BRADFORD WOODS BOROUGH

ILLICIT DISCHARGE DETECTION AND ELIMINATION PROGRAM

PAG-13 General NPDES Permit No. PAG136263

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Illicit Discharge Detection and Elimination Program

Introduction

The purpose of the Illicit Discharge Detection and Elimination (IDDE) Program is to detect and eliminate sources of pollution to the municipal separate storm sewer system (MS4) as required by the National Pollutant Discharge Elimination System/State Disposal System (NPDES/SDS) permit program, permit number: PAG136263.

The goal of this plan is to identify and then eliminate illicit discharges. Examples of illicit discharges include:

- Direct or indirect sanitary wastewater discharges that connect to the storm sewer or watercourse, such as a shop floor drain connected to a storm drain, a cross-connection between the municipal sewer and storm sewer systems, a damaged sanitary sewer line that is leaking sewage into a cracked storm sewer line, or a failing septic system that is leaking into a water course.
- Materials (e.g., used motor oil) that have been dumped illegally into a storm drain catch basin or other stormwater facility.
- Improper home or business owner activities such as washing paint brushes into a catch basin, washing new textured concrete driveways into a storm drain, draining swimming pools to the storm system (swimming pools have high pH and chlorine), excess use of fertilizers, or washing cars with chemicals that enter the storm drain system.

Additional goals of the IDDE program include:

- Improve water-quality in local waterways by reducing incidences of pollution to MS4s
- Increase awareness among municipal employees, businesses, and the general public of the direct connection between the MS4 and local waterways
- Educate municipal employees, businesses, and the general public of the hazards associated with illicit discharges and the best management practices (BMPs) available
- Facilitate consistency in response to incidences of discharges of pollutants to Borough's stormwater system through a coordinated system of procedures and training of municipal employees,

The NPDES Permit sets forth the minimum elements of the plan which are listed below. These minimum elements are described throughout the remainder of this document.

- Municipal Storm Sewer System Mapping (Part III.D.3.a)
- Ordinances (that effectively prohibit illicit discharges) (Part III. D.3.b)
- Incorporating IDDE into Maintenance and Inspection Activities (Part III.D.3.c)
- Visual IDDE Inspections (Part III.D.3d)
- Staff Training (Part III.D.3e)
- Locating Priority Areas (Part III.D.3.f)
- Response Procedures (Part III.D.3.g)

- Incident Reporting (Part III.D.3.h)

Section 1: Municipal Storm System Mapping

The NPDES Phase II Permit outlines minimum information that should be included in the Borough's municipal storm sewer system map:

- Location of all known municipal storm sewer conveyances 12" or greater in diameter, including the stormwater flow direction in the pipes,
- Outfalls, including a unique identification (ID) number assigned by the Borough, and an associated geographic number,
- Structural stormwater BMPs that are part of the Borough's small MS4,
- All receiving waters.

The Borough has completed GIS mapping of the Borough's stormwater system, including all basins, pipes, ditches and stormwater facilities, including outfall identification. Updating and maintenance is ongoing. This map will be used to schedule and track maintenance activities and plan for capital improvement projects.

The GIS map information is currently not available on-line. A wall map showing the mapped system to date is available at Public Works.

All Borough owned stormwater facilities have been identified. Outfalls have been mapped. Stormwater BMP's are in the process of being mapped (on-going process).

Receiving waters have been prioritized and identified on the GIS Stormwater Map.

Section 2: Borough Ordinance

Current Ordinance

Chapter 191 of the Borough's current municipal code prohibits illicit discharges. Connections to the stormwater system must contain only stormwater and groundwater, otherwise they are to be eliminated. The section references the fines and penalties that can be levied against violators in accordance with Article 4. The IDDE ordinance is included in the appendix for reference.

Section 3: Incorporating IDDE into Maintenance and Inspection Activities

Purpose

Potential illicit discharge problems can be revealed through outfall inspections or reports from staff, tenants, or the public as described in Section 4. When a complaint is reported, the Phase II Permit requires that a follow-up investigation be initiated within seven (7) days, on average. The follow-up investigation could include a site visit to look at the problem area, review of mapping information, review of past complaints or investigations at the location, or other data collection and review. Once a problem has been verified (either through a routine outfall inspection or follow-up to a called-in complaint) the Borough will begin an official illicit discharge investigation, following the procedures outlined in this section.

When an illegal dumping or illicit discharge problem is directly observed by a member of the Borough staff, it is generally not necessary to follow these investigation procedures. In those scenarios, the source of the problem discharge is already known. Problems revealed through direct observation are referred directly to the corrective action information in Section 7. In the event that a reported problem does not have a defined source, the procedures in this section should be followed to trace the source of the illicit discharge.

Section 4: Visual Illicit Discharge Detection Inspection Procedures

4.1 Tracing the Source

This section outlines the basic tools that can be used to trace the source of a suspected illicit discharge. Source tracing begins when a suspected problem area is identified through outfall inspections, field assessment/testing, or a complaint call. When the source of the non-stormwater discharge is not known, one of two primary methods can be used to locate the source of an illicit discharge:

- Method A – Storm Drain Network Investigations
- Method B – Drainage Area Investigations

The method used will depend on the type of information collected or reported, level of understanding of the drainage network, and existing knowledge of operations and activities on the surrounding properties. All source tracing investigations should be documented and recorded.

4.1.1 Start a File

When problems are identified, a report should be started, and assigned an incident number, creation date, case description and the primary staff contact/investigator. A report is created listing the property name, person responsible, and tracking all information related to the observed or suspected problem. The investigator assigned to the case shall keep an accurate log of labor, materials and costs associated with the investigation for invoicing the responsible party. The report should be started prior to completing any additional field work unless the nature of the discharge necessitates immediate response. In addition to filling out the report, the file should include copies of the following, if applicable:

- GIS Inspection Map;
- Photographs;
- Field notes;
- Lab testing results;
- Compliance letters sent and responses received;
- Correspondence (mail, email, telephone logs);
- Proof of corrected problems (contract and invoice or clean field investigation report).

Any field investigations, photographs, corrective actions, or other activities associated with the suspected problem area should be documented in the case log. This becomes the Borough's official record of the IDDE investigation. Additional record keeping information is included in Section 8.

4.1.2 Method A – Storm Drain Network Investigations

The source of some illicit connections or discharges can be located by systematically isolating the area from which the polluted discharge originates. This method involves progressive investigation at manholes in the storm drain network to narrow down the location where the illegal discharge is entering the drainage system. This method is best used to identify constant or frequent discharge sources such as an illicit connection from a sewer system or sink drain into the storm drainage network. One-time illegal discharges (such as a surface spill or intentional dumping into the storm drain system) should be investigated using Method B described later in this section.

Borough staff should work progressively upstream from the outfall and inspect manholes until indicators reveal the discharge is no longer present. Manhole observations can be time consuming, but they are generally a necessary step before conducting other tests. In particularly large storm drain systems, it may be helpful to first identify major branches of the system and test one manhole at the downstream end of each branch. This can help to reduce the area that must be investigated.

Storm drain network investigations include the following steps:

1. Consult the drainage system map and identify the major branches. If a drainage system map is not available or major branches cannot be identified, then sketches of the system shall be made and the system shall be identified in the GIS project queue for adding to the Borough's drainage system map.
2. Starting from the outfall, observe the next upstream manhole or junction to see if there is evidence of polluted discharge. As with the outfall inspections, field crews are looking for the presence of flow during dry weather, foul odors, colors or stained deposits, oily sheen, floatable materials, and/or other unusual observations.
3. Repeat observations at each upstream manhole or junction until a junction is found with no evidence of discharge; the discharge source is likely located between the junction with no evidence of discharge and the next downstream junction.
4. Work downstream from the "clean" manhole or junction to isolate the location where the polluted discharge is entering the storm drain system.
5. If discharge is evident from private property initiate private property site entry procedures.
6. Document all findings in field notes and keep them in the file.

When visual inspections are not enough to isolate the source of the illegal discharge, a number of additional field tests can be performed. These include:

- Dye testing,
- Video Testing/Televising,
- Smoke testing,

The Center for Watershed Protection's Illicit Discharge Detection and Elimination: A Guidance Manual provides instructions for employing these testing techniques. The relevant pages from that manual are included in Appendix C.

Confirmed illicit discharge sources should be referred to the follow-up actions and corrective action procedures described at the end of this section and in Section 7.

4.1.3 Method B – Drainage Area Investigations

The source of some illegal discharges can be determined through a survey or analysis of the drainage area of the problem outfall. Drainage area investigations are particularly useful when the discharge observed at the outfall has a distinct or unique characteristic that can allow field crews to quickly determine the type of activity or non-point source that is generating the discharge. However, drainage area investigations are generally not helpful in tracing sewage discharges, since they are not related to a specific land use.

Drainage area investigations should begin with a discussion between the field crews, inspectors, engineers, and other knowledgeable Borough staff to identify the type of site most likely to produce the observed discharge. Table 4-1 shows some of the activities or land uses most likely associated with specific discharge problems.

Table 4-1
Common Discharges and Potential Sources

Observed Discharge	**Potential Causes**
Clogging Sediment	• Construction activity without proper erosion and sediment controls • Roadway sanding operations • Outdoor work areas or material storage areas
Thick Algae Growth	• Fertilizer leak or spill • Landscaping operations • Hydroseeding following construction • Failing or leaking septic system
Oil	• Refueling operations • Vehicle or machinery maintenance activities
Sudsy Discharge	• Power washing of buildings • Vehicle or equipment washing operations • Mobile cleaning crew dumping • Laundry or Cleaner • Household greywater discharge
Clogged Grease	• Restaurant sink drain connection to stormwater system
Sewage	• Failing or leaking septic systems

Staff should make a list of likely discharge sources and consult Borough land use and drainage system maps to identify areas of likely pollutions sources near the storm drain network. Field crews should then conduct a windshield survey of the drainage area to confirm and identify potential sources of the discharge. Once potential discharge sites are identified, Borough staff should conduct individual site inspections to locate the specific source of the illegal discharge.

In some cases, dye testing (See Appendix C) may be needed to confirm that a suspected activity is actually draining into the storm drain network.

All drainage area investigations should be documented in field notes and entered in the report file.

4.1.4 Equipment
Prior to conducting field work, crews should assemble all required equipment (see Table 4-2) and review the outfall inspection records or water quality incident reports from the area to become familiar with the background information and potential pollution sources.

Table 4-2
Field Equipment for Source Investigations

Minimum 2 person crew	• Watch with second hand
Safety Gear – vest, work boots, cones	• Flash light or head lamp
Field Notebook/Pencils	• Tool Box – hammer, tape measure, duct tape, zip ties
Map or Aerial Photo of Inspection Area	• First Aid Kit
Digital camera w/ charged battery	• Clear sample bottles
Cell phone w/ charged battery	• Wide mouth container

4.2 Follow-Up Actions
Once the source of an illicit discharge has been identified, the investigator should notify the property owner or operator of the problem, and provide the appropriate educational materials and/or a notice of violation. This is an important first step in the corrective action process. The investigator completes the information to document the findings. The investigator can then begin working through the corrective action steps outlined in Section 7.

Section 5: Training Staff on Implementation of the IDDE Program

The Borough has developed a training schedule to meet the requirements of the NPDES Phase II Permit. Two primary trainings have been identified related to IDDE:

- Training for all staff that are routinely in the field to educate them on what constitutes an illicit discharge problem and how to report suspected problems.
- Training for illicit discharge responders on proper identification, investigation, clean-up, disposal, and reporting techniques for illicit discharges.

These trainings are generally conducted using materials developed for the IDDE program. General training will primarily include Power Point presentations, webcast material, and printed material distributed to staff at staff meetings. The Borough has met the permit requirement of developing a program to train all field staff, and the Borough will schedule follow-up trainings as needed to keep the information fresh or introduce new information acquired during implementation of the IDDE program.

Training for illicit discharge responders will also include distribution and review of this procedure manual as well as a refresher on Borough spill response procedures. Follow-up trainings for illicit discharge responders may take the form of debriefings following significant IDDE incidents. Debriefings allow staff to review the actions taken and identify what worked well and what should be modified for future responses.

Section 6 – Locating Priority Areas

Identification of priority areas likely to have illicit discharges, including at a minimum, evaluating land uses associated with business/industrial activities, areas where illicit discharges have been identified in the past, and areas with storage of large quantities of significant materials that could result in an illicit discharge. Based on this evaluation, the permittee shall conduct additional illicit discharge inspections in those areas identified as having a higher likelihood for illicit discharges.

6.1 Developing Priority Areas

Identifying priority areas is vital to the development of an IDDE program. This process can be broken down into three fundamental steps:

1. Use all available information to identify where illicit discharges may be found in the community;
2. Conduct dry weather field screenings to locate non-stormwater discharges;
3. Conduct water quality sampling and analysis to determine if non-stormwater discharges are present.

6.2 Locating Priority Areas

The first step in locating priority areas is to identify areas that have a high potential for illicit discharges within your community. These can be broken down into a list of commonly high probability locations where illicit discharges may be or are likely to occur.

1. Locations where there have been repeated problems in the past. This includes locations with known water quality data, as well as locations where numerous complaints have been received. These areas should be known by community officials as well as other agencies that collaborate on specific problem areas. For example: Arden Hills Utilities works on many sanitary sewer problems that can impact the MS4. Utilities would be a division within Public Works that should be contacted for such information. Likewise, the MDOH, MPCA, county health department, or a variety of other agencies/groups should be contacted when compiling this information.
2. Using existing information to assess where illicit discharges may be found and what waterbodies are particularly sensitive (e.g. drinking water sources, areas containing unique biodiversity, and swimming areas).
3. Older areas of a community may indicate possible locations where there will be illicit discharges detected. These locations may have a higher percentage of illegal connections and/or have deteriorating sewer lines leading to infiltration problems from the older infrastructure found in that area.
4. The commercial and/or industrial areas of the community will tend to have a higher percentage of illicit discharges as well. Historically, these locations have significant numbers of illegal

connections and have discharges with a high potential to affect water quality (Tuomari, 1999 and Pitt et al., 1993).

5. Stormwater outfalls and structural pollution control devices should be inspected for illicit discharges during the normal inspection period for these structures/facilities.
6. Areas with storage of large quantities of materials that could result in a spill or areas with many storage vessels of hazardous solids or liquids.

Priority Areas Identified by the Borough of Arden Hills:
Using the guidelines provided above, the Borough of Arden Hills staff has identified the following priority areas within the Borough limits:

- _____

Section 7: Response Procedures

Immediate Response Procedures
The field crew should be prepared to take immediate action in the event of encountering one of the following situations:

- Individuals actively in the process of introducing possible illegal substances or materials to the storm drain system
- Very strong chemical odor emanating from storm drain system
- Presence of fumes or smoke emanating from storm drain system
- Visible significant stream of a controlled chemical or petroleum product flowing in storm system or downstream waters
- Large chemical plume in stream or river downstream of a Borough outfall
- Any condition that poses or could pose an immediate threat to property, human health or safety, or aquatic life. The crew should take the following steps if one of the above situations is encountered:
- Ensure crew safety and the public by instructing people to stay clear of the area.
- **Call 911 to report a major spill, active illegal dumping or a potential fire incident.**
- The following offices must all be called if an unauthorized discharge of oil or hazardous material such as a spill has occurred:
  a. Non-Emergency Police Dispatch at (724) 625-3157; and

- If a spill is encountered the following information should be recorded if possible:
  a. Where is the spill?
  b. What spilled?
  c. How much spilled?
  d. How concentrated is the spilled material?
  e. Who spilled the material?
  f. Is anyone cleaning up the spill?
  g. Are there resource damages (e.g. dead fish or oiled birds)?
  h. Who is reporting the spill?
  i. Your contact information?

- If possible isolate or contain visible chemical pollution in the effected waterbody with any materials that are accessible. For small discharges earth dams, absorbent pads, and containers may be useful to contain part of the illicit discharge.
- Take detailed notes and photos/video for subsequent investigation by Borough or other agencies.

At a minimum, follow-up work includes contacting the PA DEP to determine if any additional reporting or investigative actions are necessary.

7.1 Corrective Action

7.1.1 Purpose

The Borough will respond to identified illicit discharges, illicit connections, or illegal dumping activities using progressive enforcement actions. Corrective actions will focus first on education to promote voluntary compliance and escalate to increasingly severe enforcement actions if voluntary compliance is not obtained.

7.1.2 Voluntary Compliance

The preferred approach to address illicit discharge problems is to pursue voluntary compliance through property owner or responsible party education. Often, business operators and property owners are not aware of the existence of illicit connections or activities on their properties that may constitute an illegal discharge. In these cases, providing the responsible party with information about the connection or operation, the environmental consequences, and suggestions on how to remedy the problem may be enough to secure voluntary compliance.

Education begins during the site investigation when the operation or connection is first confirmed. Property owners and operators should be notified that the problems must be corrected in a timely manner and that the Borough will be conducting a follow-up site visit to verify compliance. Field staff should also provide the property operator with an educational brochure describing illicit discharge violations and a copy of the applicable Borough code. Field staff should also remind property owners of their obligation to report discharges to the proper agencies.

7.1.3 Operational Problems

Property owners are responsible for correcting operational problems that are leading to illegal discharges to the storm drainage system. This could include moving washing activities indoor or undercover, covering material storage areas, locating an appropriate discharge location for liquid wastes, or other operational modifications. Through site visits and education, the Borough can provide technical assistance to aid property owners in identifying the required modifications.

7.1.4 Structural Problems

Most illicit connection problems will require a structural modification to correct the problem. Structural repairs can be used to redirect discharges such as sewage, industrial, and commercial cross-connections. Such cross-connections must be re-routed to an approved sanitary sewer system. Correcting structural problems is the responsibility of the property owner, though the Borough may provide technical assistance throughout the process.

Section 8 – Incident Reporting

8.1 Purpose

Illicit discharges and connections are identified through citizen reporting, interdepartmental or interagency referral, or other routine MS4 inspection activities. The Borough relies on local citizens, field staff, and inspections to detect potential problem areas quickly, so that they can be addressed before they cause significant water quality degradation.

8.2 Incident Reporting

Field staff shall be observant in their daily routines to watch for evidence of illicit discharges or unusual flows from the storm drain systems. Should a suspected discharge be discovered, it must be reported to the Borough 724-935-2990.

When a suspected illicit discharge is observed, the employee may elect to fill out a Borough of Bradford Woods Stormwater IDDE Report & Response Form (Appendix A). However, if a suspected illicit discharge is observed, to assist the Borough the information that should be recorded at a minimum is:

- ►Location
- ►Date
- ►Time
- ►License plate number (if applicable)
- ►And take photos

Once this information is submitted to the Borough a field investigation of the discharge shall occur. The employee initially observing the suspect discharge need NOT approach the potential violator at the time of the incident. However, if the violator does not appear threatening, personal information for the Illicit Discharge Reporting & Tracking Form would be beneficial.

Once recorded, incident information is referred to the appropriate Borough department and/or staff person for follow-up. In most cases, IDDE problems should be referred to the Borough for further investigation. Staff will either follow the investigation procedures in Section 6 to identify the source of the problem or, if the source is known, the corrective action procedures outlined in Section 7 will apply.

APPENDIX A

Stormwater IDDE Report & Response Form

Stormwater IDDE Report & Response Form

I. Incident Report

Incident Number:_____

Date/Time: _____AM / PM Received By: _____

Location: _____

Initial Report of Conditions: _____

_____

Reported By: _____ Phone: _____

II. Investigation

Date: _____ By: _____

Location Description/Storm Drain ID/Outfall: _____

Discharge Entered Storm Drain System/Receiving Waters? ___Yes ___No

Material Type

- ☐ Hazardous
- ☐ Sediment
- ☐ Wastewater
- ☐ Oil/Grease
- ☐ Other_____
- ☐ Unknown

Est. Quantity: _____

Additional Information: _____

Sample(s) Collected: ____ Yes _____No Photo(s) Taken: ____ Yes _____No

Observed Land Use

- ☐ Residential
- ☐ Commercial/Industrial Stormwater Permit ___Yes ___No ___Unknown
- ☐ Public

Direct/Constructed Connections Found? ___ Yes ___ No

Source Description: _____

Source/Responsible Party: _____

III. Action and Closure

Referred To: _____ Date: _____

Action Taken: _____

_____

Date Closed: _____

APPENDIX B

Enforcement Response Procedures (ERPs)

APPENDIX C

Dye Testing, Video Testing/Televising & Smoke Testing

Excerpts from The Center for Watershed Protection's:

Illicit Discharge Detection and Elimination: A Guidance Manual for Program Development and Technical Assessments

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).

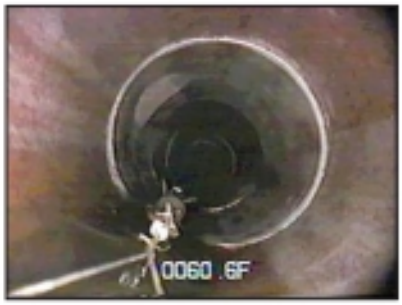

Figure 65: Camera being towed

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

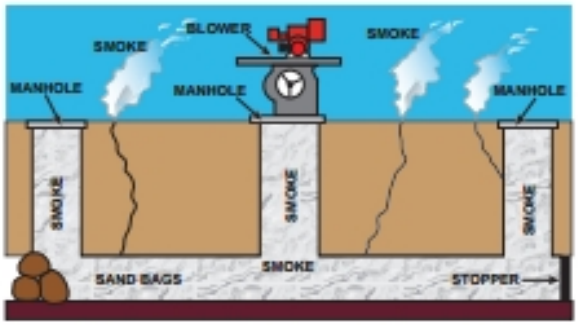

Figure 68: Smoke Testing System Schematic

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.

APPENDIX D

Illicit Discharge Ordinance