staff vehicles.
- Identification of a contractor for larger spill response.
- For spills on private property, procedures to collect cleanup and abatement costs from the responsible party.
- Procedures to document spills and spill response.

To make a spill response plan effective, municipalities need to make sure their staff understand it. They should also routinely train staff on best practices. In addition, municipalities should develop inspection checklists and response forms as part of the recordkeeping process.

A well-conceived plan reduces the likelihood of accidental spills and helps speed effective response if spills do occur.

Public Education

In addition to the procedures described above, public education is essential for reducing spills outside municipal facilities. By informing the public of actions they can take to reduce spill potential, a municipality can reduce or prevent spills. Some municipalities have set up phone numbers that citizens can use to report spills. This helps ensure that municipalities can clean up spills safely, properly and promptly.

Limitations

Municipalities need to plan their spill response and prevention programs well, define them clearly and execute them properly. One limitation of spill response and prevention is that municipalities are often largely reactive, focusing on response rather than prevention. Proper spill prevention requires that municipal staff participate in training and maintenance programs, and that plans have a strong public education component. Proper spill response also requires a proactive approach and enough funding to implement practices before a spill occurs. This includes staff training and having proper equipment and materials on hand, readily accessible and clearly marked so workers can respond according to plan.

Maintenance Considerations

To prevent spills, staff should properly maintain potential sources of spills and leaks, keeping them in good operating condition. They should also regularly inspect areas where spills might occur to ensure that spill response procedures are in view and adequate stocks of cleanup equipment are readily accessible. If facility management changes any procedures or sites, it should update the spill prevention and response plan to reflect these changes.

Cost Considerations

Costs of spill response and prevention include the cost of training municipal employees, purchasing spill kits or other on-site spill response equipment, and developing a public education program. This program will need a varying investment of staff hours and materials, depending on its extent. Spill response and prevention practices can be expensive—though arguably less so than cleaning up toxic spills that have already contaminated downstream waters and ecosystems.

Additional Information

Additional information on related practices and the Phase II MS4 program can be found at EPA's National Menu of Best Management Practices (BMPs) for Stormwater website

References

U.S. Environmental Protection Agency (EPA). (2007). *MS4 program evaluation guidance.*

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POLLUTION PREVENTION/GOOD HOUSEKEEPING

FOR MUNICIPAL OPERATIONS:

A GUIDANCE DOCUMENT
OF
BEST MANAGEMENT PRACTICES
AND
INSPECTION CHECKLISTS

WNY
Stormwater
Coalition

Erie County Department of Environment and Planning
Division of Environmental Compliance Services

POLLUTION PREVENTION/GOOD HOUSEKEEPING FOR MUNICIPAL OPERATIONS:

A GUIDANCE DOCUMENT OF BEST MANAGEMENT PRACTICES

AND INSPECTION CHECKLISTS

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INTRODUCTION

This group of (17) Pollution Prevention/Good Housekeeping Best Management Practices and Inspection checklists that relate to municipal operations and their potential effects on stormwater have been developed and assembled by a group of municipal officials that have a wealth of experience pertaining to operations and maintenance within municipalities. The information that has been formulated as guidance material for implementation of the Stormwater Phase II Municipal Separate Storm Sewer System Permit **has not** been designed to be comprehensive in all aspects of each topic. Municipalities should be "flexible" in their use of this information as pertains to their own unique municipal operations.

STORMWATER REFERENCE INFORMATION

Many sources of information concerning stormwater are available. The sources listed below were used to develop the Guidance Document:

New York State Dept. of Transportation – (http://www.dot.state.ny.us) - use the search function to locate the Environmental Handbook for Transportation Operations document and other related information

Cornell University - (http://www.cornell.edu) – the Dept. of Horticulture has information pertaining to pest control, landscaping and lawn care

U.S. Environmental Protection Agency - (http://www.epa.gov) – the National Menu of Best Management Practices (BMPs) for NPDES Storm Water Phase II document can be found at http://cfpub.epa.gov/npdes/stormwater/menuofbmps/menu.cfm within the EPA website, along with other stormwater related information

Rick\StWtrOutlineInfo

GLOSSARY OF TERMS

Biochemical oxygen demand – Depletion of dissolved oxygen in water caused by decomposition of chemical or biologic matter.

Catch Basin – A unit that is installed to capture and retain debris, particulate matter, or other solid materials, but allows stormwater to "flow through" to its discharge location

Drip Irrigation –irrigation via a perforated device (i.e. hose) that allows for a slow watering method with reduced evaporation and runoff losses

Hydraulic – Referring to water

(IPM) Integrated Pesticide Management – An environmentally sensitive approach to pest management (**not** elimination) that uses the least toxic control method – a sustainable approach to managing pests by combining biological, cultural, physical, and chemical tools.

Loading – Term used in conjunction with *sediment* and *hydraulic* to describe excessive amounts (of the term that is described)

Naturescaping – An alternative landscaping technique that incorporates native plants and creates beneficial wildlife habitat – also conserves water and energy, reduces soil/water pollution.

Oil/Water Separator – A unit that is installed "in line" to a wastewater discharge pipe which is devised to capture petroleum derived materials that float on water

Pesticides – Products that are toxic and are used to kill pests - can be classified as insecticides, herbicides, rodenticides, biocides, aquacides.

POTW – Publicly Owned Treatment Works - - a municipal wastewater treatment plant

Scupper – an opening (in a bridge deck) to allow water drainage – it does not capture debris, particulate matter, or other solid materials

Sediments - Small particles of matter that settle to the bottom of a body of water

Silt – Material consisting of mineral soil particles ranging in diameter from 0.02 millimeters to 0.002 millimeters

Stormwater - rainwater runoff or snow melt waters – these waters can interact with different types of materials, transporting contaminants to surface waters (i.e. streams, creeks, rivers)

Toxicity –The relative degree of being poisonous

Xeriscaping – An alternative landscaping technique that incorporates slow growing plants to conserve water and reduce yard trimmings

Zero input, low input (lawns) - have minimal need for care (i.e. addition of fertilizers/pesticides, water, etc.)

LANDSCAPING AND LAWN CARE
POLLUTION PREVENTION/GOOD HOUSEKEEPING PRACTICES

1. IDENTIFY IMPACTS TO/ON STORMWATER/RECEIVING WATERS (SURFACE WATERS)

    - Nutrient loading (nitrogen and phosphorous) from fertilizer runoff can cause excessive aquatic plant growth

2. PROBLEM EVALUATION: ASSESS IMPACT ON RECEIVING WATERS, PRIORITIZE

    - Biochemical Oxygen Demand

3. IDENTIFY (AND CHOOSE APPROPRIATE) SOLUTIONS (BMP's)

    - Purchase only enough lawn care products necessary for one year – store properly to avoid waste generation (spills, leaks)
    - Use slow release or naturally derived (organic) fertilizers
    - Train employees in the proper application of lawn care products
    - Develop zero input/low input lawns
    - Consider alternative landscape techniques (i.e. naturescaping, xeriscaping)
    - Plant trees away from sewer lines or other underground utilities
    - Use drip irrigation techniques for landscaping

4. INSPECTION PROCEDURES

    - Routinely monitor lawns to identify problems during their early stages
    - Identify nutrient/water needs of plants, inspect for problems by testing soils

5. MAINTENANCE PROCEDURES

    - Minimize/eliminate fertilizer application
    - Leave grass clippings on lawn, or mulch clippings into lawn
    - Limit watering as necessary to supplement rainwater (1 inch/week is adequate)
    - Mow with sharpened blades set high (3 inches) – remove only the top 1/3 of the leaves
    - Water plants in the early A.M.

6. ADVISORY

    - Refer to the Cornell University website (Dept. of Horticulture)

LANDSCAPING AND LAWN CARE INSPECTION CHECKLIST

Location: _____

COMPONENTS/ITEMS TO CHECK	PROBLEMS OBSERVED	MAINTENANCE/REPAIRS NECESSARY	ACTION
Grass/plant condition	Wilted/brown leaves	Yes No	❑ Add water
General area	Barren soils	Yes No	❑ Re-seed, cover with hay or burlap to prevent runoff

Date of Inspection _____ Name_____

Frequency _____

SPILL RESPONSE AND PREVENTION
POLLUTION PREVENTION/GOOD HOUSEKEEPING PRACTICES

1. IDENTIFY MATERIALS THAT IMPACT STORMWATER/RECEIVING WATERS (SURFACE WATERS)

    - Liquids associated with vehicle/equipment maintenance products (oils, fuels, antifreeze, etc.)
    - Rock salt
    - Chemicals (fertilizers, pesticides)

2. PROBLEM EVALUATION: ASSESS IMPACT ON RECEIVING WATERS, PRIORITIZE

    - Toxicity
    - Biochemical oxygen demand

3. IDENTIFY (AND CHOOSE APPROPRIATE) SOLUTIONS (BMP's)

    - Keep all materials properly stored in closed, labeled containment systems
    - Use secondary containment systems where appropriate
    - Obtain spill recovery materials for immediate response to a spill

4. INSPECTION PROCEDURES

    - Inspect secondary containment systems, oil/water separators periodically
    - Inspect containers for leaks, areas near storm receiver inlets and outlets, floor drains for indications of spills

5. MAINTENANCE PROCEDURES

    - Use reusable spill clean up materials (sponge mops, oil absorbent pads, etc.)
    - Pump out oil water separators as needed
    - Protect drains with oil absorbent materials
    - Clean out receivers on regular schedule
    - Remove spilled salt from salt loading area

6. ADVISORY

    - Report petroleum spills (as necessary) to the NYSDEC (851-7220 or 1-800-457-7362)
    - Refer to NYSDOT guidance information (Environmental Handbook for Transportation Operations)

SPILL RESPONSE AND PREVENTION INSPECTION CHECKLIST

Location: _____

COMPONENTS/ITEMS TO CHECK	PROBLEMS OBSERVED	MAINTENANCE/REPAIRS NECESSARY	ACTION
Products/waste storage areas	Uncovered/deteriorating containers Materials spilled, leaks	Yes No	❑ Cover/replace ❑ Clean up
Equipment storage areas	Fluid leaks	Yes No	❑ Clean up
Secondary containment systems	Structural deterioration Leakage of fluids	Yes No	❑ Repair/replace ❑ Clean up
Oil/water separators	Excessive amounts of contaminants	Yes No	❑ Pump out
Floor drains, storm receiver inlets and outlets	Accumulation of contaminants	Yes No	❑ Clean up/remove

Date of Inspection _____ Name_____

Frequency _____

PEST CONTROL
POLLUTION PREVENTION/GOOD HOUSEKEEPING PRACTICES

1. IDENTIFY IMPACTS TO/ON STORMWATER/RECEIVING WATERS (SURFACE WATERS)

    - Runoff of pesticides may harm aquatic life, may contaminate water

2. PROBLEM EVALUATION: ASSESS IMPACT ON RECEIVING WATERS, PRIORITIZE

    - Toxicity to aquatic plants and animals

3. IDENTIFY (AND CHOOSE APPROPRIATE) SOLUTIONS (BMP's)

    - Purchase only enough pesticides necessary for one year – store properly to avoid waste generation (spills, leaks, product deterioration)
    - Minimize/eliminate pesticide application, use lowest toxicity pesticides
    - Do not apply pesticides immediately prior to or during rain events
    - Ensure that employees are properly trained and certified in pesticide application techniques and safety
    - Develop zero input, low input lawns
    - Eliminate food, water, and shelter for pests
    - Adopt integrated pest management (IPM) techniques
    - Adopt alternatives to pesticides options (i.e. use mechanical traps, physical methods for removal, or biological controls)

4. INSPECTION PROCEDURES

    - Identify pests – are levels acceptable or must action be taken to control pests?
    - Inspect pesticide inventory – properly dispose of out-of-date pesticide materials

5. MAINTENANCE PROCEDURES

    - Inspect pest traps (i.e. bait boxes) regularly – remove (and properly dispose of) dead pests
    - Block/eliminate access to buildings/structures for pests
    - Remove pests (insects) by hand

6. ADVISORY

    - Abide by NYSDEC regulations (6NYCRR Part 325) pertaining to this topic
    - Refer to the Cornell University website (Dept. of Horticulture)

PEST CONTROL INSPECTION CHECKLIST

Location: _____

COMPONENTS/ITEMS TO CHECK	PROBLEMS OBSERVED	MAINTENANCE/REPAIRS NECESSARY	ACTION
Pesticide storage area	Excessive amounts of pesticides Spilled pesticides Empty containers No security or access control	Yes No	❑ Reduce volumes, implement IPM ❑ Clean up ❑ Properly dispose ❑ install
Application equipment	Improper amounts of pesticides applied	Yes No	❑ Properly calibrate
Floor	Drain system Not curbed around perimeter No impermeable surface	Yes No	❑ Eliminate ❑ Install curbing ❑ Install impermeable surface

Date of Inspection _____ Name_____

Frequency _____

PET WASTE COLLECTION
POLLUTION PREVENTION/GOOD HOUSEKEEPING PRACTICES

1. IDENTIFY IMPACTS TO/ON STORMWATER/RECEIVING WATERS (SURFACE WATERS)

    - Municipal animal shelters

2. PROBLEM EVALUATION: ASSESS IMPACT ON RECEIVING WATERS, PRIORITIZE

    - Biochemical oxygen demand
    - Solids loading

3. IDENTIFY (AND CHOOSE APPROPRIATE) SOLUTIONS (BMP's)

    - House all animals in an enclosed, roofed structure
    - ID/utilize "permitted" waste disposal facilities for animal wastes

4. INSPECTION PROCEDURES

    - Inspect shelter regularly for necessary cleanup/removal of wastes

5. MAINTENANCE PROCEDURES

    - Remove spilled food, animal wastes on a regular basis

6. ADVISORY

    - None

PET FACILITY MAINTENANCE INSPECTION CHECKLIST

Facility Location: _____

COMPONENTS/ITEMS TO CHECK	PROBLEMS OBSERVED	MAINTENANCE/REPAIRS NECESSARY	ACTION
Animal Housing area	Excessive amounts of waste Dead animals	Yes No	❑ Remove/rinse to floor drain (to sanitary sewer) ❑ Bag and remove
Facility's floor drain	Discharges directly to environment	Yes No	❑ Connect to sanitary sewer

Frequency of Inspection Daily_____ Name_____

Date _____

SEPTIC SYSTEM MANAGEMENT
POLLUTION PREVENTION/GOOD HOUSEKEEPING PRACTICES

1. IDENTIFY IMPACTS TO/ON STORMWATER/RECEIVING WATERS (SURFACE WATERS)

    - Ponding of improperly treated wastewaters (on the surface of a leach field or a sand filter system) can increase the biochemical oxygen demand of receiving waters.
    - Excessive amounts of disinfectant (i.e. chlorine) applied to a wastewater discharge from a sand filter system can cause toxicity to aquatic plants and animals

2. PROBLEM EVALUATION: ASSESS IMPACT ON RECEIVING WATERS, PRIORITIZE

    - Biochemical oxygen demand

3. IDENTIFY (AND CHOOSE APPROPRIATE) SOLUTIONS (BMP's)

    - Divert stormwater runoff (i.e. from roof drains) away from septic system
    - Divert groundwater (sump pump) discharges away from septic system
    - Locate swimming pools away from the septic system (at least 20' from the septic tank, at least 35' from the closest edge of the leach field or sand filter system)
    - Prevent problems caused by vegetation - growth of woody plants on the system
    - Prevent hydraulic loading - "Spread out" the use of devices which use large volumes of water across the entire day – clothes washing, dish washing, bathing, repair leaky fixtures
    - Minimize water usage by using flow restrictors on potable water distribution devices (i.e. shower heads, water faucets)

4. INSPECTION PROCEDURES

    Physical evidence of problems:

    - "back up" of wastewater in sewer lines
    - sewage odors
    - leach field/sand filter - wetness/ponding on surface
    - overflow of wastes from system components
    - heavy vegetation (woody plants) growth on system components

5. MAINTENANCE PROCEDURES

    - "Pump out" the septic tank as needed (NYSDEC recommends once/year)
    - Mow surface vegetation regularly
    - Prevent "heavy equipment" from driving on top of the system components

6. ADVISORY

    - Obtain site plan/site sketch of system, and retain for reference.

SEPTIC SYSTEM MANAGEMENT INSPECTION CHECKLIST

Unit ID:_____NYSDEC Permit #_____ Location_____

COMPONENTS/ITEMS TO CHECK	PROBLEMS OBSERVED	MAINTENANCE/REPAIRS NECESSARY	ACTION
Septic tank cover	Broken/cracked?	Yes No	❑ Replace
Distribution box	sewage overflowing, distribution box level?	Yes No	❑ Clean out ❑ Re-level
Leach field or sand filter	sewage on surface, odors, excessive vegetation growth	Yes No	❑ Clean out distribution lines ❑ Cut vegetation
Disinfection system (if present)	Operating improperly	Yes No	❑ Check/repair equipment
Outfall	Improper chlorine residual	Yes No	❑ Perform monitoring, sampling/analysis as permit requires

Frequency of Inspection _____ Last pump out (date) _____

Date of Inspection _____ Name_____

(If unit is a HOLDING TANK, pump out schedule)_____

VEHICLE/EQUIPMENT MAINTENANCE
POLLUTION PREVENTION/GOOD HOUSEKEEPING PRACTICES

1. IDENTIFY IMPACTS TO/ON STORMWATER/RECEIVING WATERS (SURFACE WATERS)

    - Trace amounts of metals/hydrocarbons are found in materials (i.e. fuels, antifreeze, batteries, motor oils, grease, parts cleaning solvents) that are typically used in maintenance operations

2. PROBLEM EVALUATION: ASSESS IMPACT ON RECEIVING WATERS, PRIORITIZE

    - Toxicity
    - Biochemical oxygen demand

3. IDENTIFY (AND CHOOSE APPROPRIATE) SOLUTIONS (BMPs)

    - Conduct maintenance work indoors – if work must be performed outside, guard against spillage of materials that could discharge to storm receivers
    - Seal floor drains that discharge directly to the environment, if possible
    - Initiate single purpose use of vehicle bays – dedicate one (or more) bays that have no (or sealed) floor drains for repairs/maintenance
    - Clean up spilled materials immediately, using "dry" methods
    - Install pretreatment systems (oil/water separators) where necessary in sewer lines to capture contaminants (oil, grit), and maintain as needed
    - Never leave vehicles unattended while refueling
    - Identify appropriate recycling/disposal options for wastes

4. INSPECTION PROCEDURES

    - Inspect (for maintenance purposes) floor drain systems, oil/water separators
    - Monitor "parked" vehicles/equipment for leaks

5. MAINTENANCE PROCEDURES

    - Maintain a clean work area – remove contaminants from floors, drains, catch basins, using "dry" methods
    - Use non-hazardous cleaners. Use non chlorinated solvents instead of chlorinated solvents
    - Repair or replace any leaking containers
    - Use steam cleaning /pressure washing instead of solvent for parts cleaning
    - Store waste fluids in properly capped, labeled storage containers
    - Store batteries in leak-proof, compatible (i.e. non reactive) containers
    - Rinse grass from lawn care equipment on permeable (grassed) areas
    - Protect against pollution if outside maintenance is necessary (cover storm receivers, use secondary containment vessels, etc.)

6. ADVISORY

    - Report petroleum spills (as necessary) to the NYSDEC (851-7220 or 1-800-457-7362)
    - Refer to NYSDOT guidance information (Environmental Handbook for Transportation Operations)

VEHICLE AND EQUIPMENT MAINTENANCE/STORAGE AREA INSPECTION CHECKLIST

Unit ID: _____ Location:_____

COMPONENTS/ITEMS TO CHECK	PROBLEMS OBSERVED	MAINTENANCE/REPAIRS NECESSARY	ACTION
Truck/equipment	Leaks/spills	Yes No	❑ Clean spill, repair leak, capture fluids in drip pan
Salt/sand spreader	Improper amounts of product applied	Yes No	❑ Recalibrate
Lawn care equipment	Improper operation	Yes No	❑ Inspect/repair

Date of Inspection _____ Name_____

Frequency _____

VEHICLE/EQUIPMENT WASHING
POLLUTION PREVENTION/GOOD HOUSEKEEPING PRACTICES

1. IDENTIFY IMPACTS TO/ON STORMWATER/RECEIVING WATERS (SURFACE WATERS)

    - Nutrients (biodegradable soaps)
    - Metals
    - Petroleum based wastes (organic pollutants)

2. PROBLEM EVALUATION: ASSESS IMPACT ON RECEIVING WATERS, PRIORITIZE

    - Biochemical oxygen demand from nutrient sources
    - Toxicity
    - Hydraulic loading

3. IDENTIFY (AND CHOOSE APPROPRIATE) SOLUTIONS (BMPs)

    - Initiate single purpose use of vehicle bays - dedicate only one bay for washing (with floor drain system)
    - Perform cleaning with pressurized cold water, without the use of soaps, if wastewaters will flow to a **storm sewer** system
    - Use minimal amounts of biodegradable soaps **only** if wastewaters will discharge to a **sanitary sewer** system
    - Rinse with hoses that are equipped with automatic shutoff devices and spray nozzles
    - Steam clean (without soap) where wastes can be captured for proper disposal (i.e. oil/water separator)

4. INSPECTION PROCEDURES

    - Inspect floor drain systems regularly - use only those that discharge to a sanitary sewer, identify the need for cleaning of catch basins, oil/water separators

5. MAINTENANCE PROCEDURES

    - Map storm drain locations accurately to avoid illegal discharges
    - Perform steam cleaning or pressure washing where wastes can be captured for proper disposal
    - Take precautions against excess use of/spillage of detergents

6. ADVISORY

    - Require all facilities to connect floor drain systems to sanitary sewers (if available)
    - Refer to NYSDOT guidance information (Environmental Handbook for Transportation Operations)

VEHICLE AND EQUIPMENT WASHING AREA INSPECTION CHECKLIST

Facility location: _____

COMPONENTS/ITEMS TO CHECK	PROBLEMS OBSERVED	MAINTENANCE/REPAIRS NECESSARY	ACTION
Designated "wash only" area	No impermeable pad with wastewater collection system	Yes No	❑ Designate/construct area
Wastewater discharge location	Does not flow to either a holding tank or to sanitary sewers	Yes No	❑ Properly relocate discharge
Washing/degreasing compounds	Solvent based	Yes No	❑ Change to biodegradable products
Floor drain sump	Nonexistent	Yes No	❑ Install and maintain sump, remove debris
Oil/water separator	Excessive oils/sludges	Yes No	❑ Clean out contaminants
Catch basin	Non existent, accumulation of contaminants	Yes No	❑ Install/maintain catch basin

Date of Inspection _____ Name_____

Frequency _____

ROADWAY AND BRIDGE MAINTENANCE
POLLUTION PREVENTION/GOOD HOUSEKEEPING PRACTICES

1. IDENTIFY IMPACTS TO/ON STORMWATER/RECEIVING WATERS (SURFACE WATERS)

- Road salt components - sodium, calcium, and chlorides
- Hydrocarbons
- Particulates – such as dry paint or abrasive compounds, road debris
- Debris

2. PROBLEM EVALUATION: ASSESS IMPACT ON RECEIVING WATERS, PRIORITIZE

- Particulate matter
- Toxicity (paint – may contain metals such as lead, barium, cadmium)

3. IDENTIFY (AND CHOOSE APPROPRIATE) SOLUTIONS (BMPs)

- Incorporate preventive maintenance and planning for regular operations & maintenance activities
- Pave in dry weather only.
- Stage road operations and maintenance activity (patching, potholes) to reduce spillage. Cover catch basins and manholes during this activity.
- Clean up fluid leaks or spills from paving equipment/materials immediately
- Restrict the use of herbicides/pesticide application to roadside vegetation
- Use porous asphalt for pothole repair and shoulder work
- Sweep and vacuum paved roads and shoulders to remove debris and particulate matter
- Maintain roadside vegetation; select vegetation with a high tolerance to road salt
- Control particulate wastes from bridge sandblasting operations
- Use calcium magnesium acetate for deicing around bridges to minimize corrosion
- Clean out bridge scuppers and catch basins regularly
- Direct water from bridge scuppers to vegetated areas
- Mechanically remove (i.e. sweep) debris from bridge deck and structure prior to washing

4. INSPECTION PROCEDURES

- Inspect paving, sweeping, vacuuming, and all other maintenance vehicles/equipment as appropriate
- Inspect roads and bridges for implementation of applicable BMP's

5. MAINTENANCE PROCEDURES

- Clean bridge scuppers routinely and keep free of debris
- Direct runoff water from bridges to vegetated areas
- Install catch basins in place of bridge scuppers
- Use tarps, booms, and vacuums during painting or blasting activities (refer to reference information to control/capture particulate matter)
- Repair leaking/defective containers or equipment on paving equipment

6. ADVISORY

- Refer to NYSDOT guidance information (Environmental Handbook for Transportation Operations

ROADWAY AND BRIDGE MAINTENANCE INSPECTION CHECKLIST

Bridge No.: _____ BIN: _____ Carried: _____ Crossed: _____

Wetlands Present: Y N Stream Restriction: Y N If yes, Dates: _____

COMPONENTS/ITEMS TO CHECK	PROBLEMS OBSERVED	MAINTENANCE/ REPAIRS NECESSARY	ACTION
Bridge Deck (Top Side)	Debris Along Curb	Yes No	❑ Sweep bridge, deposit debris on bank 50' from sweep and spread out ❑ Wash Bridge Deck
Bridge Seats at Abutment, or Top of Piers	Debris on Seat or Top of Pier	Yes No	❑ Remove debris, deposit on stream banks ❑ Bird Nest Present? If yes, wait until nesting is complete. ❑ Wash Abutment & Pier
Washing of Superstructure	Debris – Salts on Superstructure	Yes No	❑ Bird Nest Present? If yes, wait until nesting is complete. ❑ Flaking Paint Present? If yes, do not wash. ❑ Stream Restriction? If yes, wait until restrictions are removed. ❑ Wash Superstructure

ALTERNATIVE DISCHARGE OPTIONS FOR CHLORINATED WATER POLLUTION PREVENTION/GOOD HOUSEKEEPING PRACTICES

1. IDENTIFY IMPACTS TO/ON STORMWATER/RECEIVING WATERS (SURFACE WATERS)

    - Discharge of chlorinated (i.e. swimming pool, POTW) waters to surface waters can injure or kill aquatic life

2. PROBLEM EVALUATION: ASSESS IMPACT ON RECEIVING WATERS, PRIORITIZE

    - Toxicity – very low levels of chlorine can detrimentally affect aquatic life
    - Hydraulic loading

3. IDENTIFY (AND CHOOSE APPROPRIATE) SOLUTIONS (BMPs)

    - Dechlorinate pool water before any discharge, be it over land or to the sanitary sewer, or allow the "disinfectant" to dissipate with sunlight, use, etc. prior to discharge
    - Use ultraviolet radiation or osmosis to disinfect water/wastewater
    - Backwash water should be discharged to the sanitary sewer, if available – if not available, discharge water over vegetated areas, not to surface waters

4. INSPECTION PROCEDURES

    - Check chlorine residuals prior to discharge.
    - Do not discharge wastewaters into the sanitary sewer system during periods of high flow.

5. MAINTENANCE PROCEDURES

    - Maintain proper levels of chlorine residuals in pool.
    - Allow disinfectant to dissipate prior to discharge of pool waters.

6. ADVISORY

    - Obtain permission from the municipal POTW prior to discharging any chlorinated pool waters to a sanitary sewer system.

ALTERNATIVE DISCHARGE OPTIONS FOR CHLORINATED WATER INSPECTION CHECKLIST

Location: _____

COMPONENTS/ITEMS TO CHECK	PROBLEMS OBSERVED	MAINTENANCE/REPAIRS NECESSARY	ACTION
Pools, hot tubs	Need to empty unit and replace water	Yes No	❑ Discharge to sanitary sewers or to vegetated areas after the disinfectant dissipates, not to storm sewers or surface waters

Date of Inspection _____ Name_____

Frequency _____

HAZARDOUS AND WASTE MATERIALS MANAGEMENT
POLLUTION PREVENTION/GOOD HOUSEKEEPING PRACTICES

1. IDENTIFY IMPACTS TO/ON STORMWATER/RECEIVING WATERS (SURFACE WATERS)

- Lube oils
- Coatings and their compatible solvents (paints, thinners, etc.)
- Anti freeze
- Cleaning agents
- Fuels (gas, diesel, kerosene)

2. PROBLEM EVALUATION: ASSESS IMPACT ON RECEIVING WATERS, PRIORITIZE

- Biochemical oxygen demand
- Toxicity to aquatic plants and wildlife
- Particulate loading

3. IDENTIFY (AND CHOOSE APPROPRIATE) SOLUTIONS (BMP's)

- Ensure that all materials are stored in closed, labeled containers – if stored outside, drums should be placed on pallets, away from storm receivers – inside storage areas should be located away from floor drains
- Eliminate floor drain systems that discharge to storm drains, if possible
- Use a pretreatment system to remove contaminants prior to discharge
- Reduce stock of materials “on hand” – use “first in/first out” management technique
- Use the least toxic material (i.e. non hazardous) to perform the work
- Install/use secondary containment devices where appropriate
- Eliminate wastes by reincorporating coating/solvent mixtures into the original coating material for reuse
- Recycle materials if possible, or ensure proper disposal of wastes

4. INSPECTION PROCEDURES

- Physical on-site verification of sealed floor drains (or redirected to sanitary sewer)
- Regular inspection of material storage areas (inside and outside)
- Regular inspection and cleaning of oil/water separators by qualified contractor
- Inspect stormwater discharge locations regularly (for contaminants, soil staining, plugged discharge lines)

5. MAINTENANCE PROCEDURES

- Repair or replace any leaking/defective containers, and replace labels as necessary
- Maintain caps and/or covers on containers
- Maintain aisle space for inspection of products/wastes

6. ADVISORY

- Abide by NYSDEC regulations (6NYCRR Part 372) and OSHA regulations (29 CFR Part 1910) pertaining to these topics
- Refer to NYSDOT guidance information (Environmental Handbook for Transportation Operations)

HAZARDOUS AND WASTE MATERIALS MANAGEMENT INSPECTION CHECKLIST

Location: _____

COMPONENTS/ITEMS TO CHECK	PROBLEMS OBSERVED	MAINTENANCE/REPAIRS NECESSARY	ACTION
Outside storage areas	Weathering	Yes No	❑ Protect from weathering – store on pallets, cover
Salt piles Soil staging areas	Salt staining Silt runoff	Yes No Yes No	❑ Cover with tarps ❑ Cover with tarps, install physical barriers
Aboveground storage tanks	Deterioration	Yes No	❑ Inspect/repair/maintain, install secondary containment
Inside storage areas	Potential for discharges	Yes No	❑ Seal floor drains, install secondary containment
Drums, other containers	Deterioration Uncovered	Yes No	❑ Repair/replace ❑ Cover/cap

Date of Inspection _____ Name_____

Frequency _____

OPERATIONAL BY PRODUCTS/WASTES
POLLUTION PREVENTION/GOOD HOUSEKEEPING PRACTICES

1. IDENTIFY IMPACTS TO/ON STORMWATER/RECEIVING WATERS (SURFACE WATERS)

    - Potential for leaching of toxic and biologic contaminants to receiving waters

2. PROBLEM EVALUATION: ASSESS IMPACT ON RECEIVING WATERS, PRIORITIZE

    - Toxicity
    - Biochemical oxygen demand

3. IDENTIFY (AND CHOOSE APPROPRIATE) SOLUTIONS (BMP's)

    - Post “no dumping” signs
    - Illuminate area if possible
    - Prevent access – erect barriers
    - Identify the by products/wastes that should be recycled (i.e. paper, cardboard) or can be legally disposed of on municipal lands (i.e. deer carcasses) by referencing NYSDEC regulations (6NYCRR PART 360)

4. INSPECTION PROCEDURES

    - Regularly scheduled inspections - for maintenance concerns
    - Unscheduled patrolling of areas by police

5. MAINTENANCE PROCEDURES

    - Clean up and dispose of “illegally dumped” materials, trash/debris in accordance with environmental regulations
    - Cut and remove vegetation

6. ADVISORY

    - Abide by NYSDEC regulations (6NYCRR Part 360) pertaining to this topic
    - Refer to NYSDOT guidance information (Environmental Handbook for Transportation Operations)

OPERATIONAL BY-PRODUCTS AND WASTES INSPECTION CHECKLIST

Location _____

(example. Temporary dumping areas for bulky trash items)

COMPONENTS/ITEMS TO CHECK	PROBLEMS OBSERVED	MAINTENANCE/REPAIRS NECESSARY	ACTION
Condition of general area	Possible runoff to/ contamination of storm sewer or water body	Yes No	❑ Remove ❑ Fix
Type of material/waste observed?	Appropriate?	Yes No	❑ Remove to appropriate container/location
Security	Regular policing of area, Location properly secured/closed/locked?	Yes No	❑ Secure waste area
Disposal	Past disposal date?	Yes No	❑ Dispose timely

Inspection Frequency _____

Last Clean-up Date _____

Date of Inspection _____ Name_____

CATCH BASIN AND STORM DRAIN SYSTEM CLEANING
POLLUTION PREVENTION/ GOOD HOUSEKEEPING PRACTICES

1. IDENTIFY IMPACTS TO/ON STORMWATER/RECEIVING WATERS (SURFACE WATERS)

- **Catch basins** capture grit and debris, which, if not removed in a timely fashion, can discharge toxic and biological pollutants during rain and/or snow melt events
- **Storm drainage systems**, while not designed for capture of solid materials, can perform in the same manner with similar results.
- **Storm ditches**, if stripped of vegetation during cleaning, can result in silt deposition in receiving waters

2. PROBLEM EVALUATION: ASSESS IMPACT ON RECEIVING WATERS, PRIORITIZE

- Toxicity – heavy metals, organic compounds, etc.
- Biochemical oxygen demand
- Sediment loading

3. IDENTIFY (AND CHOOSE APPROPRIATE) SOLUTIONS (BMP's)

- Address:
  - storm drain receivers and (below grade) storm sewer systems
  - parking lot receivers
  - open ditches
  - catch basins and floor drain systems inside of buildings should be either:
    - sealed to prevent discharge
    - "permitted" by NYSDEC
    - discharged to sanitary sewers
- Contaminated wastewaters should not be discharged to a catch basin/street receiver/ditch
- Increase frequency of cleaning, as necessary
- Repair/replace storm drain receiver and catch basin receiver grates as necessary

4. INSPECTION PROCEDURES

- Physical inspection – prioritize storm drain systems and catch basins – catch basins on steep grades may need more frequent cleaning
- Clean catch basin when depth of deposits are >1/3 the depth from the bottom of the basin to the invert of the lowest pipe/opening into or out of basin – Institute temporary street parking bans to facilitate access to catch basins
- Ditch inspections – ID problems while traveling to job site
- Storm event inspection – identify pollution problems (i.e. sediments) to determine the need for additional protective measures
- Post storm event inspection – ID problems (i.e. blockages)

5. MAINTENANCE PROCEDURES

- Catch basins/storm sewer pipe – cleaning in spring to remove sand/grit/salt from winter road maintenance, cleaning in fall to remove leaves/silt/debris
- Established ditch:
  - Maintain proper slope
  - Maintain vegetation by cutting (to capture sediment) – Do not allow vegetation to grow to a height that would impair sight lines of drivers of motor vehicles
  - Remove obstacles/ debris – (i.e. trash, tree branches, brush, cut vegetation)
  - Excavation/ditch scraping – if necessary, use devices (i.e. hay bales, silt fence) to capture sediment prior to stormwater discharge into receiving waters, reseed ditch
- New installation – capture particulate matter – install sediment basins/other devices in ditch
- Proper disposal of debris

6. ADVISORY

- Refer to NYSDOT guidance information (Environmental Handbook for Transportation Operations)

CATCH BASIN AND STORM DRAIN SYSTEM CLEANING INSPECTION CHECKLIST

Road Name: _____ Road Number: _____ Road Section: From: _____ To: _____

COMPONENTS/ITEMS TO CHECK	PROBLEMS OBSERVED	MAINTENANCE/ REPAIRS NECESSARY	ACTION	LOCATION (House number, distance from intersection)
Catch Basin/ Drop Inlet	Deterioration of Structure	Yes No	❑ Repair Structure or Grate ❑ Replace Structure or Grate	
	Clogged Inlets During or After Storm Event	Yes No	❑ Clean Grate / Inlet	
	Deposits in Structure	Yes No	❑ Clean Out Structure	
Storm Manhole	Deterioration of Structure	Yes No	❑ Repair Structure or Cover ❑ Replace Structure or Cover	
	Deposits in Structure	Yes No	❑ Clean Out Structure	
Storm Sewer Piping	Clogged Pipe	Yes No	❑ Clean Out Pipe	
	Deteriorated Pipe	Yes No	❑ Replace Pipe	
Ditches (Pollutants)	Excessive Vegetation	Yes No	❑ Mow Vegetation ❑ Scheduled Ditch Cleaning	
	Debris (branches, litter, garbage, etc.)	Yes No	❑ Clean Out Ditch	
	Excessive Siltation	Yes No	❑ Clean Out & Regrade Ditch	
Roadside / Cross Culverts	Clogged Pipe	Yes No	❑ Clean Out ❑ Review Size & Replace ❑ Clean Out & Regrade Ditch	
	Deteriorated Pipe	Yes No	❑ Replace Pipe ❑ Line Pipe	
Sediment Basins	Excessive Vegetation	Yes No	❑ Mow	
	Excessive Sediment Deposits	Yes No	❑ Clean Out Basin	
Outfall	Pollutants	Yes No	❑ Rip-rap	

Date of Inspection _____Name_____ Frequency _____

STREET CLEANING AND MAINTENANCE
POLLUTION PREVENTION/GOOD HOUSEKEEPING PRACTICES

1. IDENTIFY IMPACTS TO/ON STORMWATER/RECEIVING WATER (SURFACE WATERS)

- Poorly maintained streets allow for a "build up" of trash, grit, and debris, from which sediment and toxic/biological pollutants can be "washed out" during rain and /or snow melt events.
- Street repair/paving processes use materials that can contaminate receiving waters if they interact with stormwater.

2. PROBLEM EVALUATION: ASSESS IMPACT ON RECEIVING WATERS, PRIORITIZE

- Particulate matter – can cause sediment loading
- Biochemical oxygen demand
- Toxicity to aquatic plants and wildlife

3. IDENTIFY (AND CHOOSE APPROPRIATE) SOLUTIONS (BMP's)

- Street sweeping/vacuuming - at regular intervals, and "as needed"
- Perform operations such as paving in dry weather only.
- Prior to road reconstruction, consider/evaluate the use of "shouldered roads" instead of "curbed roads"
- Maintain roadside vegetation; select plants/trees that can withstand the action of road salt. Direct runoff to these areas.

4. INSPECTION PROCEDURES

- Inspect streets, and plan (as needed) for maintenance/repairs
- Prioritize – some streets (i.e. those with high traffic flows, on flat grades, or with many trees) may need more frequent cleaning

5. MAINTENANCE PROCEDURES

- Spring sweeping/vacuuming – remove salt/sand residues
- Fall sweeping, collection of leaves at appropriate time intervals
- Dry sweep or vacuum streets during dry weather
- Initiate temporary street by street parking bans to allow access for cleaning
- Maintain equipment - check for/repair fluid leaks
- Stage road operations and maintenance activity (patching, pothole repair) to reduce spillage of materials. Cover catch basins and manholes during activity

6. ADVISORY

- Refer to NYSDOT guidance information (Environmental Handbook for Transportation Operations)

STREET CLEANING AND MAINTENANCE INSPECTION CHECKLIST

Location/Section of Road _____

COMPONENTS/ITEMS TO CHECK	PROBLEMS OBSERVED	MAINTENANCE/REPAIRS NECESSARY	ACTION
Roads (curb line)	Debris, grit, stone	Yes No	❑ Shovel or Vacuum
Milling	Broken pavement (excavated material)	Yes No	❑ Cover storm inlets, shovel, vacuum
Paving	Tack coat overspray	Yes No	❑ Cover storm inlets
Storm drain inlets	Broken brick, block, mortar	Yes No	❑ Repair
Roadside vegetation	Too high None observed	Yes No Yes No	❑ Cut ❑ Re-seed

Date of Inspection _____ Name_____

Frequency _____

ROAD SALT STORAGE AND APPLICATION
GOOD HOUSEKEEPING/POLLUTION PREVENTION PRACTICES

1. IDENTIFY IMPACTS TO/ON STORMWATER/RECEIVING WATERS (SURFACE WATERS)

- Salt is very soluble in water, and, in high concentrations, can have a deleterious effect on plants and aquatic life.

2. PROBLEM EVALUATION: ASSESS IMPACT ON RECEIVING WATERS, PRIORITIZE

- Toxicity

3. IDENTIFY (AND CHOOSE APPROPRIATE) SOLUTIONS (BMP's)

- Require covered facility for salt storage (prevents lumping and run-off loss), and size properly for seasonal needs
- Store salt on highest ground elevation to allow for infiltration of stormwater
- Calibrate salt spreaders for proper application
- Consider alternative deicing materials (i.e. calcium chloride, magnesium chloride)
- Use a wetting agent with salt to minimize "bouncing" during application
- Cover salt loading area, or build into storage shed
- Unload salt deliveries directly into storage facility, or if not possible, move inside immediately

4. INSPECTION PROCEDURES

- Look for physical evidence of problems:

  - inspect salt storage shed for leaks, structural problems
  - inspect salt piles for proper coverage, tarps for leaks or tears
  - inspect salt application equipment
  - inspect salt regularly for lumping or water contamination
  - inspect surface areas for evidence of runoff – salt stains on ground near and around the salt shelter, loading area, or downslope
  - inspect for excessive amounts of salt on roads

5. MAINTENANCE PROCEDURES

- Service trucks and calibrate spreaders regularly to ensure accurate, efficient distribution of salt
- Educate and train operators on hazards of over-salting to roads and environment
- Repair salt storage shed – structural problems can lead to salt spillage
- Repair/replace tarps

6. ADVISORY

- Refer to NYSDOT guidance information (Environmental Handbook for Transportation Operations)

ROAD SALT STORAGE AND APPLICATION INSPECTION CHECKLIST

Unit ID: _____ Location _____

COMPONENTS/ITEMS TO CHECK	PROBLEMS OBSERVED	MAINTENANCE/REPAIRS NECESSARY	ACTION
Storage shed	Salt outside of shed	Yes No	❑ Move salt into shed
Truck loading area	Salt on ground	Yes No	❑ Pick up, load onto truck ❑ do not overfill truck
Roads – (sites of application)	Excessive salt on ground	Yes No	❑ Remove by sweeping?
Salt spreader	Excessive salt on ground	Yes No	❑ Recalibrate salt spreader?

Date of Inspection _____ Name_____

ROAD KILL COMPOSTING OPERATIONS
GOOD HOUSEKEEPING/POLLUTION PREVENTION PRACTICES

1. IDENTIFY IMPACTS TO/ON STORMWATER/RECEIVING WATERS (SURFACE WATERS)

    - Potential for leaching of biologic contaminants to receiving waters

2. PROBLEM EVALUATION: ASSESS IMPACT ON RECEIVING WATERS, PRIORITIZE

    - Biochemical oxygen demand

3. IDENTIFY (AND CHOOSE APPROPRIATE) SOLUTIONS (BMP's)

    - Establish compost pile/windrow on a well drained, impervious surface that has minimal slope – segregate from other operations
    - Identify the proper types of carcasses (typically, deer) that should be composted
    - Locate compost piles at least 200 ft. away from receiving waters or wetlands
    - Prevent access by vermin/scavengers – erect barriers (i.e. snow fence) around pile

4. INSPECTION PROCEDURES

    - Check for odors, temperature of compost, exposed carcasses
    - Keep records (use a daily log)

5. MAINTENANCE PROCEDURES

    - Monitor temperatures
    - Take samples, analyze for pathogens
    - Establish windrows
    - Prevent erosion
    - Recycle completely composted material

6. ADVISORY

    - Abide by NYSDEC regulations (6NYCRR Part 360) pertaining to this topic
    - Refer to NYSDOT guidance

ROAD KILL COMPOST SITE INSPECTION CHECKLIST

Location: _____

COMPONENTS/ITEMS TO CHECK	PROBLEMS OBSERVED	MAINTENANCE/REPAIRS NECESSARY	ACTION
Compost pile	Exposed Carcasses	Yes No	❑ Add cover material (wood chips, compost)
	Odors	Yes No	❑ Cover with wood chips ❑ Add lime
	Liquid runoff (leachate)	Yes No	❑ Absorb with wood chips, return to compost pile
	Animals scavenging	Yes No	❑ Fence area ❑ Temporarily cover with tarp
	Wood chips too dry Wood chips too wet	Yes No Yes No	❑ Add water ❑ Allow to dry
	Insufficient compost temperature	Yes No	❑ Temporarily cover with tarp

Date of Inspection _____ Name_____

Frequency _____

Rick\stwtr\insp cklsts

MARINA OPERATIONS
POLLUTION PREVENTION/GOOD HOUSEKEEPING PRACTICES

1. IDENTIFY IMPACTS TO/ON STORMWATER/RECEIVING WATERS (SURFACE WATERS)

- Liquids associated with boat maintenance products (oils, fuels, antifreeze, wood preservatives, etc. and particulate matter (i.e. boat bottom paint from hull sanding) can contain toxics
- Boat sewage can contain pathogenic bacteria that contribute increased biochemical oxygen demand to waterways
- Barren soils can contribute to sedimentation

2. PROBLEM EVALUATION: ASSESS IMPACT ON RECEIVING WATERS, PRIORITIZE

- Biochemical oxygen demand
- Toxicity
- Sediment loading

3. IDENTIFY (AND CHOOSE APPROPRIATE) SOLUTIONS (BMP's)

- Construct and maintain pump out stations (for sanitary wastes)
- Build and maintain fish cleaning stations
- Stabilize shoreline
- Designate locations for boat maintenance away from the water
- Minimize impervious areas – install vegetated buffer strips (i.e. grass, shrubs)
- Provide covered trash receptacles, spill clean up kits at fueling stations
- Educate (posters, signage) boaters and other marina users of potential problems

4. INSPECTION PROCEDURES

- Identify areas of runoff that lack vegetation
- Regularly inspect fueling stations (including tanks and piping), maintenance areas for spills, other potential sources of pollution
- Regularly check (and empty as necessary) fish cleaning stations, sewage pump out stations, trash cans

5. MAINTENANCE PROCEDURES

- Empty trash cans and pump out stations as needed
- Maintain vegetated areas between the water and work areas
- Replace spill clean up kits as necessary

6. ADVISORY

- Refer to: Shipshape Shores and Waters: A Handbook for Marina Operators and Recreational Boaters - http://www.epa.gov/owow/nps/marinashdbk2003.pdf

MARINA OPERATIONS INSPECTION CHECKLIST

Location: _____

COMPONENTS/ITEMS TO CHECK	PROBLEMS OBSERVED	MAINTENANCE/REPAIRS NECESSARY	ACTION
Trash cans, sewage pump out stations, fish cleaning stations	Full	Yes No Yes No	❑ Empty, dispose of wastes properly
Fueling stations	Spills	Yes No Yes No	❑ Clean up
Vegetated areas	Barren soils	Yes No	❑ Re-vegetate
		Yes No	❑
		Yes No	❑
		Yes No	❑

Date of Inspection _____ Name_____

Frequency_____

Rick\stwtr\insp cklsts

CONSTRUCTION AND LAND DISTURBANCE
POLLUTION PREVENTION/GOOD HOUSEKEEPING PRACTICES

1. IDENTIFY IMPACTS TO/ON STORMWATER/RECEIVING WATERS (SURFACE WATERS)

    - Sediment runoff (i.e. silt, debris) can affect fish reproduction and habitat
    - Removal of shade trees from stream banks can increase water temperature which can result in reduced dissolved oxygen content in streams

2. PROBLEM EVALUATION: ASSESS IMPACT ON RECEIVING WATERS, PRIORITIZE

    - Particulate matter – can cause sediment loading
    - Biochemical oxygen demand – increases with temperature, depletes oxygen

3. IDENTIFY (AND CHOOSE APPROPRIATE) SOLUTIONS (BMP's)

    - Plan the construction and/or land clearing activities so that soil is not exposed for long periods of time
    - Minimize compaction of soils and impervious cover
    - Maximize opportunities for infiltration
    - Install sediment control devices before disturbing soil
    - Limit grading to small areas
    - Stabilize site to protect against sediment runoff
    - Protect against sediment flowing into storm drains
    - Maintain native vegetation (especially near waterways)
    - Install sediment barriers on slopes or divert stormwater

4. INSPECTION PROCEDURES

    - Regularly scheduled inspections (of sediment control devices, erosion safeguards)
    - Inspect during storm or snow melt events

5. MAINTENANCE PROCEDURES

    - Check/repair all devices that have been installed to ensure protection against erosion

6. ADVISORY

    - Refer to NYSDOT guidance information (Environmental Handbook for Transportation Operations)
    - NY State Standards and Specifications for Sediment and Erosion Control
    - NY State Stormwater Management Design Manual

CONSTRUCTION AND LAND DISTURBANCE INSPECTION CHECKLIST

Location: _____

COMPONENTS/ITEMS TO CHECK	PROBLEMS OBSERVED	MAINTENANCE/REPAIRS NECESSARY	ACTION
Sediment control devices	None observed In disrepair	Yes No Yes No	❑ Install ❑ Repair
Sediment barrier devices	None observed In disrepair	Yes No Yes No	❑ Install ❑ Repair
		Yes No	❑
		Yes No	❑
		Yes No	❑
		Yes No	❑

Date of Inspection _____ Name_____

Frequency __initial, and as needed (coinciding with storm events)

Rick\stwtr\insp cklsts

ATTACHMENT 17

SWEEPING LOG

MCM6 - SWEEPING LOG

Municipality:_____

ROAD ☐ **PARKING LOT** ☐ **BRIDGE** ☐ **RIGHT OF WAY** ☐
OTHER ☐

DATE:_____

NAME/DESCRIPTION - _____

COMMENTS:

PROCEDURAL NARRATIVE:

All municipal roads, bridges, parking lots, and right of ways to be cleaned and swept once every five years in the spring (following winter activities such as sanding). Sweeping and cleaning of each area is to be documented in a sweeping log and the overall status tracked on municipal road mapping.

This requirement is not applicable to:

i. **Uncurbed roads with no catch basins;**
ii. **High-speed limited access highways; or**
iii. **Roads defined as interstates, freeways, and expressways, or arterials by the United States Department of Transportation, Federal Highway Administration, Highway Functional Classification Concepts, Criteria and Procedures, 2013.**

NAME/SIGNATURE:_____

ATTACHMENT 18

MUNICIPAL FACILITIES INVENTORY

Street address	Acreage of facility	Owner	Name of facility	Type of facility	Type of activities present at site	Responsible Dept	Contact information	BMPs identified	Prioritization (low/high)	Receiving waterbody name	Receiving waterbody class	Receiving waterbody WI/PWL segment ID	Receiving waterbody WI/PWL impairment status	Receiving waterbody WI/PWL pollutant of concern, if appl.
116 Union Corners Rd	113.60	Town of Warwick	Union Corners Park	Town Park	Park & Sports Field	DPW	Benjamin Astorino (845) 986-3358	N/A	low	Quaker Creek & tribs	C	1306-0025	needs verification	D.O., Phosphorus, Water Level Flow
1 Public Works Road	38.90	Town of Warwick	Town of Warwick DPW	Town Garage	DPW Garage	DPW	Benjamin Astorino (845) 986-3358	N/A	high	Wawayanda Creek, Upper & minor trbs	B(T)	1306-0015	needs verification	Nutrients, Phosphorus, sild/sediment
1 Water Tank Way	4.80	Town of Warwick	Wickham Holding Tank	Water Storage Tank	Water Storage	DPW	Benjamin Astorino (845) 986-3358	N/A	low	Wawayanda Creek, Upper & minor trbs	B(T)	1306-0015	needs verification	Nutrients, Phosphorus, sild/sediment
425 Kings Highway	1.70	Town of Warwick	Wickham Pump House	Pump Station	Pump Station	DPW	Benjamin Astorino (845) 986-3358	N/A	low	Wawayanda Creek, Upper & minor trbs	B(T)	1306-0015	needs verification	Nutrients, Phosphorus, sild/sediment
132 Kings Highway	38.90	Town of Warwick	Warwick Town Hall	Town Hall	Gov. offices	DPW	Benjamin Astorino (845) 986-3358	N/A	low	Wawayanda Creek, Upper & minor trbs	B(T)	1306-0015	needs verification	Nutrients, Phosphorus, sild/sediment
1 Miriam Drive	1.00	Town of Warwick	Bellvale Pump House	Pump Station	Pump Station	DPW	Benjamin Astorino (845) 986-3358	N/A	low	Wawayanda Creek, lower & tribs	C(T)	1306-0079	needs verification	Nitrite, pH
10 Miriam Drive	2.90	Town of Warwick	Bellvale Pump House	Pump station	Pump Station	DPW	Benjamin Astorino (845) 986-3358	N/A	low	Wawayanda Creek, lower & tribs	C(T)	1306-0079	needs verification	Nitrite, pH
392 Jersey Ave, GWL	0.13	Town of Warwick	Water Treatment	Treatment Bldg	Water Treatemnt	DPW	Benjamin Astorino (845) 986-3358	N/A	low	Greenwood Lake	A(T)	1501-001	needs verification	D.O. & Phosphorus
6 Skytop Lane	0.28	Town of Warwick	Water Storage Tank	Water Storage Tank	Water Storage Tank	DPW	Benjamin Astorino (845) 986-3358	N/A	low	Greenwood Lake	A(T)	1501-001	needs verification	D.O. & Phosphorus
61 Brook Trail	0.11	Town of Warwick	Water Storage Tank	Water Storage Tank	Water Storage Tank	DPW	Benjamin Astorino (845) 986-3358	N/A	low	Greenwood Lake	A(T)	1501-001	needs verification	D.O. & Phosphorus
1 Well Site Way	2.80	Town of Warwick	Well House	Resevoir Bldg.	Well House	DPW	Benjamin Astorino (845) 986-3358	N/A	low	Quaker Creek & tribs	C	1306-0025	needs verification	D.O., Phosphorus, Water Level Flow
50 State School Rd		Town of Warwick	Adminstration Bldg	Adminstration Bldg	Adminstration Bldg	DPW	Benjamin Astorino (845) 986-3358	N/A	low	Long House Creek, Upper & tribs	B(T)	1306-0082	needs verification	D.O.
37 Kay Road	4.80	Town of Warwick	Pine Island Park	Park	Sports Fields	DPW	Benjamin Astorino (845) 986-3358	N/A	low	Pochuck Creek & minor tribs	C	1306-0078	needs verification	TDS
39 Kay Road	0.01	Town of Warwick	Pine Island Park	Park	Sports Fields	DPW	Benjamin Astorino (845) 986-3358	N/A	low	Pochuck Creek & minor tribs	C	1306-0078	needs verification	TDS
41 Kay Road	1.40	Town of Warwick	Pine Island Park	Park	Sports Fields	DPW	Benjamin Astorino (845) 986-3358	N/A	low	Pochuck Creek & minor tribs	C	1306-0078	needs verification	TDS
59 Wickham Rd		Town of Warwick	Water Storage Tank & Pump house	Water Storage Tank & Pump house	Water Storage Tank & Pump house	DPW	Benjamin Astorino (845) 986-3358	N/A	low	Kinne Brook & tribs	B	1401-0060	needs verification	no data available

Street address	Acreage of facility	Owner	Name of facility	Type of facility	Type of activities present at site	Responsible Dept	Contact information	BMPs identified	Prioritization (low/high)	Receiving waterbody name	Receiving waterbody class	Receiving waterbody WI/PWL segment ID	Receiving waterbody WI/PWL impairment status	Receiving waterbody WI/PWL pollutant of concern, if appl.
53 John Hicks Drive		Town of Warwick	Tech. Park	WFD-LRO (TECH Park)	Office & Tech. Buildings	DPW	Benjamin Astorino (845) 986-3358	N/A	low	Long House Creek, Upper & tribs	B(T)	1306-0082	needs verification	D.O.
255 State School Rd	610.40	Town of Warwick	Wickham Woodlands	Commerical & Sports Fields	Commerical & Sports Fields	DPW	Benjamin Astorino (845) 986-3358	N/A	low	Wawayanda Creek, Upper & minor trbs	B(T)	1306-0015	needs verification	Nutrients, Phosphorus, sild/sediment
166 State School Rd		Town of Warwick	Pump house	Pump House	pump station	DPW	Benjamin Astorino (845) 986-3358	N/A	low	Wawayanda Creek, Upper & minor trbs	B(T)	1306-0015	needs verification	Nutrients, Phosphorus, sild/sediment
19 Hillside Ave	2.2	#REF!	Water Treatment	Hillside Water District	Water Treatment	DPW	Benjamin Astorino (845) 986-3358	#REF!	low	Long House Creek, Upper & tribs	B(T)	1306-0082	needs verification	D.O.

ATTACHMENT 19

LIST OF ACRONYMS

Appendix A. Acronyms and Definitions

Acronym List

BMP – Best Management Practice

CFR – Code of Federal Regulations

CGP – SPDES General Permit for Stormwater from Construction Activities, GP-0-20-001

CWA – Clean Water Act

ECL – Environmental Conservation Law

EDC – Effective Date of Coverage

EDP– Effective Date of the Permit

eNOI – Electronic Notice of Intent

EPCRA - Emergency Planning and Community Right-To-Know Act

ERP – Enforcement Response Plan

IDDE – Illicit Discharge Detection and Elimination

MCM – Minimum Control Measure

MS4 – Municipal Separate Storm Sewer System

MS4 GP – SPDES General Permit for Stormwater Discharges from the Municipal Separate Storm Sewer Systems, GP-0-24-001

MSGP – SPDES Multi-Sector General Permit for Stormwater Discharges Associated with Industrial Activity, GP-0-23-001

NOI – Notice of Intent

NPDES – National Pollutant Discharge Elimination System

NYCRR – New York Codes, Rules and Regulations

NYS DEC – New York State Department of Environmental Conservation

O&M – Operations and Maintenance

ORI – Outfall Reconnaissance Inventory

POC – Pollutant of Concern

RSE – Regional Stormwater Entity

SPDES – State Pollutant Discharge Elimination System

SMP – Stormwater Management Practice

SWMP – Stormwater Management Program

SWMP Plan – Stormwater Management Program Plan

SWPPP – Stormwater Pollution Prevention Plan

TMDL – Total Maximum Daily Load

USEPA – United States Environmental Protection Agency