Outfall Reconnaissance Procedures and Guidelines

PURPOSE

The Outfall Reconnaissance Inventory (ORI) is designed to:

- Identify and record basic characteristics of existing drain outfall.
- Evaluate suspect outfalls.
- Assess the severity of illicit discharge problems, if any.

SCHEDULE

ORI are to be performed annually, at the end of every fall, during prolonged dry periods and during non-growing season with low groundwater levels. Moreover, ORI field work should be conducted at least 48 hours after the last rain event.

STAFFING

The ORI requires at least a two-person crew, for safety and efficiency. All crew members are to be trained on how to complete the ORI and have a basic understanding on illicit discharges and water quality impacts. Training on ORI would be conducted by Mason LD as necessary.

RESOURCES NEEDED TO CONDUCT THE ORI

Mapping:

Field maps of each campus are to provide labeled streets and hydrologic features (Streams, wetlands and lakes). ORI maps should be used to check the accuracy and quality of pre-existing mapping information, such as location of outfalls and stream origins. Refer to Appendices A-1 and A-2 for ORI maps of George Mason University.

Field Sheets:

ORI sheets are used to record descriptive and qualitative information about each outfall inventoried in the field. Data from the field sheets represents George Mason University's outfall tracking system. ORI forms are to be complete in the field by the inspection crew and are to be entered and updated in the Mason LD's stormwater management data base.

Outfall Reconnaissance Inventory Sheet:

- Reflects information needed to field verify location of outfalls depicted in ORI map as well as invert elevations. Locations of outfalls are to be determined with the use of GPS equipment.
- Reflects all physical characteristics including type, shape, dimensions, material, etc

Outfall Inspection Sheet:

- Reflects information associated with quality of outfall with regards to:
  - Concentration of water- pipe flow and surface water elevation, which help determine the presence of a pipe blockage or scouring velocities
  - Physical conditions/ indicators: including but not limited to outfall damages, deposits, abnormal vegetation, sediment, etc.
  - Characteristics of flow: including but not limited to temperature, odor, color, PH, etc.
  - Signs of dumping and illicit discharges

  An overall rating is to be given by the investigator to determine corrective actions required and level of priority for maintenance.

Each ORI sheets must be signed by at least one of the investigators. A copy of both, the Outfall Reconnaissance sheet and the Outfall inspection sheet, is provided in Appendices B-1 and B-2, respectively. Field crews are expected to carry GMU identification and a list of emergency phone numbers to report any emergency leaks, spills obvious illicit discharges or other water quality problems to the appropriated authority. A list of emergency phone numbers is available in Appendix C

Field Equipment:

Basic equipment needed during field work includes:

- GPS Survey Unit
- Camera
- Measuring Tape
- Watch
- Flashlight
- Clipboard, pencils and ORI sheets
- Thermometer
- Flow meter
- Test Strips
- Test Bottles

Basic safety items

- Surgical Gloves
- Cell phones or walkie-talkies
- First Aid Kit (Minimum needed: repellents packet, insect sting relief packet, sun block).

PROCEDURE

ORI procedures consist on surveying George Mason University's entire drainage network annually. The ORI is to be performed on every stream and/or channel mile with in George Mason University's MS4 using Field Maps and Field equipment to locate all existing outfalls on and make sure such outfalls are depicted in the campus utility map. Field crews are to conduct an ORI by walking all streams and channels to find outfalls, record their location spatially with a GPS unit. Every outfall is to be photographed and marked by directly writing a unique identifying number that serves as its sub-"watershed address." See section Outfall Identification for numbering system. A sample of the flow should be taken for water quality examination, see section 5 under Outfall inspection for water sample collection procedures. Samples are to be labeled with date and outfall identification number. Photographs, samples and a separate ORI report (see Field sheets), for each outfall, are to be submitted to Mason LD. Field sheets should include data on outfall characteristic and observations. Information collected and recorded in ORI sheets are to be stored into the maintenance database for the stormwater management system.

The ORI applies to all outfalls encountered during the stream walk, with the following exceptions:

- Drop Inlets from roads in culverts (Unless evidence of illegal dumping, dumpster leaks, etc)
- Weep holes
- Discharges from roof downspouts that sheet flow over ground

Outfalls to be recorded:

- Both large and small diameter pipes that appear to be part of the storm drain infrastructure.
- Field connections to culverts
- Submerged or partially submerged outfalls
- Outfalls that are blocked with debris or sediment deposits
- Small diameter pipes

Common outfalls encountered in the field are illustrated Appendix D.

Outfall Identification Number

The outfall identification number is assigned based on the outfall location in relation to the master utility map of each campus. The utility map of each campus is divided by quadrants which cover approximately 12 acres of land. Outfall identification numbers should reflect the number of the quadrant in which they are located with respect to the Mason's utility map. A letter should be assigned to the identification number identifying the campus in which such outfall is located. For example, outfall W11-4 is the 4th outfall located on the west campus depicted in quadrant 11.

Recording Data

Outfall Reconnaissance Inventory

Section 1: General Information

This section is used to record basic information about the survey and is used to create an accurate record of when and where data was collected. Information in this section is to include GPS coordinates for the outfall, stream, community, etc.

Section 2: Outfall Description

This section is used to provide basic characteristics for the outfall including type, shape, invert elevation, material, dimensions and depth of submergence or water elevation when water is present. This information is used to confirm and supplement existing storm drain maps.

Outfall Inspection

Section 1: General Data

This section is used to record basic information about the survey including date and time, temperatures, weather conditions, GPS coordinates, etc. This section provides information on when and where and under what conditions data was collected.

Section 2: Physical Conditions/ Indicators

This section is used to provide information any physical indicators or conditions that might require attention. This section can be associated with both flowing and non-flowing outfalls. Indicators can be detected by smell or sight, and require no measurement equipment. Such indicators do not always predict illicit discharges (See Definitions section for illicit discharges). Some of the indicators described in this section include, outfall damage, deposits, stains, abnormal vegetation, sediment, etc. See Appendix for common examples of physical indicators and severity. Many of these physical indicators can

represent an intermittent or transitory discharge that has occurred in the past, even if the pipe is not flowing at the time of the inspection.

Section 3: Quantitative Characterization

This section is used to provide information on any measurements taken in the field, such as, flow depth, velocity of water, temperature, pH and ammonia. Field crew are to measure the flow rate using two techniques: (1) Recording the time it takes to fill a container of a known volume and; (2)measure the velocity and multiply it by the estimated cross-sectional area of the flow.

The first technique is to be used in relatively flat and shallow flow, while the second technique is preferred for larger discharges where container is too small to effectively capture the flow.

The velocity of the flow is to be determined by defining a fixed flow length and observing the time it takes for a light object (ping pong ball, crumble leave, etc.) 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). The cross-sectional area (in square feet) is measured by multiplying readings of depth and width of flow. Once the cross-sectional area is determined, the flow rate (cubic feet/second) is computed by multiplying the cross-sectional area by the flow velocity (feet/second).

The quality of water in flowing outfalls is to be measured by collecting a sample of the discharge. All measurements should be made from a sample bottle that contains flow captured from the outfall. Measurements should be recorded in this section. When interpolation is required, results should not exceed mid-range between two color points.

Section 4: Physical Characteristics/ Indicators for Flowing Outfalls

Section 4 records data about four sensory indicators: odor, color, turbidity and floatables, which are based on the investigator's sense of smell or sight. No equipment is required to complete this part of the inspection form. While sensory indicators are not always reliable in predicting ALL illicit discharges, these are important indicators of severe or obvious discharges. Severity of the sensory indicator is to be recorded on a scale of 1 through three. Types and severity of indicators and discharges are defined in ORI sheets.

Section 5: Sample Collection

This section records samples taken in the field from flowing outfalls. Sample identification number should identify the outfall number (OID), the date (DD/MM/YY), and the sample number for that specific outfall. See Section 3 for procedures in how to collect samples for outfall discharges.

Section 6: Overall Condition

This section describes the general condition of the outfall based on the number of indicators and the severity of such indicators. Section 6 of the inspection form is very important as it helps identify and prioritize outfalls that need more attention. Corrective maintenance schedules are to be based on the overall conditions of the outfall. This section also summarizes the discharge potential of each outfall.

Section 7: Recommendation

In this section, based on the field visit and the data collected, the investigator is to give a final recommendation that summarizes the correctives actions necessary to restore the conditions of the outfall.

Lastly, both the outfall reconnaissance and the inspection forms allow for additional comments from the investigator, which are to be recorded in the last section of the sheet. Additional information can be submitted as attachments when necessary.

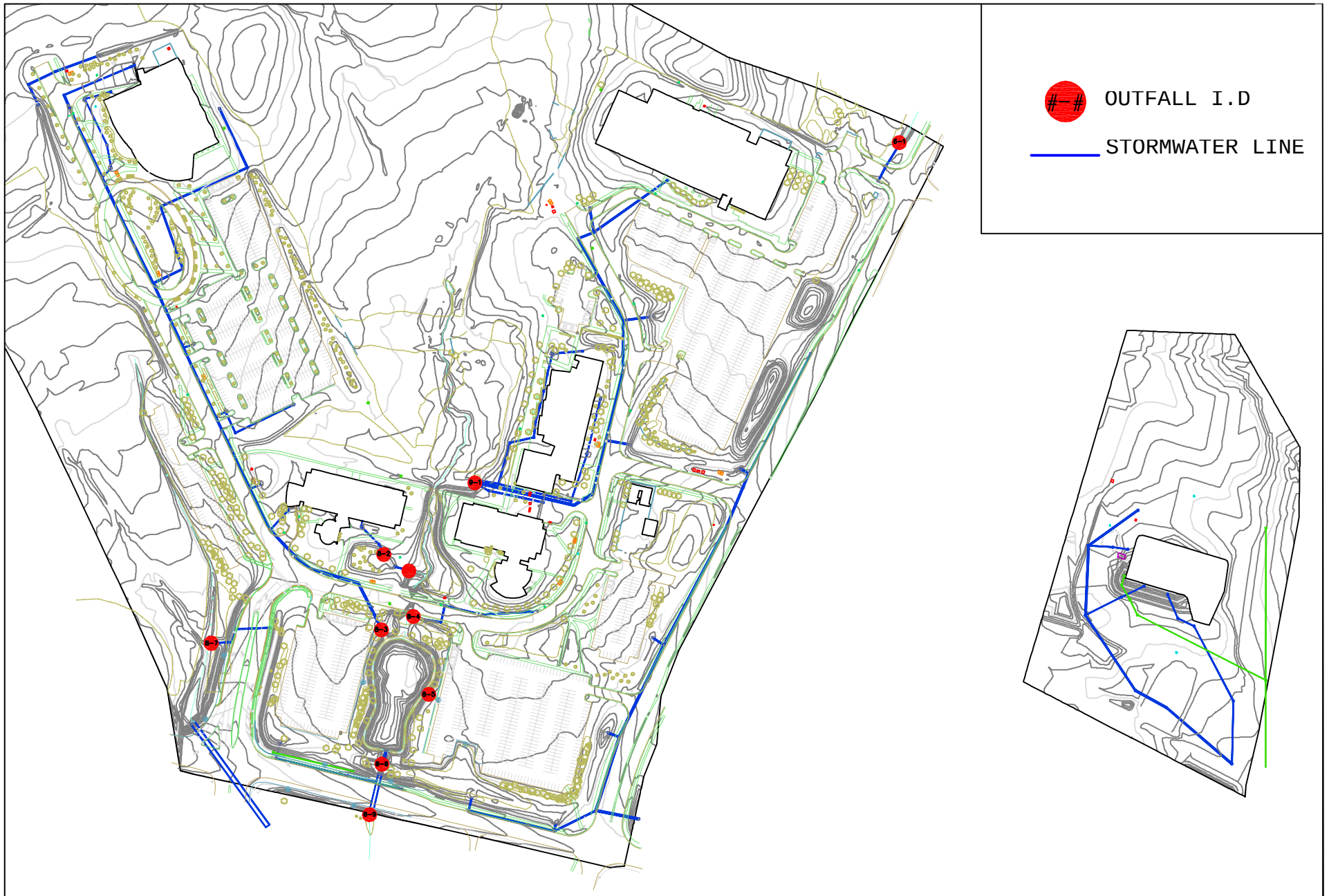
APPENDIX A:

Outfall Reconnaissance Maps

GEORGE MASON UNIVERSITY

OUTFALL RECONNAISSANCE MAP- FAIRFAX CAMPUS

LAND DEVELOPMENT 2012



GEORGE MASON UNIVERSITY

OUTFALL RECONNAISSANCE MAP- PRINCE WILLIAM CAMPUS

LAND DEVELOPMENT 2012

APPENDIX B:

Outfall Reconnaissance Inventory Sheets

OUTFALL RECONNAISSANCE INVENTORY

Entry Date:_____

Form Completed by:_____ **Investigator:** _____

Section 1: General Information

Outfall ID:_____ **GPS Location:** (N)_____(E)_____

Stream:_____ **Community:**_____

Origin of Discharge:_____ **Outfall on Map:** **Yes** ☐ **No** ☐

Outfall Photograph	Location Map

Section 2: Outfall Description

Type	Material	Shape	Dimensions	Submerged
☐ **Closed Pipe**	☐ RCP ☐ CMP ☐ PVC ☐ HDPE ☐ Steel ☐ Other:_____	☐ Circular ☐ Single ☐ Eliptical ☐ Double ☐ Box ☐ Triple ☐ Other: _____	Height (in): _____ Width (in): _____ Diameter (in): _____	In water: ☐ No ☐ Partially ☐ Full
☐ **Open drainage**	☐ Concrete ☐ Earthen ☐ Rip-rap ☐ Other:_____	☐ Trapezoid ☐ Parabolic ☐ V-shaped ☐ Other:_____	Depth (ft): _____ Top width (ft): _____ Bottom width (ft): ____	Water depth (ft):_____ Height from invert to stream flow (ft):_____
☐ **Outfall Protection**	Length = _____	Width = _____	Size of Rip Rap = _____	

Invert Elevation: _____

The informaition provided has been field verified by the investigator to the best of his/her knowledge and judgement.

Investigator's Signature:_____

OUTFALL INSPECTION

Section 1: General Data

Outfall ID:_____ **GPS Location:** (N)_____(E)_____

Date:_____ **Time:** _____

Temperature:_____ **Rainfall (in)**: Last 24 hours_____Last 48 hours_____

Inspector:_____ **Time of last Rain:** ☐ < 24 hrs ☐ < 48 hrs ☐ < 72 hrs ☐ > 72 hrs

Photos #s:_____

Outfall Photograph	Location Map

Piped outfalls only:

Pipe Flow: ☐ None ☐ < 1/4 Pipe ☐ < 1/2 Pipe ☐ < 3/4 Pipe ☐ Full ☐ Trickle
Pipe Submergence: ☐ None ☐ < 1/4 Pipe ☐ < 1/2 Pipe ☐ < 3/4 Pipe ☐ Full
Comments:

Section 2: Physical Conditions/ Indicators

Indicator	Check if present	Decription	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 □ Suds □ Oil Sheen □ Excessive Algae □ Other	
Pipe Benthic Growth	☐	□ Brown □ Orange □ Green □ Other	
Sediment	☐	□ No □ Partially □ Full	
Rip-rap/ Energy Dissipation	☐	□ Good □ Fair □ Poor □ N/A	
Other Observations:			

Skip sections 5 and 7 if no flow is present.

Section 3: Quantitative Characterization for flowing outfalls ONLY

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	_____' _____"	Sec	Stop Watch
Temperature			^{o}F	Thermometer
pH			pH Units	Test strip/ Probe
Ammonia			mg/L	Test strip

Section 4: Physical Characteristics/ Indicators for flowing outfalls ONLY

Indicator	Check if present	Decription	Relative Severity Index (1-3)
Odor	☐	□ Sewage □ Rancid/Sour □ Sulfide □ Petroleum/gas □ Other	□ 1- Faint □ 2- Easily Detected □ 3- Noticible 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	☐	Severity	□ 1- Slight Cloudiness □ 2- Cloudy □ 3- Opaque
Floatables Do not Include Trash*	☐	□ Sewage (Toilet Paper, etc) □ Suds □ Petroleum (Oil Sheen) □ Other	□ 1- Few/ Slight □ 2- Some □ 3- Some; Origin Clear
Comment:			

Section 5: Data Collection

Sample Collected: □ Yes □ No **Sample ID: _____**

Sample for Lab: □ Yes □ No *If yes* , **Collected From:** □ Flow □ Pool

Section 6: Overall Outfall Characterizations

Overall Conditions: □ Good □ Fair[1] □ Poor[2] □ Critical

Good: no damages or indicators present

[1] Fair: Presence of two or more indicators with low severity

[2] Poor: One or two indicators with a severity of 3

Critical: more than two indicators with severity of 3

illicit Discharge □ Unlikely □ Potential[1] □ Suspect[2] □ Obvious

Unlikely: non-flowing outfalls with no physical indicat

[1] Potential: Presence of two or more indicators

[2] Suspect: flowing outfalls with high severity on 1 or more indicators

Obvious: discharge does not require sample collection confirmation

Section 7: Recommendations

□ Investigate Illicit Discharge Corrective Action:_____ Priority: □ 1 □ 2 □ 3

□ Infrastructure Repairs Needed Corrective Action:_____ Priority: □ 1 □ 2 □ 3

□ Debris Removal Needed Corrective Action:_____ Priority: □ 1 □ 2 □ 3

Priority 1: Inmediate action is required *Priority 2: Needs attention* *Priority 3: Regular Maintenance*

Comments:

Notes:

[*]Trash is not an indicator of illicit discharges, but it should be noted

APPENDIX C:

Emergency Phone Numbers

Emergency Phone Numbers

Environmental Health and Safety Office (EHS)

- Erica Livingston, Environmental Compliance Officer
  4400 University Drive MS 5G8
  Fairfax Virginia, 22030
  Office Phone: (703) 993-1766
  Cellular Phone: (703)926-3583
  Home (Cellular) Phone: (412) 965-0960

Facilities Administration

- Brad Glatfelter, Project Engineer Land Development
  4400 University Drive MS 2C1
  Fairfax Virginia, 22030
  Office Phone: (703) 993-4051
  Cellular Phone: (571) 265-1977
  Home (Cellular) Phone: (717) 332-2825

- Diana Villa, Project Engineer Land Development
  4400 University Drive MS 2C1
  Fairfax Virginia, 22030
  Office Phone: (703) 993-5043
  Cellular Phone: (571) 205-9177

- Robbie Houser, ESC Inspector
  4400 University Drive MS 2C1
  Fairfax Virginia, 22030
  Office Phone: (703) 993-
  Cellular Phone: (571)499-9438

APPENDIX D:

Typical Outfalls

 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)

Typical Outfall Types Found in the Field

Source: U.S. EPA Illicit Discharge Detection and Elimination: A Guidance Manual

APPENDIX E:

Interpreting Indicators/ Determining Severity of Indicators

Color: Brown; Severity: 2
Turbidity Severity: 2

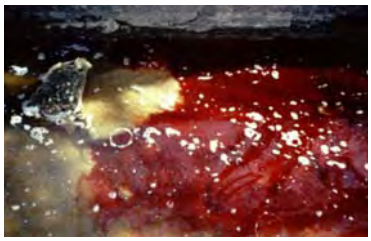
Chromium Spill
Color: Green; Severity: 3
Turbidity Severity: None

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)

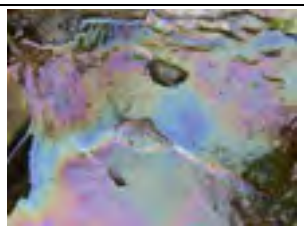
Slight Turbidity
Turbidity: 1
(Difficult to interpret this observation; May be natural or an illicit discharge)

Construction Site Discharge
Turbidity Severity: 3

Discharge of Rinse from Floor Sanding (Found during wet weather)
Turbidity Severity: 3

Interpreting Color and Turbidity

Source:U.S.EPA Illicit Discharge Detection and Elimination: A Guidance Manual 2008

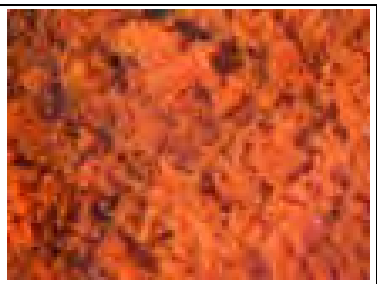
SUDS		
 Natural Foam Note: Suds only associated with high flows at the “drop off” Do not record.	 Low Severity Suds Rating: 1 Note: Suds do not appear to travel; very thin foam layer	 High severity suds Rating: 3 Sewage
OIL SHEENS		
 Low Severity Oil Sheen Rating: 1	 Moderate Severity Oil Sheen Rating: 2	 High Severity Oil Film Rating: 3

Determining the Severity of Floatables

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 suds

Source:U.S.EPA Illicit Discharge Detection and Elimination: A Guidance Manual 2008

Bacterial growth at this outfall indicates nutrient enrichment and a likely sewage source.



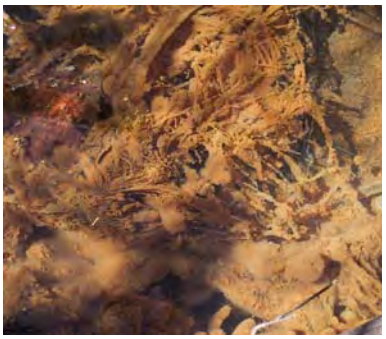
This bright red bacterial growth often indicates high manganese and iron concentrations. Surprisingly, it is not typically associated with illicit discharges.

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.

Interpreting Benthic and Other Biotic Indicators

Source:U.S.EPA Illicit Discharge Detection and Elimination: A Guidance Manual 2008

 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.

Typical Findings at both Flowing and Non-Flowing Outfalls

Source:U.S.EPA Illicit Discharge Detection and Elimination: A Guidance Manual 2008