How You Know An IDDE Investigator?
Agenda: AM

• IDDE 101
• IDDE & Water Quality
• Desktop Analysis & Prioritizing
• Indicator Methods
• Hampton Roads Discussion
• Fixing/Source Tracking
Agenda: PM

Break-Out 1
• Field Investigations
• Hands-On Use of Testing Kits

Break-Out 2
• Expert Panel Protocols – Crediting Discharge Elimination
• Hands-On Exercises & Discussion
What is an Illicit Discharge?

A dry weather discharge to the storm sewer system that contains pollutants except:

i. discharges pursuant to a NPDES permit and

ii. discharges resulting from fire fighting activities (40 CFR 122.26)
IDDE Guidance Manual

- Joint EPA-funded project between CWP and University of Alabama
- 8 Program Components
- Desktop Methods
- Field and Lab Protocols
- Model Ordinance
- Technical Appendices
- Download at www.cwp.org or http://cfpub.epa.gov/npdes/
What are common illicit discharges?

**Sewage:**
- Broken or leaking sanitary sewer line
- Sewer cross-connections
- Connection of floor drains to storm sewer
- Sanitary sewer overflows
- Pump station failure
- Straight-pipe sewer discharge
- Failing septic systems

**Miscellaneous**
- Concrete washout water
- Illegal dumping practices: motor oil, paint
- Restaurant grease

**Wash Water**
- Laundry wash water
- Commercial car washing
- Floor drains connected to stormwater pipes
Sources of Illicit Discharges

- Illegal dumping practices (95%)
- Broken sanitary sewer line (81%)
- Cross-connections (71%)
- Connection of floor drains to storm sewer (62%)
- Sanitary sewer overflows (52%)
- Inflow / infiltration (48%)
- Straight pipe sewer discharge (38%)
- Failing septic systems (33%)
- Improper RV waste disposal (33%)
- Pump station failure (14%)
Discharge Frequency

- Continuous discharges
- Intermittent discharges
- Transitory discharges
Continuous Discharges

- Occur all or most of the time
  - Broken sewage pipes
  - Direct connections (sometimes)
- Worst pollutant source
- Easiest to find
- Best way to find them: comprehensive outfall surveys and tracking to source
Sanitary Sewer Cross Connections

Image credit: Amick and Burgess (2000)
Sewer Pipe Leakage
Intermittent Discharges

- Occur over a shorter period of time (e.g., a few hours per day or a few days per year)
- Likely to come back
- May “miss them” if you don’t look for clues and patrol regularly
- Best way to find them: Look for signs of past flow; look at different hours/days; use hotlines or citizen reporting
Laundry Washwater

- Laundry water directly or indirectly connected to storm drain system
Commercial Car Washing

• Wash water drains to the storm drain system
Floor Drains

- Directly connected to storm drain system
Mop Water Dumping
Transitory Discharges

• Occur once or infrequently
• Examples Include:
  • Spills
  • One-Time Dumping
• Best way to deal with them: education, prevention, safety plans, hotlines
Paint wash

- Washing out brushes and buckets on the ground or into storm drains
Chemical and oil leaks/dumping
Concrete washout

- Washing out concrete truck without proper containment
Concrete washout

The right way!
Relationship To Good Housekeeping

- Sites where routine operations can generate indirect discharges
- Discharges are generally intermittent or transitory
- Generating sites can be identified and discharges can be prevented
<table>
<thead>
<tr>
<th>Land Use</th>
<th>Generating Site</th>
<th>Example Discharges</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential</td>
<td>Apartments, multi-family, single family homes</td>
<td>Septic, dumping, swimming pools, car washing</td>
</tr>
<tr>
<td>Commercial</td>
<td>Car dealers, commercial laundry, marinas, restaurants</td>
<td>Outdoor washing, food waste disposal, vehicle maintenance and repair, power washing, dumpster juice</td>
</tr>
<tr>
<td>Industrial</td>
<td>Auto recyclers, metal plating, paper and wood, printing</td>
<td>Rinse, process, wash, and cooling water disposal; spills and leaks; leaking underground storage tanks</td>
</tr>
<tr>
<td>Institutional</td>
<td>Churches, hospitals, schools / universities</td>
<td>Vehicle maintenance and repair; power washing, outdoor storage, loading/unloading (washdowns / spills)</td>
</tr>
<tr>
<td>Municipal</td>
<td>Public works yards, airports, ports, landfills, municipal fleet storage areas</td>
<td>Outdoor fluid storage, vehicle maintenance and repair, power washing, dumping / spills</td>
</tr>
</tbody>
</table>
Regulatory Context

Permit No.: VA0088625
Effective Date: [5 years after effective date]
Expiration Date: [5 years after effective date]

AUTHORIZATION TO DISCHARGE UNDER THE VIRGINIA STORMWATER MANAGEMENT PROGRAM AND THE VIRGINIA STORMWATER MANAGEMENT ACT

VIRGINIA REGISTER OF REGULATIONS

TABLE OF CONTENTS
- Register Information Page .............................................. 2087
- Publication Schedule and Deadlines ............................... 2088
- Petitions for Rulemaking ............................................... 2089
- Notices of Intended Regulatory Action ......................... 2090
- Regulations adopted ......................................................... 2091
- Information, monitoring .................................................. 2092
Phase II

- Storm sewer map
- Ordinance or other legal mechanism to prevent discharges
- Written procedures
- Program plan & annual reporting
Written Procedures

- Field screening
- Schedule
- Methodologies

- Tracking
- Public reporting

Table 3. Illicit Discharge Tracking Sheet

<table>
<thead>
<tr>
<th>Date Illicit Discharge Observed &amp; Reported:</th>
<th>Report Initiated by: Phone, drop-in, contact information, etc.</th>
<th>Location of Discharge: If known – lat/long, stream address or outfall #, nearby landmark, etc.</th>
<th>Description of Discharge: E.g. – dumping, wash water, suds, oil, etc.</th>
<th>Actions to be Taken: Who, What, When and How…(what should be done)</th>
<th>Results &amp; Follow-Up of Investigation: Outcome of Actions taken and any necessary follow-up (what was done)</th>
<th>Date Investigation Resolved or Closed:</th>
</tr>
</thead>
<tbody>
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</tr>
</tbody>
</table>
Phase II MS4 Minimum Measure #3
Schedule (Table 1)

What MS4s HAVE To Do

<table>
<thead>
<tr>
<th>IDDE Procedures</th>
<th>12 months from coverage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outfall Map</td>
<td>48 months, keep updated</td>
</tr>
</tbody>
</table>
Phase 1

- Notes allowable discharges unless significant pollutant source
- 189,000 lf of sanitary sewer inspections (annual)
- Reduce floatables, oils, fluids, hazardous waste, grass clippings, etc.
- “Dry” weather screening
- Eliminate discharges within 30 days or other plan
- Spill response
- Industrial & high risk runoff – inspections every 5 years
Field Guide & Procedures

• Common Pollution Problems

• Illicit Discharge Characteristics
  o Odor
  o Color
  o Turbidity
  o Floatables

• Written Procedures

• WILL be adapted to HR Area
Recommendations of the Expert Panel to Define Removal Rates for the Elimination of Discovered Nutrient Discharges from Grey Infrastructure

FINAL APPROVED REPORT

Submitted by:
Marianne Walch, Megan Brosh, Lori Lilly, Jenny Tribb, June Whitehurst, Barbara Brunbaugh, Diana Handley, Mark Hoskins, Kevin Ut, Robert Pitt, Tanya Spano and Whitney Katchmark.

Approved by Urban Stormwater Workgroup: September 23, 2014
Approved by Watershed Technical Workgroup: November 6, 2014
Approved by Water Quality Goal Implementation Team: November 10, 2014

Photo credit: Arlington County DES

Prepared by:
Tom Schnieder and Cetlins Lane, Chesapeake Stormwater Network
Bill Stock, Center for Watershed Protection, Inc.

• Enhanced Program
• Individual Discharge Removal & Documentation
# Program Self-Assessment

## IDDE Program Self Assessment

### Gathering Basic Information

The first portion of the self assessment focuses on gathering basic information about the community’s infrastructure and general water quality concerns.

<table>
<thead>
<tr>
<th>Infrastructure Profile</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>What is the total area of the jurisdiction?</td>
<td></td>
</tr>
<tr>
<td>What is the total area regulated under the MS4?</td>
<td></td>
</tr>
<tr>
<td>How many miles of streams exist in the jurisdiction?</td>
<td></td>
</tr>
<tr>
<td>How many miles of storm drains exist in the jurisdiction?</td>
<td></td>
</tr>
<tr>
<td>What total area is serviced by storm drains?</td>
<td></td>
</tr>
<tr>
<td>What is the general age and condition of the infrastructure?</td>
<td></td>
</tr>
<tr>
<td>How many storm drain outfalls exist in the jurisdiction?</td>
<td></td>
</tr>
<tr>
<td>What total area is serviced by sanitary sewers?</td>
<td></td>
</tr>
<tr>
<td>What total area is serviced by septic systems?</td>
<td></td>
</tr>
<tr>
<td>What total area is serviced by a combined sewer system?</td>
<td></td>
</tr>
<tr>
<td>What total area is serviced with water lines carrying treated drinking water?</td>
<td></td>
</tr>
<tr>
<td>What total area is serviced by wells?</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Land Use</th>
<th></th>
</tr>
</thead>
</table>
Hampton Roads
IDDE Workshop

IDDE & Water Quality

June 13, 2016
HRPDC
Discharge Flow Types

- Pathogenic & toxic discharges
  - Sanitary wastewater
  - Commercial & Industrial discharges

- Nuisance & aquatic life threatening discharges
  - Landscaped irrigation runoff
  - Construction site dewatering
  - Automobile washing
  - Laundry wastes

- Unpolluted discharges
  - Infiltrating groundwater
  - Natural springs
  - Domestic water line leaks
Mode of Entry

Direct entry
- Sewage, industrial, commercial cross-connection
- Straight pipe

Indirect entry
- Groundwater seepage
- Spills
- Dumping
- Outdoor washing activities
- “Nuisance” or non-target water
Discharge Frequency

- **Continuous discharges**
  - Occur *most or all of the time*

- **Intermittent discharges**
  - Occur over a *shorter period of time* (e.g., a few hours per day or a few days per year)

- **Transitory discharges**
  - Occur *rarely*, usually in response to a singular event such as an industrial spill, ruptured tank, sewer break, transport accident or illegal dumping episode
# Wastewater

<table>
<thead>
<tr>
<th>Color</th>
<th>Odor</th>
<th>Effects on Water</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gray</td>
<td>Sewage</td>
<td>Lowers oxygen / kills life; contributes pathogenic bacteria</td>
</tr>
</tbody>
</table>

“Sewage Fungus” – a filamentous bacterium, appears after 2-3 days of continuous sewage discharge

“Floatables” – TP, suds
Western Run
Dry Weather Load from Flowing Outfalls as Percent of Instream Load

0.0% 20.0% 40.0% 60.0% 80.0% 100.0% 120.0%

Total Nitrogen (lb/yr) Total Phosphorus (lb/yr) Volume (MG/yr)

- All outfalls
- Potential Illicit Discharges (exceed any criteria)
- Load - Confirmed Sewage Discharge

People exploring the river with equipment, glasses, and maps.
Illicit discharges in pipes <36” in diameter (Lilly & Sturm, 2010)

- 45% of all potential illicit flows
- 100% of small pipes with dry weather flow exceeded 1 or more criteria
- Volume: 49-146 MG/yr
- TP: 26-78 lb/yr
- TN: 726-2,179 lb/yr
- Avg. E. coli concentration: 16,714 CFU/100ml
Case Study – Salisbury, MD

April 19, 2011

Petroleum smell
Ammonia: 0.27 mg/l
E. coli: 13,200 CFU/100 ml
**IDDE Cost-effectiveness Case Study – Salisbury, MD**

<table>
<thead>
<tr>
<th></th>
<th>Total Nitrogen</th>
<th>Total Phosphorus</th>
</tr>
</thead>
<tbody>
<tr>
<td>Illicit Discharge Daily Load</td>
<td>9.9 lbs</td>
<td>0.3 lbs</td>
</tr>
<tr>
<td>Illicit Discharge Annual Load</td>
<td>3,614 lbs</td>
<td>110 lbs</td>
</tr>
<tr>
<td>Actual cost to repair</td>
<td>$1,000</td>
<td></td>
</tr>
<tr>
<td>Cost / pound reduced (annual)</td>
<td>$0.28</td>
<td>$9.09</td>
</tr>
</tbody>
</table>
TN load: 120-359 lb/yr
TP load: 43-128 lb/yr

= 143 ½-acre bioretentions to treat TP (49 to treat TN); cost of 590-1,700 K
## Washwater

<table>
<thead>
<tr>
<th>Floatable</th>
<th>Odor</th>
<th>Effects on water</th>
</tr>
</thead>
<tbody>
<tr>
<td>Suds</td>
<td>Sweet, fruity, detergent, chlorine</td>
<td>Destroys the external mucus layers that protect fish from bacteria and parasites; causes severe damage to the gills.; kills fish eggs; decreases surface tension of water and increases the potential for contaminants to be absorbed.</td>
</tr>
</tbody>
</table>

Puget Sound study – “A single uncontrolled residential car wash activity might be inconsequential, however, when extrapolated over an entire urban area for a year, the pollutant loading becomes significant.”

- Petroleum hydrocarbon waste: gasoline, diesel, and motor oil (estimated 190 gallons of annual mass loading).
- Nutrients: phosphorous and nitrogen (estimated 400 pounds of annual mass loading).
- Ammonia (estimated 60 pounds of annual mass loading).
- Surfactants (estimated 2,200 pounds of annual mass loading)
- Solids (estimated 30,000 pounds of annual mass loading).
Maple Ave ID Investigations
Takoma Park, MD

Maple Ave - 550 acres
Maple Ave Outfall

- Suds discharges known to occur frequently
- Smells like detergent
- Any patterns on times of day or days of the week when these are seen?
- Enter the Moultrie game camera...
Maple Ave Outfall Suds Discharges
Suds Tracking

- 12/3-12/17/2015
- ~70 suds discharges detected

<table>
<thead>
<tr>
<th>Time Interval</th>
<th>Number of Occurrences</th>
</tr>
</thead>
<tbody>
<tr>
<td>0:00-3:00</td>
<td>3:00-6:00</td>
</tr>
<tr>
<td>6:00-9:00</td>
<td>9:00-12:00</td>
</tr>
<tr>
<td>12:00-15:00</td>
<td>15:00-18:00</td>
</tr>
<tr>
<td>18:00-21:00</td>
<td>21:00-24:00</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Day of the Week</th>
<th>Number of Occurrences</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mon</td>
<td>10</td>
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<td>Tues</td>
<td>8</td>
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<tr>
<td>Wed</td>
<td>6</td>
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<td>Thurs</td>
<td>14</td>
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<tr>
<td>Fri</td>
<td>7</td>
</tr>
<tr>
<td>Sat</td>
<td>5</td>
</tr>
<tr>
<td>Sun</td>
<td>15</td>
</tr>
</tbody>
</table>
Other Pollutants: Air Conditioner Condensate...??

- 86 sites visited
- 38% of sites had a discharge
- All discharges (n=33) exceeded ammonia threshold of 0.2 mg/l, 58% > 5.0 mg/L
- All samples (n=9) exceeded water quality standards for zinc and copper

Figure 3. Heavy metal concentrations from HVAC discharges (n = 9).
Sources of Contamination in HVAC Discharges

- Microbial biocides
- Illicit cooling tower water
- Copper piping
- Refrigerant leaks

Table 4. Measured pollutant load estimates from all discharges (n = 33).

<table>
<thead>
<tr>
<th>Pollutant</th>
<th>50%-100% Annual Load, 150 Days (lb/year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Nitrogen</td>
<td>14.0–28.0</td>
</tr>
<tr>
<td>Copper</td>
<td>0.6–1.1</td>
</tr>
<tr>
<td>Zinc</td>
<td>0.5–1.0</td>
</tr>
</tbody>
</table>

- 5-30% ammonium chloride
- Kills bacteria that cause Legionnaires
- Toxic to aquatic organisms and should not be released into the environment
Conclusion

• Illicit discharges have varying toxicity, modes of entry and frequency patterns.
• These factors determine their overall impact to water quality.
• Continuous discharges typically have the most impact, even with small volumes.
• Intermittent discharges can also have a big impact on water quality but can be much harder to track down.
Desktop Analysis & Prioritization

June 13, 2016
HRPDC
Desktop Analysis of Illicit Discharge Potential (IDP)

- A method of developing a targeted approach to identify priority areas subject to a higher rate of illicit discharges, while using a GIS-based program

- Answers the question ... “Where should we focus our resources?”
GIS-based Analysis:

1. Delineate subwatersheds
2. Compile mapping and data
3. Compute discharge screening factors
4. Characterize IDP across subwatersheds
5. Generate maps to support field investigation
1. Delineate Subwatersheds
2. Available Data
“Wish List” of GIS Data (Screening Factors)

- Past Discharge Complaints
- Poor Dry Weather Water Quality
- Density of Generating Sites
- Density of Industrial NPDES Permits
- Stormwater Outfall Density
- Age of Subwatershed Development
- Water Monitoring Data
- Former Combined Sewers
- Older Industrial Operations
- Aging or Failing Sewers
- Density of Older Septic Systems
- Past Sewer Conversions

Collaborate to prioritize and develop a robust GIS dataset
### 3. Calculate Discharge Screening Factors

<table>
<thead>
<tr>
<th>Watershed Name</th>
<th>Commercial (Acres)</th>
<th>%</th>
<th>Industrial (Acres)</th>
<th>%</th>
<th>Total Wsd Acres in MS4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cocalico Creek</td>
<td>1.97</td>
<td>0.07</td>
<td>7.21</td>
<td>0.24</td>
<td>2943.48</td>
</tr>
<tr>
<td>Conestoga River</td>
<td>37.42</td>
<td>1.46</td>
<td>3.77</td>
<td>0.15</td>
<td>2563.17</td>
</tr>
<tr>
<td>Maiden Creek</td>
<td>438.50</td>
<td>1.61</td>
<td>1129.77</td>
<td>4.15</td>
<td>27204.73</td>
</tr>
<tr>
<td>Manatawny Creek</td>
<td>104.04</td>
<td>0.68</td>
<td>341.26</td>
<td>2.24</td>
<td>15203.89</td>
</tr>
<tr>
<td>Perkiomen Creek</td>
<td>64.99</td>
<td>1.26</td>
<td>28.82</td>
<td>0.56</td>
<td>5162.45</td>
</tr>
<tr>
<td>Sacony Creek</td>
<td>5.38</td>
<td>0.28</td>
<td>5.26</td>
<td>0.28</td>
<td>1910.62</td>
</tr>
<tr>
<td>Schuylkill</td>
<td>3700.19</td>
<td>3.97</td>
<td>4193.85</td>
<td>4.50</td>
<td>93148.72</td>
</tr>
<tr>
<td>Swamp Creek</td>
<td>286.04</td>
<td>3.88</td>
<td>610.16</td>
<td>8.28</td>
<td>7369.76</td>
</tr>
<tr>
<td>Tulpehocken Creek</td>
<td>1379.10</td>
<td>3.86</td>
<td>592.46</td>
<td>1.66</td>
<td>35701.74</td>
</tr>
</tbody>
</table>
4. Prioritize Subwatersheds Using IDP Screening Factors

<table>
<thead>
<tr>
<th>Subwatershed</th>
<th>Past discharge complaints</th>
<th>Poor dry weather WQ</th>
<th>Density of SW outfalls</th>
<th>Average age of dev.</th>
<th>Raw IDP score</th>
<th>Normalized IDP score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subwatershed A</td>
<td>8 (2)</td>
<td>30% (2)</td>
<td>14 (2)</td>
<td>40 (2)</td>
<td>8</td>
<td>2</td>
</tr>
<tr>
<td>Subwatershed B</td>
<td>3 (1)</td>
<td>15% (1)</td>
<td>10 (2)</td>
<td>10 (1)</td>
<td>5</td>
<td>1.25</td>
</tr>
<tr>
<td>Subwatershed C</td>
<td>13 (3)</td>
<td>60% (3)</td>
<td>16 (2)</td>
<td>75 (3)</td>
<td>11</td>
<td>2.75</td>
</tr>
<tr>
<td>Subwatershed D</td>
<td>1 (1)</td>
<td>25% (1)</td>
<td>9 (1)</td>
<td>15 (2)</td>
<td>5</td>
<td>1.25</td>
</tr>
</tbody>
</table>

Basis for Assigning Scores...

<table>
<thead>
<tr>
<th>Past discharge complaints/reports (total # logged)</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 5</td>
<td>5 - 10</td>
<td>&gt; 10</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Dry weather water quality (# times bacteria stds exceeded)</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 25%</td>
<td>25 - 50%</td>
<td>&gt; 50%</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Storm water outfall density (# outfalls / stream mile)</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 10</td>
<td>10 - 20</td>
<td>20</td>
<td></td>
</tr>
</tbody>
</table>

| Average age of development (years)                      | 1  | 2  | 3  |
|------------------------------------------------ --------|----|----|----|
| < 25                                                     | 25 - 50 | > 50 |
5. Results Shown by Subwatershed

Key:
- Yellow: Low IDP risk
- Orange: Medium IDP risk
- Red: High IDP risk

- Minimal Illicit Discharge Problems
- Severe Illicit Discharge Problems
- Clustered Illicit Discharge Problems
EXAMPLE
Stafford County, VA
(slides courtesy of Paul Santay)
Aerial Photo: Intersection of Jefferson Davis Highway & Foreston Woods Drive. Austin Run (VA Impaired Water) from west-to-east
GIS layer (ZONING DISTRICT) added:
R1 & R3 – Residential; B2 – Commercial; M1 & M2 – Industrial
GIS layer (OUTFALLS & BMP) added:
Green Dot – Outfalls (ACoE); Yellow Dot (BMPs)
Aerial Photo: Only include OUTFALLS within 500 ft.
Prioritization

Courtesy: Keri Lindberg, Maine Healthy Beaches
## Prioritization

**Courtesy: Keri Lindberg, Maine Healthy Beaches**

<table>
<thead>
<tr>
<th></th>
<th>High Bacteria</th>
<th>Low Bacteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>High Optical Brightener</td>
<td>Black water (e.g. human sources-malfunctioning septic system, sanitary sewer cross connection)</td>
<td>Grey or Gray water (e.g. laundry, wash water)</td>
</tr>
<tr>
<td>Low Optical Brightener</td>
<td>Human or non-human sources</td>
<td>Potentially low or no fecal contamination</td>
</tr>
</tbody>
</table>
Prioritization

Courtesy: Keri Lindberg, Maine Healthy Beaches
Prioritization

Courtesy: Keri Lindberg, Maine Healthy Beaches

- Transforming data to usable information
- Priority areas to survey for malfunctioning septic systems
- Multiple towns & agency partners share data & remediation strategies

GIS: Risk Analysis

- Monitoring data
- Within 250' of coast/river/tidal zone
- Slope > 20%
- Within 250' of Waterbody/wetland
- Within 250' of an Impervious Surface
- Within 75' of a Stream
Desktop Assessment
Benefits

• GIS or other database system to track outfalls

• Understand severity of IDDE problems

• Creating basic mapping for IDDE field work

• Prioritize field efforts to find and fix illicit discharges
Hampton Roads
IDDE Workshop

Indicator Methods

June 13, 2016
HRPDC
Visual Indicators of Pollution at Outfall Pipes

Outfall Damage
Deposits/Stains
Abnormal Vegetation
Poor Pool Quality
Pipe Benthic Growth
## Indicators

<table>
<thead>
<tr>
<th>Source</th>
<th>Indicator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wastewater</td>
<td>Gray, sewage odor, sewage fungus, floatables</td>
</tr>
<tr>
<td>Washwater</td>
<td>Suds, detergent or sweet smell</td>
</tr>
<tr>
<td>Sediment</td>
<td>Orange/brown color</td>
</tr>
<tr>
<td>Tap water</td>
<td>Chlorine smell (maybe)</td>
</tr>
<tr>
<td>Paint</td>
<td>Color, turbidity</td>
</tr>
<tr>
<td>Concrete washout</td>
<td>Turbidity</td>
</tr>
<tr>
<td>Industrial</td>
<td>Color, odors</td>
</tr>
</tbody>
</table>
Foam

“Natural” foam
• Formed when organic matter decomposes
• Can be caused by turbulence (e.g. Waterfalls)
• Does not “last”
• Brownish / tannish edges

“Un-natural” Foam
• Has “staying” power
• Whiter
• May have an odor

Jury is out – a water sample is needed for a definitive answer
Iron Floc

• Normally a naturally occurring phenomenon resulting from iron bacteria growth.
• These harmless bacteria "bloom" when oxygen, water and iron combine. The bacteria are typically rust-colored and appear oily.
• Generally associated with acidic soils.
• May be especially evident after heavy rains, when iron leaches from the soil.
Sheens can occur from naturally occurring bacteria - these break into pieces when touched with a stick or other object.

Petroleum-based sheens break apart and then come back together when disturbed.
Chemical Indicator monitoring

• Purpose:
  • Identify problem outfalls not apparent from physical indicators / visual assessments alone
  • Verify suspect or problem outfalls for confirmation of the presence of an illicit discharge
  • Determine potential flow type
  • Provide more information on intermittent discharges
Indicators to Identify Sources of Contamination

Ideal indicator to identify major flow sources has the following characteristics:

- Significant difference in concentrations between possible pollutant sources;
- Small variations in concentrations within each likely pollutant source category;
- Conservative behavior (i.e., no significant concentration change due to physical, chemical or biological processes);
- Ease of measurement with adequate detection limits, good sensitivity and repeatability.
Simple and Inexpensive Analytical Methods

- Can be used in the field, but usually much easier, safer, and more efficient in lab
- Comparative colorimetric methods (apparent color, detergents after extraction)
- Simple probes (pH, conductivity, ion selective potassium)
- Spectrophotometric (fluoride, ammonia, boron)
Equipment Considerations

- Accuracy (proximity to true value)
- Precision (repeatability or reproducibility)
- Range (min and max)
- Single parameter vs multi-parameter
- Waste
- Portability
- Safety
- Cost – up-front, per sample, standards/buffer solutions/sterile dilution bottles, carrying cases
IDDE Flow Chart
(Brown et al, 2004)
Flow Chart Should Be Modified for Your Community

- Ammonia
  - Ammonia/potassium ratio > 0.36
    - Potential Wastewater
  - Surfactants > 0.5 mg/L
  - Fluoride 0.25-0.7 mg/L
  - Likely Tap or Irrigation Water
- Discharge of Unknown Origin or Blend
- Likely Groundwater

Center for Watershed Protection
Single Parameter Screening

• Detergents
  o Best single parameter to detect illicit discharge
  o Analysis best conducted in controlled lab setting
• Ammonia
  o Concentrations >1mg/L is positive indicator of sewage
  o Analysis in field using portable spectrophotometer or colorimeter
## Industrial Indicators

<table>
<thead>
<tr>
<th>Benchmark</th>
<th>Concentration</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Ammonia (mg/L)</strong></td>
<td>≥ 50</td>
<td>- Existing “Flow Chart” Parameter&lt;br&gt;- Concentrations higher than the benchmark can identify a few industrial discharges</td>
</tr>
<tr>
<td><strong>Potassium (mg/L)</strong></td>
<td>≥ 20</td>
<td>- Existing “Flow Chart” Parameter&lt;br&gt;- Excellent indicator of a broad range of industrial discharges</td>
</tr>
<tr>
<td><strong>Color (Units)</strong></td>
<td>≥ 500</td>
<td>- Supplemental parameter that identifies a few specific industrial discharges</td>
</tr>
<tr>
<td><strong>Conductivity (µS/cm)</strong></td>
<td>≥ 2,000</td>
<td>- Identifies a few industrial discharges&lt;br&gt;- May be useful to distinguish between industrial sources</td>
</tr>
<tr>
<td><strong>Hardness (mg/L as CaCO₃)</strong></td>
<td>≤ 10&lt;br&gt;≥ 2,000</td>
<td>- Identifies a few industrial discharges&lt;br&gt;- May be useful to distinguish between industrial sources</td>
</tr>
<tr>
<td><strong>pH (Units)</strong></td>
<td>≤ 5</td>
<td>- Only captures a few industrial discharges&lt;br&gt;- High pH values may also indicate an industrial discharge but residential wash waters can have a high pH as well</td>
</tr>
<tr>
<td><strong>Turbidity (NTU)</strong></td>
<td>≥ 1,000</td>
<td>- Supplemental parameter that identifies a few specific industrial discharges</td>
</tr>
</tbody>
</table>
Chemical Fingerprint Library

- Shallow Groundwater
- Spring Water
- Tap water
- Irrigation
- Sewage
- Septic Tank Discharge
- Common Industrial Discharges
- Commercial Car Wash
- Commercial Laundry
# Richmond Chemical Fingerprint Library

<table>
<thead>
<tr>
<th>Sampling Location</th>
<th>Fluoride</th>
<th>Total Coliform P/A-Colilert</th>
<th>Conductivity Anionic detergents</th>
<th>Ammonia</th>
<th>Total nitrogen</th>
<th>Total phos</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Commercial Car Wash</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>4.626</td>
<td>375.680</td>
<td>75.640</td>
<td>0.948</td>
<td>9.797</td>
<td></td>
</tr>
<tr>
<td>Weighted Mean</td>
<td>1.863</td>
<td>379.821</td>
<td>39.636</td>
<td>1.169</td>
<td>9.797</td>
<td></td>
</tr>
<tr>
<td>Std Dev</td>
<td>5.711</td>
<td>137.502</td>
<td>54.444</td>
<td>1.909</td>
<td>9.322</td>
<td></td>
</tr>
<tr>
<td>COV</td>
<td>32.619</td>
<td>18,906.727</td>
<td>2,964.197</td>
<td>3.643</td>
<td>86.908</td>
<td></td>
</tr>
<tr>
<td><strong>Commercial Laundry</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>23.678</td>
<td>554.615</td>
<td>22.723</td>
<td>0.958</td>
<td>11.247</td>
<td></td>
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<tr>
<td>Weighted Mean</td>
<td>8.255</td>
<td>591.750</td>
<td>13.325</td>
<td>1.047</td>
<td>11.247</td>
<td></td>
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<tr>
<td>Std Dev</td>
<td>18.837</td>
<td>257.993</td>
<td>10.580</td>
<td>0.409</td>
<td>7.129</td>
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<tr>
<td>COV</td>
<td>354.818</td>
<td>66,560.423</td>
<td>111.945</td>
<td>0.167</td>
<td>50.823</td>
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<tr>
<td><strong>Drinking Water</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>0.695</td>
<td>31.000</td>
<td>144.769</td>
<td>0.008</td>
<td>0.056</td>
<td>1.100</td>
</tr>
<tr>
<td>Weighted Mean</td>
<td>0.691</td>
<td>31.000</td>
<td>149.286</td>
<td>0.014</td>
<td>0.088</td>
<td>1.100</td>
</tr>
<tr>
<td>Std Dev</td>
<td>0.076</td>
<td>20.985</td>
<td>0.021</td>
<td>0.139</td>
<td></td>
<td></td>
</tr>
<tr>
<td>COV</td>
<td>0.006</td>
<td>440.359</td>
<td>0.000</td>
<td>0.019</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Ground Water</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>0.097</td>
<td>158.467</td>
<td>0.019</td>
<td>0.053</td>
<td>8.067</td>
<td></td>
</tr>
<tr>
<td>Weighted Mean</td>
<td>0.075</td>
<td>164.444</td>
<td>0.031</td>
<td>0.051</td>
<td>8.067</td>
<td></td>
</tr>
</tbody>
</table>
Q/A
Hampton Environmental Services

Illicit Discharge Detection & Elimination
Tracking and Enforcement Procedures
Environmental Services

- Mosquito Control
  - Outreach & Education
  - Surveillance
  - Disease Testing
  - Larval Control
  - Adult Control

- Aquatic Herbiciding

- Rodent Control
  - Inspection & Abatement
  - Muskrat Relocation

- NPDES Programs
  - SWMF Inspection
  - Illicit Discharge Program
  - NewMarket Creek Inspection

Vertebrate & Invertebrate Information Hub
Illicit Discharge Detection & Elimination

311 Call Center

Field Screening
* Routine Investigations
* Stormwater Employee Calls

60 Potential Discharge Sites Tested per Fiscal Year

Inter-Departmental Investigations
* Wastewater Department
* Fire Department

Desktop Assessment
* Gas Stations
* Auto-Body Repair Shops
* Car Wash Practices
* Industrial / Commercial Business Complexes
* Ongoing Construction Projects

VPDES Permitted Sites Through DEQ
Testing Procedures

- Use of Photometer 9500
  - Ammonia
  - Bromine
  - Chlorine LR
  - Copper
  - Phosphate LR
  - Phenols
- Detergents
- pH and Temperature Meter
- Refractometer
- E. Coli
Tracking Procedures

Flow found in outfall during Dry Weather Conditions

Thresholds not reached
- Re-visit up to two additional Times during the permit cycle. Ideally, at a different time and day of the week.

Thresholds reached
- Drainage Investigation:
  - Typically done by at least two inspectors
  - Use of GIS mapping to follow flow through stormdrains to Discharge location.

Illicit Discharge indicators Found during Wet Weather Conditions
Enforcement Procedures

• Introduction and Purpose of Visit
• Compliance is main goal
• Paperwork is given explaining violation
• Meet with Stormwater and Legal Team to discuss if fines are to be given.
• Notice of Violation letter sent via Certified Mail to formally address violation and/or levy fines.
Example #1
Example #2
Example #3
Key Notes to Enforcement

• Keep data at all times
  – Photographs
    (Date and Time Stamps)
  – Paperwork, Business Cards, Contacts
  – Certified Letters

• Communication
  – Operations Team
    (Inspectors & Management)
  – Legal Team
  – Other Departments
  – Property or Business Owner
Hampton Roads
IDDE Workshop
Overview of Expert Panel
Protocols

June 13, 2016
HRPDC
Presentation Credit

Chesapeake Stormwater Network

http://chesapeakestormwater.net/events/nutrient-discharges-from-grey-infrastructure/
Expert Panel

Timeline
• Began in Summer 2012
• Deliberated for two years
• Findings released June 2014
• Final approval by EPA/Bay Program 11/10/2014

Expert Panel Roster

<table>
<thead>
<tr>
<th>Panelist</th>
<th>Affiliation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jenny Tribo</td>
<td>Hampton Roads Planning District Commission</td>
</tr>
<tr>
<td>Megan Brosh</td>
<td>Baltimore County Department of Environmental Protection</td>
</tr>
<tr>
<td>Barbara Brumbaugh</td>
<td>City of Chesapeake, VA</td>
</tr>
<tr>
<td>Diana Handy</td>
<td>Arlington County Department of Environmental Services</td>
</tr>
<tr>
<td>Mark Hoskins</td>
<td>Dewberry, VA</td>
</tr>
<tr>
<td>Whitney Katchmark</td>
<td>Hampton Roads Planning District Commission</td>
</tr>
<tr>
<td>Lori Lilly</td>
<td>Independent Consultant</td>
</tr>
<tr>
<td>Bob Pitt</td>
<td>University of Alabama</td>
</tr>
<tr>
<td>Tanya Spano</td>
<td>Metropolitan Washington Council of Governments</td>
</tr>
<tr>
<td>Kevin Utt</td>
<td>City of Fredericksburg, VA</td>
</tr>
<tr>
<td>Marianne Walch</td>
<td>Delaware Department of Transportation</td>
</tr>
<tr>
<td>June Whitehurst</td>
<td>City of Norfolk, VA</td>
</tr>
<tr>
<td>Bill Stack</td>
<td>Center for Watershed Protection</td>
</tr>
</tbody>
</table>

Special thanks to Bill Stack, Center for Watershed Protection
Nutrient Discharges

- Refers to the complex range of non-stormwater flows that deliver nutrients into receiving waters during dry and wet weather – cause by spills leaks, and overflows
- Created by pollutant generating activities/sources
- Associated with grey infrastructure
- Transported by stormwater runoff and groundwater migration
Discovered Nutrient Discharges from Grey Infrastructure

Schueler et al (2014)

- 20-40% of dry weather loading
- 1-2% of wet weather loading
- Option 1 Credit for Advanced Nutrient Discovery programs – NO LONGER AN OPTION
- Option 2 Credit for Elimination of Individual Nutrient Discharges (IND; beginning in 2016)
Discovered Nutrient Discharges from Grey Infrastructure

Discovered versus Reported NDs

- **Discovered Nutrient Discharge:** An existing nutrient discharge that is found through systematic assessment of a catchment, sewershed or stream corridor by the designated MS4 permit agency or local sewer utility, using the screening, tracing and analysis methods described in this report. Nutrient discharges that are discovered using these methods may be eligible for a credit if they lead to the prevention or elimination of the discharge.

- **Reported Nutrient Discharge:** Unexpected discharges from pipe breaks, spills, leaks and overflows that are reported to the local authority by the public or first responders and require immediate emergency repairs to stop the discharge. Most of these involve sudden pipe and/or infrastructure failure that is easily observed. Reported nutrient discharges are generally NOT eligible for nutrient reduction credits.
Discovered Nutrient Discharge  Reported Nutrient Discharge

Photo credit: The Washington Post
Discharge Detectives

- Need to use nutrient-based indicators during routine outfall screening
- Once a discharge is found, other discovery methods are needed to track it back to its source
Crediting for Individual Discharges
<table>
<thead>
<tr>
<th>No.</th>
<th>Discharge Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>N-1</td>
<td>Laundry Wash Water</td>
</tr>
<tr>
<td>N-2</td>
<td>Commercial Car Wash</td>
</tr>
<tr>
<td>N-3</td>
<td>Floor Drains</td>
</tr>
<tr>
<td>N-4</td>
<td>Misc. High Nutrient Discharges</td>
</tr>
<tr>
<td>N-5</td>
<td>Sanitary Direct Connection</td>
</tr>
<tr>
<td>N-6</td>
<td>Sewer Pipe Exfiltration</td>
</tr>
<tr>
<td>N-7</td>
<td>Drinking Water Transmission Loss</td>
</tr>
<tr>
<td>N-8</td>
<td>Dry Weather Sanitary Sewer Overflows</td>
</tr>
</tbody>
</table>
Non-Eligible Nutrient Discharges

- Unexpected nutrient discharges from pipe breaks, spills, leaks and overflows that are reported to the local authority by the public or first responders and require immediate emergency repairs to stop the discharge.
- Residential car washing
- Transitory illicit discharges associated with power-washing, dumpster juice, transport accidents, and illegal sewage disposal by boats and RVs.
- Wet Weather Sanitary Sewer Overflows
- Catastrophic wet weather sanitary sewer overflows that exceed the sewer design capacity
- Combined Sewer Overflows *
- Septic field discharges caused by system failure *
The Crediting Approach

The guiding principle is that elimination of a discovered nutrient discharge could only be considered as a urban BMP, if they:

• Are detected and physically eliminated
• On-site sampling of the discharge that has been eliminated to define one or more of the following parameters -- nutrient concentration, flow rate and duration
• Subsequent inspections and/or monitoring verify or otherwise confirm that discharge no longer exists
Summary of the 3 Protocols to Estimate Nutrient Reduction Credits

The Panel defined three protocols to determine conservative and verifiable nutrient reduction. In this context the term “protocol” refers to the method used to define and verify the load reduction credit associated with finding and fixing an individual nutrient discharge, as follows:

<table>
<thead>
<tr>
<th>Protocol</th>
<th>Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protocol 1: The Prevented Load Calculation</td>
<td>Requires direct sampling of flow and concentration or the use of default values</td>
</tr>
<tr>
<td>Protocol 2: The Before and After Load Approach</td>
<td>Requires metering or tracing of changes in sewer or drinking water flow before and after infrastructure upgrades</td>
</tr>
<tr>
<td>Protocol 3: The Overflow Reduction Tracking Method</td>
<td>Requires tracking dry weather overflow events in a sewershed before and after FOG pretreatment or infrastructure upgrades</td>
</tr>
</tbody>
</table>
Empirical Approach to Crediting

Annual Load = Conc. x Avg. Daily Flow x Conv. Factor x Duration
<table>
<thead>
<tr>
<th>No.</th>
<th>Discharge Type</th>
<th>Method</th>
<th>Nutrients</th>
<th>Flow Volume</th>
<th>Flow Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>N-1</td>
<td>Laundry Wash Water</td>
<td>1</td>
<td>S or D</td>
<td>E or M</td>
<td>E</td>
</tr>
<tr>
<td>N-2</td>
<td>Commercial Car Wash</td>
<td>1</td>
<td>S</td>
<td>E or M</td>
<td>E</td>
</tr>
<tr>
<td>N-3</td>
<td>Floor Drains</td>
<td>1</td>
<td>S</td>
<td>E or M</td>
<td>E</td>
</tr>
<tr>
<td>N-4</td>
<td>Misc. High Nutrient Discharges</td>
<td>1</td>
<td>S</td>
<td>E or M</td>
<td>E</td>
</tr>
<tr>
<td>N-5</td>
<td>Sanitary Direct Connection</td>
<td>1</td>
<td>S or D</td>
<td>E or M</td>
<td>E</td>
</tr>
<tr>
<td>N-6</td>
<td>Sewer Pipe Exfiltration</td>
<td>2</td>
<td>S or D</td>
<td>M</td>
<td>E</td>
</tr>
<tr>
<td>N-7</td>
<td>Drinking Water Transmission Loss</td>
<td>2</td>
<td>S or D</td>
<td>M</td>
<td>E</td>
</tr>
<tr>
<td>N-8</td>
<td>Dry Weather SSOs</td>
<td>3</td>
<td>S or D</td>
<td>E</td>
<td>M</td>
</tr>
</tbody>
</table>

**KEY:**
- S = SAMPLE
- D = Use DEFAULT VALUE
- E = ESTIMATE
- M = MEASURE
## Default Values

Table 1: Default Nutrient Concentrations Associated Different Discharge Types

<table>
<thead>
<tr>
<th>ND</th>
<th>Name</th>
<th>TN (mg/L)</th>
<th>TP (mg/L)</th>
<th>Notes/Sources</th>
</tr>
</thead>
<tbody>
<tr>
<td>N-1</td>
<td>Laundry</td>
<td>3.2</td>
<td>0*</td>
<td>Brown, 2004, Appendix E</td>
</tr>
<tr>
<td>N-2</td>
<td>Car Wash</td>
<td>0.9</td>
<td>0.1</td>
<td>Brown, 2004, Appendix E</td>
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<tr>
<td>N-3</td>
<td>Floor Drain</td>
<td>4.9</td>
<td>--</td>
<td>Requires sampling</td>
</tr>
<tr>
<td>N-4</td>
<td>Misc. Discharge</td>
<td>N/A</td>
<td>N/A</td>
<td>Requires sampling</td>
</tr>
<tr>
<td>N-5</td>
<td>Sanitary Direct</td>
<td>33.0</td>
<td>6.0</td>
<td>EPA, 2004</td>
</tr>
<tr>
<td>N-6</td>
<td>Sewage Exfiltration</td>
<td>33</td>
<td>6.0</td>
<td>Subject to Discount</td>
</tr>
<tr>
<td>N-7</td>
<td>DW transmission</td>
<td>1.7</td>
<td>0.3</td>
<td>Or From DW CCR's and Subject to Discount</td>
</tr>
<tr>
<td>N-8</td>
<td>Dry Weather SSO</td>
<td>33</td>
<td>6.0</td>
<td>EPA, 2004</td>
</tr>
</tbody>
</table>

* assumed to be zero as to reflect P ban in laundry detergent (Litke, 1999).
**N-1: Laundry Washwater**

**Definition:** Washwater flows that result in the discharge of washwater into the storm drain system. It may involve a residential situation or a commercial laundry operation.

**Discharge Characteristics**
- Intermittent discharge
- Enters stream directly through straight pipe
- Multiple Methods of Discovery
- Regulated by MS4 Permit
- Pipe reconnection to eliminate discharge
- Protocol 1 used to calculate credit
- Requires measurement or estimation of flow rate
- Verification involves inspection confirming the reconnection
N-2: Commercial Car Wash

**Definition:** Washing of vehicles that results in the discharge of washwater into the storm drains system. It may involve a commercial car wash operation (fixed or mobile).

**Discharge Characteristics**
- Intermittent
- Multiple Methods of Discovery
- Regulated by MS4 Permit
- Pipe reconnection to eliminate discharge
- Protocol 1 used to calculate credit
- Requires measurement of nutrient concentration and estimation of flow rate and duration
- Verification includes: Confirmation inspection after reconnection AND confirmation screening during business hours
N-3: Floor Drains

**Definition:** Floor or foundation drains illegally connected to the storm drain system.

**Discharge Characteristics**
- Intermittent
- Multiple Methods of Discovery
- Regulated by MS4 Permit
- Pipe reconnection to eliminate discharge
- Protocol 1 used to calculate credit
- Requires measurement of nutrient concentration and estimation of flow rate and duration
- Verification includes inspection confirming reconnection
N-4: Misc. High Nutrient Discharges

**Definition:** This discharge category applies to other non-sanitary, high-nutrient discharges that are discovered during nutrient-based outfall screening. The most common so far has been nutrient-associated cleaning agents used to keep outdoor HVAC systems healthy. If other such discharges are discovered, then direct monitoring is required to establish the credit.

**DISCHARGE CHARACTERISTICS**

- Intermittent
- Indirect Entry through an inlet
- Methods of Discovery:
  - Nutrient source sampling
  - Rooftop inspection
- Pollution Prevention to eliminate discharge
- Protocol 1 used to calculate credit
- Requires nutrient concentration measurement and estimation of flow rate
- Verification methods are discharge dependent:
N-5: Sanitary Direct

**Definition:** A sewer pipe that is improperly connected to the storm drain system either through a cross-connection or from a straight pipe. This discharge category produces a continuous discharge of raw sewage into the storm sewer system or directly to a stream.

**Discharge Characteristics**

- Continuous
- Direct Entry to storm sewer or stream
- Multiple Methods of Detection
- Regulated by MS4 Permit and/or WW permit
- Pipe reconnection to eliminate discharge
- Protocol 1 used to calculate credit
- Requires measurement of nutrient concentration
- Verification includes: Confirmation inspection after reconnection AND Outfall screening once a year for at least 3 years
**Definition:** Loss of sewage from sanitary sewer pipes during dry weather through the groundwater matrix to the storm drain system as a result of cracks or leaks in sewer pipes.
N-7: Drinking Water Transmission Loss

**Definition:** The loss of drinking water as it is delivered in pipes to the consumer that reaches the stream through storm drain pipes and/or groundwater migration.

**Discharge Characteristics**

- Continuous
- Regulated differently by each state
- Multiple Elimination Methods:
  - Slip-lining of Pipes
  - Pipe Replacement
  - Pipe upgrades
- Protocol 2 used to calculate credit
- Requires 6 mos of before and after sewer metering to measure flow
- Nutrient concentrations derived from CCRs
- Verification includes:
  - Flow monitoring at the site of repair and above and below the problem water line for one year
N-8: Dry Weather SSOs

**Definition:** A sanitary sewer overflow that occurs during dry weather periods as a function of either a blockage or failure of the sanitary sewer system.

**Discharge Characteristics**
- Transitory
- Regulated by NPDES WW permit
- Multiple Elimination Methods:
  - FOG Reduction Programs
  - Pretreatment Requirements
  - Sewer Realignment
  - Pipe Replacement
  - Manhole Casing
- Protocol 3 used to calculate credit
- 2 years of before and after tracking of the number and flow volume of overflows within the sewershed
- Verification includes:
  - See confirmation monitoring above
Individual Credit Reporting

- Type of discharge eliminated (e.g. N-1, N-2, etc)
- Total N and P load removed (lbs)
- Protocol used (1, 2 or 3)
- Nutrient concentration, pre and post elimination (mg/l)
- Discharge flow volume prior to elimination (gallons)
- Estimated flow duration (up to maximum of one year)
- River basin segment where the discharge was corrected
- Year that discharge was eliminated
MS4 Recordkeeping

- Whether direct monitoring or default values were used for calculating the load reduction. If default values, report the values used in the calculations.
- The date that the nutrient discharge was detected and the date that it was eliminated.
- All monitoring data used to establish the concentration, including duplicate sample, analytical methods and QA/QC procedures.
- The method used to measure the flow rate, and at least three flow measurements collected before and after the discharge is eliminated.
- Defining the flow as either continuous or intermittent and if, intermittent, the technical assumptions used to determine the percentage of the year the flow occurred.
- The final load reduction calculations that were performed in pounds per year (lb/yr).
- Confirmation that the DND was eliminated
Q/A
Field Investigations & Safety

June 13, 2016
HRPDC
“Dry Weather” Outfall Screening

- Looking at and testing flow from pipes, not in-stream
- At least 48 hours after precipitation (runoff-producing rain event)
- During period of low groundwater
Time of Year Considerations

Winter
- Frozen flows
- Safety
- Road salt

Spring
- High groundwater table

Summer
- Excess vegetation - hard to find outfalls
- A/C condensate

Temperature effects on equipment
Time of Year Considerations

- Vegetation died back
- Not too cold; good time for field work
- Road salt and groundwater influences at a minimum

Fall
If you find an illicit discharge:

• Take photos and notes
• Collect a sample – if safe
• Mark the outfall or manhole
• Try to track down source of discharge
Use a Field Form

OUTFALL Reconnaissance Inventory/Sample Collection Field Sheet

Section 1: Background Data
- Instrumented
- Date
- Time
- Investigator
- Task Force
- Field Notes
- Time
- Date
- Sample Location
- GPS Coordinates

Section 2: Overall Description
- Location
- Materials
- Shape
- Dimensions (in.)
- Number

Section 3: Quantitative Characteristics
- Field Data for Flowing Outfalls
  - Parameter
  - Result
  - Unit
  - Equipment

Section 4: Physical Indicators for Flowing Outfalls Only
- Indicator
- Check if Present
- Description
- Relative Severity Index (1-3)

Section 5: Physical Indicators for Both Flowing and Non-Flowing Outfalls
- Indicator
- Check if Present
- Description
- Comments

Section 6: Overall Outfall Characteristics
- Indicators
- Presence (presence of one or more indicators)
- Relative severity
- Observed

Section 7: Data Collection
- 1. Sample Site
- 2. Stream
- 3. Measurement
- 4. Identification
- 5. Interpretation
- 6. Any Non-Hazardous Concerns

Center for Watershed Protection - revised 11/11/14
Take Notes About:

- Specific location (GPS)
- Odor/smell
- Color
- Clarity/murkiness
- Floatables
- Anything you find about where it’s coming from
Record Basic Characteristics

- Dimensions
- Material
- Vegetation
- Receiving channel conditions
Physical Indicators
(for flowing outfalls)

- Is there flow?
- Odor
- Color
- Transparency
- Floatables

Source: Fort Worth DEM
Other Information

- Outfall Damage
- Deposits/Stains
- Abnormal Vegetation
- Poor Pool Quality
- Pipe Benthic Growth
Quick and Dirty Outfall Inspection Exercise
Taking a Sample

- DO NOT take sample if discharge has strong smell or is hard to reach
- Only take sample if it seems safe
- Use sample bottle or bags that can seal well
- Wear gloves
- Avoid touching inside lip of container
- Record site id, date, location and sample collectors on bottle and on form
- Keep sample on ice if testing for bacteria
# Holding Samples

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Holding Time</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bacteria</td>
<td>6 hours</td>
<td>Cool, 4ºC</td>
</tr>
<tr>
<td>Ammonia</td>
<td>Process immediately</td>
<td>Can preserve with sulfuric acid and hold for 28 days</td>
</tr>
<tr>
<td>Fluoride</td>
<td>28 days (HDPE plastic container only)</td>
<td>Cool, 4ºC</td>
</tr>
<tr>
<td>Anionic Surfactants</td>
<td>2 days</td>
<td>Cool, 4ºC</td>
</tr>
<tr>
<td>Potassium</td>
<td>6 months</td>
<td>Frozen</td>
</tr>
<tr>
<td>Total nitrogen / Total phosphorus</td>
<td>24 hours 30 days</td>
<td>Cool, 4ºC Frozen below -20ºC</td>
</tr>
<tr>
<td>pH</td>
<td>Process immediately</td>
<td></td>
</tr>
<tr>
<td>Temperature</td>
<td>Process immediately</td>
<td></td>
</tr>
</tbody>
</table>
**Bags or Bottles?**

**Considerations:** What parameter are you collecting for (bacteria - sterile, nutrients - autoclaved bottle)? Does the sample need to be frozen? Are you on foot or in a car?

- Don’t break
- Need to be clean
- Bulky to carry around in backpacks
- Can re-use

- Easy to carry when empty
- No prep needed
- Sterile
- Can leak if not closed properly

- Sterile bottle

- Not true!
Partially submerged outfalls

- Mixing with stream water (dilution or masking of a potential problem)
- Collect from pool or move to an up-pipe manhole to collect a sample
Trickle Flows

- Can be difficult to collect samples
- Plumbers putty can be used to direct flow to a “spout”
- Use smaller volume containers for collecting flow measurement
- Concern for sterile samples
Sampling From Manhole

- Necessary when dealing with submerged outfalls or tracking illicit discharges
- Can be difficult to collect, esp. if just a trickle
- Concern is collecting flow measurement and sterile samples
Sampling From Bridge

Nasco sampler can fit with different size Whirlpack
Simple, Low-Cost Equipment

- **Comparative colorimetric methods** (apparent color, detergents)
- **Simple probes** (pH, conductivity)
- **Spectrophotometric** (fluoride, ammonia, potassium)
- **Refractometer** (salinity)
Bacteria Testing

Quanti-Tray
by IDEXX

Petrifilm plates
by 3M
Optical Brightener Traps

Optical brighteners are present in laundry washwater, intermittently present in wastewater

**Optical Brightener Traps:**

- Detects detergents that are intermittently present
- Anchor absorbent pads in storm drains (2-7 days)
- Dry & view under black light
Field vs. Lab Analysis

- Real time
- Can follow-up right away
- Waste disposal

- Controlled conditions (fewer mistakes)
- More accuracy
- Materials readily available
In-House vs. Outsourcing

Questions to ask:

- How quickly are sampling results needed?
- How much staff time and training is needed to support in-house analysis?
- Do you have a safe environment to analyze samples and dispose of waste?
  - Sinks, ventilation, eyewash station
- What is comparative cost for sample analysis in each option?
- Do you have access to space/resources in a lab in your community?
  - Wastewater treatment plant or drinking water lab
Field Safety

Do

- Wear waders, with good grip - streams can be slippery
- Wear rubber gloves when collecting samples
- Wear goggles when handling reagents
- Wear steel toed boots and use a pick (not your fingers) when pulling manholes
- Wear a safety vest
- Carry a flashlight, a cell phone and keep emergency numbers handy
- Use safety cones and an appropriate number of staff to safely work in the road
- Carry a (stocked and up-to-date) first aid kit
Field Safety

Don’t

• Pull a manhole with your back toward the street
• Enter a manhole or outfall without confined space entry training
• Dispose of reagents or other chemicals in the stream
• Conduct any sampling if the discharge is very severe – call emergency services
Waste Disposal

- Ammonia waste – flush with cold water in sink
- Fluoride waste – flush with cold water in sink
- Bacteria plates – soak in bleach solution, put in trash
Lab Safety

Do

• Wear latex gloves when processing samples
• Wear goggles when handling reagents
• Wear closed-toe shoes and pull hair back
• Dispose of materials properly, according to MSDS sheets and local regulations
• Soak bacteria plates in bleach after counting
• Use a hood, if / when necessary – consult MSDS sheet
• Stay organized when running multiple tests – keep separate data sheets, stopwatches, etc.
• Store materials in appropriate containers when not in use
• Wash and dry all equipment when you are done
Lab Safety

Do
• Know where the eye wash station, fire extinguisher and other safety equipment are before beginning lab work
• Wash your hands before leaving the lab

Don’t
• Wear loose hanging clothing
• Eat in the lab (esp. while conducting tests) – ew!
# Methods to Track Down Sources

<table>
<thead>
<tr>
<th>Common Methods</th>
<th>Other Methods</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tracking Up Storm Drain Network</td>
<td>Trained Sewage Sniffing Dogs</td>
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<tr>
<td>Drainage Area Investigation</td>
<td>Sewer pipe flow metering</td>
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<tr>
<td>Video Surveys</td>
<td>Continuous tracers in sewers</td>
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<td>Dye Testing</td>
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<td>Smoke Testing</td>
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</tr>
</tbody>
</table>
Track Up Storm Drain Network

- During dry weather only
- Isolate flow at manholes
- Look for physical indicators
- Sample in manholes & test for chemical indicators
Isolating Flow in Storm Drain

- Start at outfall & move up pipe network
- **Goal:** Isolate flow to between 2 manholes

Splitting the Trunk

1. Identify major branches to the trunk (largest diameter pipe in the network)
2. Identify manholes where branches connect to trunk, plus one immediately upstream.
3. Working up the network, investigate
4. Manholes on each contributing branch and trunk
5. Narrow the discharge to a specific section of trunk or contributing branch
6. Move up until a specific pipe segment is isolated
For Intermittent Flows

Catch the flow:

- Dam flow with sandbags (if not tidal)
- Install when no rain is predicted
- Leave in for 48 hours or less

(Source: Jewell, 2001)
Drainage Area Investigation

- Drive or walk around looking at potential discharge source sites

- Only works if flow is distinct (e.g., color, odor, or high indicator reading)

- Not very helpful for finding sewage leaks
Video Surveys

• Closed caption television (CCTV) – robot camera
• Use for sanitary sewer or storm pipes
• Live image to see cracks, leaks, breaks, and blockages
• Best for continuous discharges
Dye Testing

- Add to plumbing fixtures to see if/where dye comes into storm sewers (cross-connection)

- Use when discharge has been isolated to very small drainage area (<10 properties)

- Must gain access to private property; inform residents & agencies

- Requires extra staff to find dye
IDDE Canine Unit

- Dogs trained to detect smell of sewage (presence/absence)
- Outfall screening and tracking up storm drain network
- Faster than us humans
- Environmental Canine Services LLC (based in Maine)
Fixing

Key Elements of Success:
• Well defined legal authority
• Strong enforcement
• Follow-up measures

Four Questions:
• Who is responsible?
• Methods to fix?
• How long should it take?
• How is removal or correction confirmed?
Who is responsible?

The property owner or municipality/utility? ...

Generally, if illicit discharge from:

- Internal plumbing connection property owner
- Service lateral cross-connection ➔ property owner
- Infrastructure failure within sanitary sewer or MS4 ➔ municipality/utility
- Transitory discharge ➔ property owner
Methods to Fix?

- Varies depending on type and location.

  Develop a pre-approved list of certified/licensed contractors.

  Use in-house contractors/staff to repair as part of routine maintenance activities.
How long should it take?

Varies depending on type and location – though local ordinance may provide time frame for removing discharge and repairing.

Generally –

- If illicit discharge is significant health or environmental threat ➔ fix immediately
- After notification by municipality
  ➔ Stop discharge w/in 7 days
  ➔ Repair w/in 30 days