Catchment Investigation Plan

December 2019

Revision 0

Table of Contents

Illicit Discharge Detection and Elimination Plan

Tables

Figures

1.0 Introduction

1.1 MS4 Program

This Catchment Investigation Plan supplements the New Hampshire Department of Transportation's ("Department") previously prepared Illicit Discharge Detection and Elimination Plan (IDDE) to address the requirements of the United States Environmental Protection Agency's (USEPA's) 2017 National Pollutant Discharge Elimination System (NPDES) General Permit for Stormwater Discharges from Small Municipal Separate Storm Sewer Systems (MS4) in New Hampshire, hereafter referred to as the "2017 New Hampshire MS4 Permit" or "MS4 Permit."

In addition to an IDDE Plan, the 2017 MS4 Permit requires the Department to implement written Catchment Investigation Procedures to systematically prioritize and investigate catchment areas to each outfall or interconnection within the MS4 Urbanized Area.

1.2 General Requirements and Timeline

Consistent with Section 2.3.4.8 of the MS4 Permit, the Department has systematically evaluated their existing stormwater infrastructure data to prioritize outfalls for future catchment investigations based on their potential risk of having an illicit discharge or connection. This Plan describes the procedures used to prioritize outfalls as well as those that will be used to investigate the individual catchments for each outfall within the MS4 area. Catchment investigation procedures must contain, at a minimum, the following for each outfall;

- Review of Maps, Historic Plans and Records, and Other Sources of Data
- Description of the Manhole Inspection Methodology
- Procedures to Isolate and Confirm Sources of Illicit Discharges

1.2.1 Timeline

Table 1-1. Catchment Investigation Implementation Timeline

Catchment Investigation Task	Completion Date from Effective Date of Permit				
	1.5 Years	2 Years	3 Years	7 Years	10 Years
Written Catchment Investigation Procedure	X				
Begin Investigations of Catchments w/ Problem Outfalls		X			
Complete Investigations of Catchments w/ Problem Outfalls				X	
Complete Investigations of Catchments w/ Likely Sewer Input				X	
Complete Investigations of ALL Catchments					X

1.3 Outfall Prioritization for Catchment Investigations

Consistent with Section 2.3.4.7.a.ii of the Permit, will classify its stormwater outfalls and interconnections into one of the following categories based on existing data and selected System Vulnerability Factors as described below:

Problem Outfalls: Outfalls/interconnections with known or suspected contributions of illicit connections based on existing information including previous sampling results or observations that indicate likely sewer input as described below.

High Priority Outfalls: Outfalls/interconnections that are neither a Problem or an Excluded outfall and discharge to an area of public health concern including water bodies with recreational public beaches, used for drinking water supply or support shellfish beds.

Low Priority Outfalls: Outfalls/interconnections that are neither a Problem, High Priority or Excluded outfall.

Excluded: Outfalls/interconnections that have one of the following features are considered Excluded from the IDDE process because there is very low potential for an illicit connection:

- Discharges from a single drainage structure
- Discharges from a catchment that is entirely within a Limited Access Right of Way
- Discharges from a catchment that has no building/residence within 100 feet

The Department has identified approximately 2,800 regulated outfalls that discharge to waters of the United States in the "Urbanized Area" subject to the 2017 MS4 Permit.

Section 2.3.4.7.b.iii.4.b of the 2017 MS4 Permit suggests that any the following conditions observed or recorded during dry weather sampling may indicate sewer inputs from an illicit discharge or connection. Table 1-2 lists three (3) dry weather results or observations that the Permit suggests are potential indicators of sewer inputs or an illicit connection/discharge. The likelihood of an illicit connection or discharge is listed from highest to lowest according to the Permit.

Table 1-2. Dry Weather Sampling Results that May Indicate Sewer Inputs or an Illicit Connection

Condition	Observation or Combination of Testing Results
1	Observed olfactory or visual evidence of sewage or sanitary waste
2	Ammonia levels $\geq$ 0.5 mg/l and surfactants levels $\geq$ 0.25 mg/l and bacteria levels that exceed water quality standards[1],
3	Ammonia levels $\geq$ 0.5 mg/l; surfactants levels $\geq$ 0.25 mg/l and detectable levels of chlorine

Note: [1]The Permit mentions that elevated bacteria levels above state water quality standards may also be an indication of an illicit connection or discharge if levels of the other parameters are also elevated. In other words, elevated bacteria levels alone are not a strong indicator of an illicit connection.

2.0 Evaluation of Existing Data Sources

2.1 Dry Weather Sampling Data

The Department conducted a pilot study of dry weather screening/sampling in July and August of 2019, where 120 outfalls were inspected for dry weather flow. These 120 outfalls are part of a subset of 200± stormwater outfalls that were previously observed to have dry weather flow during dry weather conditions. Of these 120 outfalls inspected in 2019, forty-two (42) were observed to have dry weather flow and were sampled for various potential sewer input indicators and pollutants of concern consistent with the MS4 Permit. The Department plans to continue dry weather sampling in the summer of 2020 for the remaining outfalls that had previously observed dry weather flow.

Of the 42 outfalls sampled in the pilot dry weather study, only six (6) outfalls had levels for the various indicator parameters that were above indicator thresholds listed in Table 1-2. Table 2-1 below summarizes the dry weather sampling results for these six outfalls.

Table 2-1: Elevated Parameter Levels Observed in Recent Dry Weather Sampling

Outfall	Receiving Water	Ammonia (mg/L)	Chlorine (mg/L)	Surfactants (mg/L)	Bacteria (MPN /100 mil		Other Pollutants of Concern	
					E. coli	*Entero*	TP (mg/L)	CL (mg/L)
	Threshold	*> 0.5*	*>0.25*	*>0.25*	*406*	*104*	*>0.10*	*>230*
789	Surface water	**0.75**	<0.2	**1.0**	--	2.0		
2138	Wetland	**1.5**	**0.05**	0.2	**>2419.6**	--		
4475	Surface water	<0.1	**0.05**	**0.3**	71.7	--	0.04	960
4879	Surface water	0.1	<0.2	**2.0**	--	**>2420**		
6549	Wetland	0.1	**0.05**	0.1	**1553.1**	--		
7465	Wetland	0.1	0.00	0.25	**1986.3**	--		

Only Outfall #2138 had a combination of observed results that met one of the conditions listed Table 1-2 that may indicate a higher potential for an illicit connection. None of the outfalls had any observed olfactory or visual evidence of sewage. Elevated ammonia and surfactants levels were observed in Outfall #789, but the chlorine and bacteria levels were both below the indicator thresholds. It was later determined that construction activity was occurring upstream of this outfall at the time of sampling which likely influenced the sampling results.

The other four (4) outfalls had elevated levels of chlorine, surfactants or bacteria but the ammonia levels were below the indicator threshold and, thus, did not meet any of the conditions listed in Table 1-2 that may indicate an illicit connection. Thus, based on these results, Outfall #2138 will be considered a High Priority outfall for future catchment investigations, but the other five (5) outfalls will be considered Low Priority.

2.2 Storm Drain Mapping

Section 2.3.4.8.c.i of the Permit states that the permittee shall also review relevant mapping and historic plans to estimate preliminary catchment areas around each outfall.

The Department maintains an extensive geodatabase of inlets, outlets, drainage structures, treatment structures and culvert pipes not only within the urbanized area but throughout the State. This geo-database referred to as Culverts and Closed Drainage Systems (CCDS) is a vital asset management tool for the Department and is well supported for collection of existing infrastructure data and documentation of modifications to the CCDS assets.

The Department also maintains an extensive geodatabase of As-Built plans that provides engineering details for much of the state roadway drainage system. These plans provide engineered verified details on road construction and any alterations to the storm drainage infrastructure. The Department has this extensive data base of As-Built plans not only as a result of its own roadway improvement projects but also because its Right-of-Way Access and Encroachment Policy, which requires a detailed engineering application and review for any proposed access, alteration or connection to the state drainage system.

The Department policy is based on NH state law (RSA 236:13) making it unlawful for any person, firm or corporation to make a connection into a State road drainage system, or to drain or pump water onto the traveled surface of a State Highway without first obtaining written permission from the Commissioner of the State Department of Transportation via the issuance of a Driveway Access Permit Application

Together these two geo-databases, along with the use of street views in Google™ maps, the Department has been able to estimate preliminary limits of the catchment areas to each of the MS4 outfalls that show how stormwater flows from the highway pavement, along the curb line gutters, through the CCDSs and eventually to a water of the United States. It also allows the Department to identify which roadway sections are subject to the various MS4 water quality-based requirements including:

- IDDE prioritization
- Street Sweeping
- CB cleaning; and
- Additional Appendix H & F requirements

The Department has identified approximately 2,800 regulated outfalls that discharge to waters of the United States in the "Urbanized Area" subject to the MS4 Permit.

2.3 System Vulnerability Factors

The MS4 Permit lists the following System Vulnerability Factors (SVFs) to be considered in identifying or categorizing outfalls that have a higher potential for illicit connections or discharges compared to other areas.

- Areas with a history of Sanitary Sewer Overflows (SSOs) resulting from wet weather, high water table or fats/oil/grease blockages or areas adjacent to sewer pump/lift stations, siphons, or known sanitary sewer equipment along the right-of-way or catchment areas with known failures or blockages.
- Roadway areas with common or twin-invert manholes serving storm and sanitary sewer alignments or with common or shared trench construction serving both sanitary sewer and storm drain alignments.
- Roadway areas with crossings of storm and sanitary sewer alignments where the sanitary sewer is above the storm drain
- Sanitary sewer alignments known or suspected to have been constructed with an underdrain system.
- Age of development and infrastructure: Areas with the sanitary sewer systems that are more than 40 years old may have a high illicit discharge potential.
- Sewer conversion: Areas that were once serviced by septic systems and have been converted to sewer connections may have a high illicit discharge potential.
- Known areas involving road construction and municipal sewer mains within ROW or prior work on storm drains or sewer lines
- Known septic system breakouts or areas with septic systems that are thirty (30) years or older in residential land use areas are prone to have failures and may have a high illicit discharge potential.

For a number of reasons, these (SVFs) are not applicable or are much less likely to influence the Department's storm drain system compared to a typical municipal storm drain system. First and foremost, as mentioned above, any modification to the storm drain system or encroachment into the state Right-of-Way (ROW) requires an application and review process through the Department Access and Encroachment Policy to make sure any changes are consistent with state and federal regulations.

The Department has had some level of review and control for proposed modifications or encroachment in its ROW since the 1930's. In addition, modifications or connections to the Department's storm drain system along certain roadways and associated ROWs are either prohibited or restricted in the following manner:

a. Along all major Interstates and roads in the Turnpike system, which are limited access roadways, essentially no modifications are allowed in the ROW,
b. Within controlled access ROWs, modification is allowed in a few defined locations after an encroachment application review and an agreement is completed,
c. Within a regular roadway ROW, any modifications to the drainage systems is controlled by encroachment application review and agreement

In addition, any road improvements and storm drain changes proposed by the Department involves a detailed engineering and regulatory review through the internal project development team. Given these procedures in place through both the project development review and the encroachment permit review for alterations (driveway, trench, and utility), proposed by others, the potential for underground utilities and the influence of any sanitary sewer pipes within the Department's ROW is extremely low. Most modifications to the Department's storm drain system are verified by Professional Engineers.

Also, the Department rights-of-way typically extend 50 to 100 feet from the edge of pavement along most roadways, which provides a considerable separation distance from most buildings or residences that may be located adjacent to the ROW. This distance also reduces the potential for commercial buildings or residents to covertly connect to the Department's storm drain system without their knowledge. Thus, the potential for illicit connections to exist within the Department's roadway storm drain system is much lower than what might be expected for typical municipal storm drain systems.

In many of the more "urbanized" areas of the state, where state roads traverse through central villages or downtown areas of various towns and cities, the Department has granted authority or responsibility to the particular municipality to maintain these road segments which are referred to as "Urban Compact" zones. This responsibility is considered to include outfall screening/sampling as well as illicit discharge identification and elimination.

2.4 Selected System Vulnerability Factors

Given the extent to which the Department reviews and controls activities within its rights-of-way and associated roadway drainage systems and the limited potential for illicit connections to occur within its storm drain system compared to a typical municipal storm drain system, the Department has determined that there are essentially two relevant System Vulnerability Factors (SVF's) that can be used to assess the potential for illicit connections or discharges into the Department's storm drain system. The two SVFs include the following:

1. If no detailed as-built plan currently exists for the outfall catchment area; or,
2. Previous dry weather sampling results indicate elevated levels of sewer indicator parameters or a pollutant of concern.

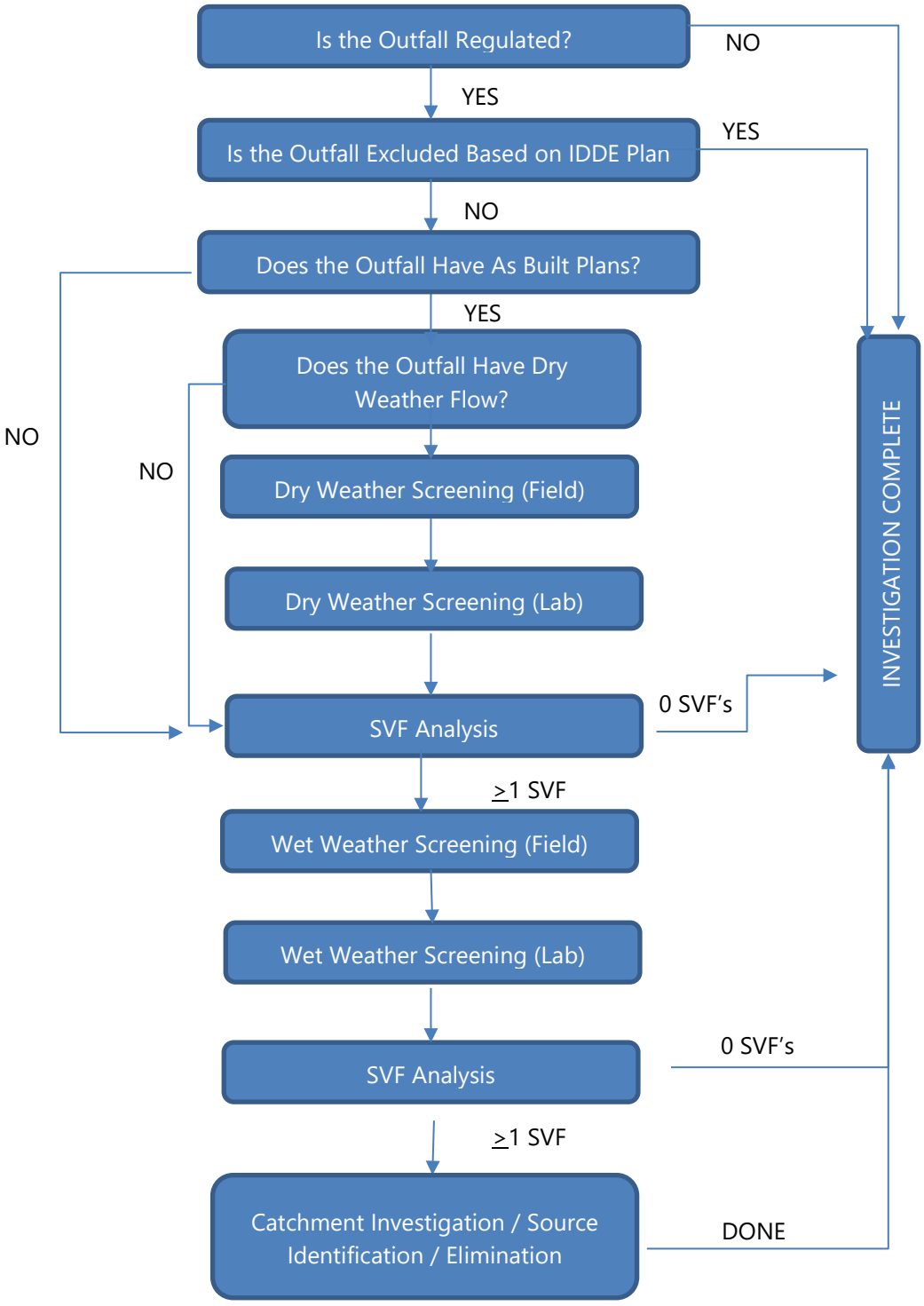
Figure 2.1 presents the preliminary results of the outfall prioritization for future catchment investigations based on the selected System Vulnerability Factors. Currently, approximately 80 regulated outfalls were found to have no detailed as-built plans in the geodatabase. These outfalls along with Outfall #2138 based on the dry weather sampling results are classified as High Priority outfalls for catchment investigations. The other five (5) outfalls that were found to have elevated levels of one indicator parameter but not ammonia along with approximately 80± outfalls that were previously observed to have dry weather flow but still need to be screened/sampled during dry weather conditions are classified as Low Priority. These priority classifications are subject to change depending on the dry weather screening/sampling results for outfalls that still need to be field investigated.

Table 2-2. Catchment Investigation Outfall Priority Categorization Based on SVFs

Priority Category	Estimated No. of Outfalls
Problem	0
High Priority	81
Low Priority	85

Note: These numbers are subject to change in the future as more information is collected as the field efforts progress.

Figure 2.1: Outfall Prioritization Screening Process for Catchment Investigations



3.0 Manhole Inspection Methodology

The Department will initiate investigations that involve systematically inspecting, evaluating and sampling, if necessary, key junction manholes in the drainage system connected to High Priority outfalls. For most catchments, manhole inspections will start at the outfall and move upstream into the system. Inspections will be conducted in conjunction with the required wet-sampling when feasible. Wet weather sampling protocols are discussed further below.

Infrastructure connection information will be incorporated into the SADES storm system map, and catchment delineations will be refined based on the field investigation, where necessary. The SVF inventory will also be updated based on information obtained during the field investigations, where necessary.

Several important terms related to the dry weather manhole inspection program are defined by the MS4 Permit as follows:

- **Junction Manhole** is a manhole or structure with two or more inlets accepting flow from two or more MS4 alignments. Manholes with inlets solely from private storm drains, individual catch basins, or both will be identified and documented but are not considered junction manholes for these purposes.

- **Key Junction Manholes** are those junction manholes that can represent one or more junction manholes that receive flow from developed areas building connections, sanitary sewer or septic systems may influence the storm drain system as opposed to undeveloped or forested areas. The Permit allows for junction manholes to be excluded if located upstream and in the immediate vicinity from another or that is serving a drainage alignment with no potential for illicit connections.

For all catchments identified for investigation, during dry weather, field crews will systematically inspect **key junction manholes** for evidence of illicit discharges. This program involves progressive inspection and sampling at manholes in the storm drain network to isolate and eliminate illicit discharges.

The manhole inspection methodology will be conducted in one of two ways (or a Inspection of key junction manholes will proceed as follows:

1. Manholes will be opened and inspected for visual and olfactory evidence of illicit connections.

2. If flow is observed, a sample will be collected and analyzed at a minimum for ammonia, chlorine, and surfactants. Sampling and analysis will be in accordance with procedures outlined in the Department's IDDE Plan. Additional indicator sampling may be done to assist in determining potential sources (e.g., bacteria for sanitary flows, conductivity to detect tidal backwater, etc.).

3. Where sampling results or visual or olfactory evidence indicate potential illicit discharges, the area draining to the junction manhole will be flagged for further upstream manhole investigation and/or isolation and confirmation of sources.

4. Subsequent key junction manhole inspections will proceed until the location of suspected illicit discharges or SSOs can be isolated to a pipe segment between two manholes.

5. If no evidence of an illicit discharge is found, catchment investigations will be considered complete upon completion of key junction manhole sampling.

3.1 Wet Weather Sampling Program

Consistent with the Permit, wet weather sampling will be conducted for each catchment that has at least one (1) of the System Vulnerability Factor. Wet weather sampling will be conducted during high groundwater conditions in the March to June period to assess whether wet weather-induced flows indicate any influence of sanitary sewers or septic systems in the MS4 area. Wet weather sampling will occur during or after a storm event of sufficient depth (0.25 inches of more) or intensity to produce a stormwater discharge.

Sampling will be done in a manner to avoid the "first flush" and be collected at least a half-hour after the storm begins. The Department will analyze wet weather samples for the same parameters conducted during the dry weather sampling including the following:

- Ammonia
- Chlorine
- Surfactants,
- Conductivity
- Salinity
- *E. coli* (freshwater) or enterococcus (saline or brackish waters)
- Temperature and
- Pollutants of Concern (based on 303d listed impairments).

Based on the wet-weather sampling and field investigations results, the Department will identify outfalls that may potentially indicate sanitary sewer inputs or an illicit connection and require additional confirmatory sampling or investigation techniques to find or isolate the source for the elevated levels as described in next section. The sampling results and follow-up investigation activities will be summarized in the annual report.

4.0 Isolation and Confirmation of Illicit Discharges

If evidence of an illicit discharge is detected and the source is not readily apparent, additional investigation may be needed upstream of the outfall and between drainage structures to isolate and confirm the source of the illicit discharge. The following methods may be used in isolating and confirming the source of illicit discharges

- Sandbagging
- Smoke Testing
- Dye Testing
- CCTV/Video Inspections
- Optical Brightener Monitoring

These methods are described in the sections below. In depth source isolation and confirmation procedures will be provided upon completion of dry weather screening.

4.1 Sandbagging

This technique can be useful when attempting to isolate small, intermittent flows with very little perceptible or periodic flow. The technique involves placing sandbags or similar barriers (e.g., caulking, weirs/plates, or other temporary barriers) within outlets to manholes to form a temporary dam that collects any intermittent flows that may occur. Sandbags are typically left in place for 48 hours and should only be used when dry weather is forecast.

If flow has collected behind the sandbags/barriers after 48 hours, it can be assessed using visual observations or by sampling. If no flow collects behind the sandbag, the upstream pipe network can be ruled out as a source of the intermittent discharge. Finding appropriate durations of dry weather and the need for multiple trips to each manhole makes this method both time-consuming and somewhat limiting.

4.2 Smoke Testing

Smoke testing involves injecting non-toxic smoke into drain lines and detecting the emergence of smoke from sanitary sewer vents from buildings that are illegally connected to the storm drain system or detect cracks and leaks in the system itself. Typically, a smoke bomb or smoke generator is used to inject the smoke into the system at a catch basin or manhole and air is then forced through the system. Test personnel are place in areas where there are suspected illegal connections or cracks/leaks, noting any escape of smoke (indicating an illicit connection or damaged storm drain infrastructure).

It is important when using this technique to make proper notifications to area residents and business owners as well as local police and fire departments.

If the initial test of the storm drain system is unsuccessful then a more thorough smoke-test of the sanitary sewer lines can also be performed. Unlike storm drain smoke tests, buildings that do not emit smoke during sanitary sewer smoke tests may have problem connections and may also have sewer gas venting inside, which is hazardous.

It should be noted that smoke may cause minor irritation of respiratory passages. Residents with respiratory conditions may need to be monitored or evacuated from the area of testing altogether to ensure safety during testing.

4.3 Dye Testing

Dye testing involves flushing non-toxic dye into plumbing fixtures such as toilets, showers, floor drains and sinks and then determining if the dye is observed in nearby storm drains and sewer manholes as well as stormwater outfalls for the presence of the dye. Similar to smoke testing, it is important to inform local residents and business owners. Police, fire, and local public health staff should also be notified prior to testing in preparation of responding to citizen phone calls concerning the dye and their presence in local surface waters.

A team of two or more people is needed to perform dye testing (ideally, all with two-way radios). One person is inside the building, while the others are stationed at the appropriate storm sewer and sanitary sewer manholes (which should be opened) and/or outfalls. The person inside the building adds dye into a plumbing fixture (i.e., toilet or sink) and runs a sufficient amount of water to move the dye through the plumbing system. The person inside the building then radios to the outside crew that the dye has been dropped, and the outside crew watches for the dye in the storm sewer and sanitary sewer, recording the presence or absence of the dye.

The test can be relatively quick (about 30 minutes per test), effective (results are usually definitive), and inexpensive. Dye testing is best used when the likely source of an illicit discharge has been narrowed down to a few specific houses or businesses.

4.4 CCTV/Video Inspection

Another method of source isolation involves the use of mobile video cameras that are guided remotely through stormwater drain lines to observe possible illicit discharges. IDDE program staff can review the videos and note any visible illicit discharges. While this tool is both effective and usually definitive, it can be costly and time consuming when compared to other source isolation techniques.

5.0 Illicit Discharge Removal

When the specific source of an illicit discharge is identified, the Department will exercise its authority as necessary to require its removal. The annual report will include the status of IDDE investigation and removal activities including the following information for each confirmed source:

- The location of the discharge and its source(s)
- A description of the discharge
- The method of discovery
- Date of discovery
- Date of elimination, mitigation or enforcement action OR planned corrective measures and a schedule for completing the illicit discharge removal
- Estimate of the volume of flow removed.

5.1 Confirmatory Outfall Screening

Within one (1) year of removal of all identified illicit discharges within a catchment area, confirmatory outfall or interconnection screening will be conducted. The confirmatory screening will be conducted in dry weather unless applicable System Vulnerability Factors have been identified, in which case both dry weather and wet weather confirmatory screening will be conducted. If confirmatory screening indicates evidence of additional illicit discharges, the catchment will be scheduled for additional investigation.

6.0 Ongoing Screening

Upon completion of all catchment investigations and illicit discharge removal and confirmation (if necessary), each outfall or interconnection will be re-prioritized for screening and scheduled for ongoing screening once every five (5) years. Ongoing screening will consist of dry weather screening and sampling consistent with the procedures described in the corresponding IDDE Plan. Ongoing wet weather screening and sampling will also be conducted at outfalls where wet weather screening was required due to System Vulnerability Factors and will be conducted. All sampling results will be reported in the annual report.