



November 5, 2014

**Illicit Connection and Illicit Discharge Field Screening and Source Tracing Guidance Manual Training**

Rebecca Dugopolski, PE



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### Today's Agenda

Time	Topic	Length
1:30 – 1:45	Introduction	15 min
1:45 – 2:30	Manual Structure and Content	45 min
2:30 – 3:15	Team Exercise	45 min
3:15 – 3:30	Break	15 min
3:30 – 5:15	Field Equipment Demo Stations	1 hr, 45 min
5:15 – 5:30	Q&A and Wrap-up	15 min



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### Learning Objectives

- Become familiar with the content of the Illicit Connection and Illicit Discharge Field Screening and Source Tracing Guidance Manual
- Understand how to use the manual when investigating an illicit discharge
- Learn how to use some common field equipment for indicator sampling



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### Restrooms? Cell Phones?

Restrooms?

Please silence your cell phones.



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### Outline

- Introduction
  - Background
  - Permit Requirements
- Manual Structure and Content
  - Field Screening Methodologies
  - Indicators
  - Source Tracing Methodologies
  - Appendices
- Team Exercise
- Field Equipment Demo Stations
- Q&A and Wrap-up



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### Outline

- Introduction
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- Team Exercise
- Field Equipment Demo Stations
- Q&A and Wrap-up



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**Background**

- Project partners = King County, Washington Stormwater Center, Spokane County, and Herrera
- Funding = Grant of Regional or Statewide Significance (GROSS grant) from Ecology
- Goal = develop an Illicit Discharge Field Screening Guidance Manual for the entire State of Washington
- Intended audience = permit coordinators and field staff (Phase I and Phase II, Eastern and Western WA)



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**Background**

- Why do we need another manual?
  - Wide variety of field screening methodologies used with varying degrees of success
  - Flexibility is needed to determine which methodology is most appropriate
  - Statewide guidance is more efficient than each jurisdiction spending limited time and resources to conduct independent research
- What do we hope to achieve?
  - A single, detailed illicit discharge field screening and source tracing guidance manual that can be used by municipal staff across the state
  - Summarize most effective field screening and source tracing methodologies and indicators, applications, limitations



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**Background**

- **July 2012:** Illicit Discharge Field Screening Survey distributed to several regional forums
  - 35 responses (Eastern and Western WA; Phase I and Phase II)
  - Input on methodologies and indicators used
- **August – November 2012:** Literature Review
  - 25 references reviewed
  - Local and national references
- Summary Report available on the Washington Stormwater Center website:  
<http://www.wastormwatercenter.org/news/?id=219>



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## Background

- **Sept. and Nov. 2012:** Presentations and discussions
  - ROADMAP
  - Eastern Washington Stormwater Coordinators Group (EWSCG)
  - South Sound Phase II Coordinators Group
  - APWA Meeting
  - North Sound Coordinators Forum
- **Feb. and March 2013:** Manual update and review
  - ROADMAP
  - EWSCG
- **April 2013:** Public review draft of manual



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## Permit Requirements – Phase I

Category	Phase I Permit (2013-2018)
Field Screening Requirements	Implementation of a field screening methodology appropriate to the characteristics of the MS4 and water quality concerns.
Field Screening Methodologies	Screening for illicit connections may be conducted using <i>Illicit Discharge Detection and Elimination: A Guidance Manual for Program Development and Technical Assessments</i> (Center for Watershed Protection 2004), or another methodology of comparable or improved effectiveness.
Business Inspections	Each Permittee shall develop a source control inventory which list businesses and/or properties with pollutant generating activities or sources; 20% of these businesses and/or properties shall be inspected annually.
Field Screening Performance Measures	Each Permittee shall implement an ongoing field screening program of, on average, 12% of the Permittee's conveyance systems each calendar year. <b>Cities:</b> Field screening of all conveyance systems within the Permittee's incorporated area at least once between February 2007 and July 31, 2018.

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## Permit Requirements – Phase I (cont.)

Category	Phase I Permit (2013-2018)
Field Screening Performance Measures (cont.)	Each Permittee shall implement an ongoing field screening program of, on average, 12% of the Permittee's conveyance systems each calendar year. <b>Counties:</b> Field screening of all conveyance systems within the Permittee's urban/higher density rural sub-basins at least once between February 2007 and July 31, 2018.
Source Tracing	Procedures for tracing the source of an illicit discharge; including visual inspections, and when necessary, opening manholes, using mobile cameras, collecting and analyzing water samples, and/or other detailed inspection procedures.



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### Permit Requirements – Phase II

Category	Phase II Permit (2013-2018)
Field Screening Requirements	Implementation of a field screening methodology appropriate to the characteristics of the MS4 and water quality concerns.
Field Screening Methodologies	Screening for illicit connections may be conducted using <i>Illicit Discharge Detection and Elimination: A Guidance Manual for Program Development and Technical Assessments</i> (Center for Watershed Protection 2004), or another methodology of comparable or improved effectiveness.
Business Inspections	Not specified in permit, but Permittees can use business inspections for meeting the Field Screening Performance Measures
Field Screening Performance Measures	All Permittees (except for the City of Aberdeen) shall complete field screening for at least 40% of the MS4 no later than December 31, 2017, and on average 12% each year thereafter.
Source Tracing	Procedures for tracing the source of an illicit discharge; including visual inspections, and when necessary, opening manholes, using mobile cameras, collecting and analyzing water samples, and/or other detailed inspection procedures.

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### Permit Requirements – Eastern WA

Category	Eastern WA Phase II Permit (2014-2019)
Field Screening Requirements	Field assessment activities, including visual inspection of outfalls or facilities during dry weather.
Field Screening Methodologies	Not specified in permit, but Permittees must develop procedures (see Field Screening Performance Measures below)
Business Inspections	Not specified in permit, but Permittees can use business inspections for meeting the Field Screening Performance Measures
Field Screening Performance Measures	Field assessing at least 40% of the MS4 within the Permittee's coverage area no later than December 31, 2018, and on average 12% each year thereafter to verify outfall locations and detect illicit discharges
Source Tracing	Procedures for tracing the source of an illicit discharge; including visual inspections, and when necessary, opening manholes, using mobile cameras, collecting and analyzing water samples, and/or other detailed inspection procedures.

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### Outline

<ul style="list-style-type: none"> <li>■ Introduction                             <ul style="list-style-type: none"> <li>■ Background</li> <li>■ Permit Requirements</li> </ul> </li> <li>■ Manual Structure and Content                             <ul style="list-style-type: none"> <li>■ Field Screening Methodologies</li> <li>■ Indicators</li> <li>■ Source Tracing Methodologies</li> <li>■ Appendices</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>■ Team Exercise</li> <li>■ Field Equipment Demo Stations</li> <li>■ Q&amp;A and Wrap-up</li> </ul>
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## Manual Outline

<p><b>Section 1 – Introduction</b></p> <ul style="list-style-type: none"> <li>■ Background</li> <li>■ Scope of manual</li> <li>■ Manual organization</li> </ul>	<p><b>Section 3 – Field Screening Methodologies</b></p>
<p><b>Section 2 – Definitions and Regulatory Requirements</b></p> <ul style="list-style-type: none"> <li>■ Definitions and acronyms</li> <li>■ Regulatory requirements</li> </ul>	<p><b>Section 4 – Indicators</b></p> <p><b>Section 5 – Source Tracing Methodologies</b></p> <p><b>Appendices</b></p>

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## Section 3 - Field Screening Methodologies

- **Selecting a Field Screening Methodology**
  - Figure 1 – Field Screening and Source Tracing Methodology Flow Chart
- **General Guidelines**
  - Data Management Recommendations
  - Safety Considerations
  - Costs
- **Field Screening Methodology Pullout Sections**
  1. Business Inspections
  2. Catch Basin/Manhole Inspections
  3. Ditch Inspections
  4. Outfall Inspections
  5. Stormwater BMP Inspections
  6. Video Inspections
- **Other Field Screening Methodologies**

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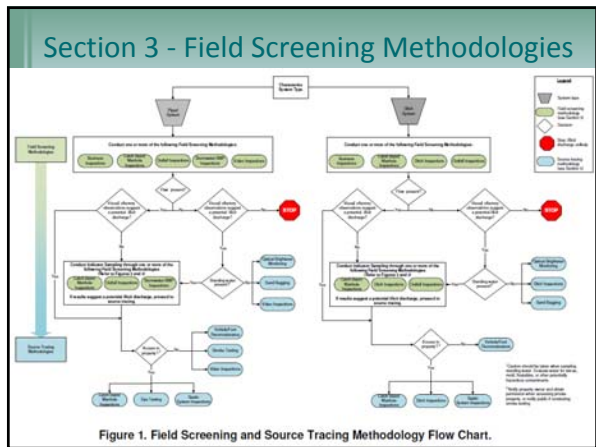
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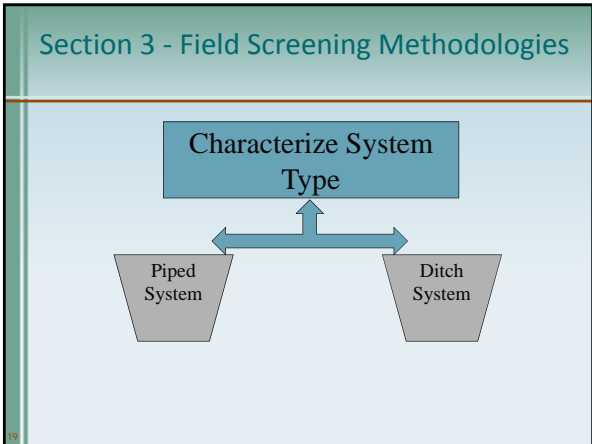
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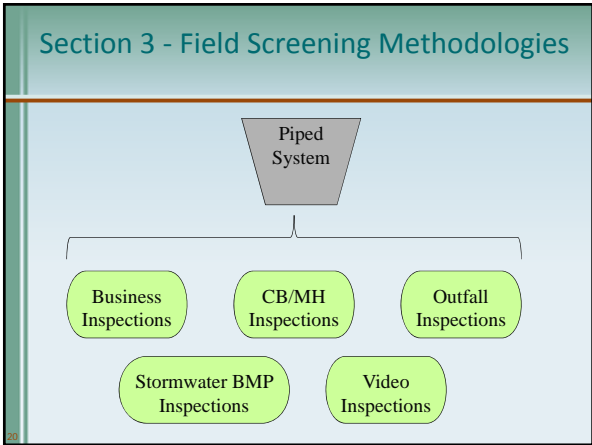
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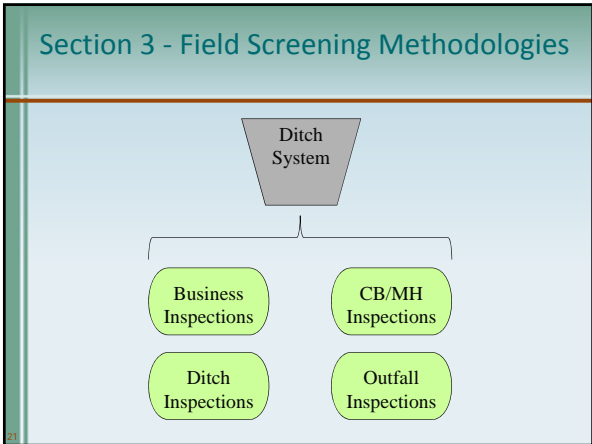
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### Section 3 - Field Screening Methodologies

Methodology	Field Screening	Source Tracing
Business inspections	X	X
Catch basin/manhole inspections	X	X
Ditch inspections	X	X
Outfall inspections	X	
Stormwater BMP inspections	X	
Video inspections	X	X

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### Section 3 - Field Screening Methodologies

**Catch Basin/Manhole Inspections**

**Description**

Catch basin/manhole inspections are a field screening methodology that involve entering a catch basin and visually inspecting for debris, obstructions, and other issues. Inspections are conducted during the winter and spring to identify catch basin/manhole issues before they become more serious. Inspections are conducted by staff on-line to identify catch basin/manhole issues during routine inspections and to identify catch basin/manhole issues during stormwater inspections. Inspections are conducted during the winter and spring to identify catch basin/manhole issues before they become more serious. Inspections are conducted by staff on-line to identify catch basin/manhole issues during routine inspections and to identify catch basin/manhole issues during stormwater inspections.

**Application**

Catch basin/manhole inspections can be used to screen branches of the storm drainage system for block drainage. Catch basin/manhole inspections can be used for field screening of a larger drainage area to identify the branch or segments containing the block drainage or other issues.

Block Drainage System Type	Land Use Type
<input type="checkbox"/> Other	<input type="checkbox"/> High
<input type="checkbox"/> Road center area (I-10)	<input type="checkbox"/> Other
<input type="checkbox"/> Residential	<input type="checkbox"/> Commercial
<input type="checkbox"/> Commercial	<input type="checkbox"/> Industrial
<input type="checkbox"/> Office	<input type="checkbox"/> Military
<input type="checkbox"/> Other	<input type="checkbox"/> Residential

**Equipment**

The following suggested staffing and equipment apply to catch basin/manhole inspections:

- 1 field staff
- 100' pipe or 2 inch collar
- Saturated ropes of the storm drainage and sanitary sewer system
- Catch basin/manhole inspection forms with line forms for block drainage identification
- Field computer and/or clipboard and pencil

- Field Screening Methodology Pullout Sections
  - Description
  - Applications
    - Pipe and/or ditch systems
    - Small and/or large drainage areas
    - Land use types
  - Equipment (checkboxes for field crews)

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### Section 3 - Field Screening Methodologies

**Manhole Inspection**

**Abstract**

The methods for conducting catch basin/manhole inspections as well as the format of the inspection form used can be modified by each jurisdiction as needed. Two general methods for conducting catch basin/manhole inspections for field screening are provided below.


**Minimum Staff Approach**

**1. Office Investigation:**

- Identify pairs of staff who will work together. The buddy system is recommended for field work for health and safety reasons. Consider traffic control and confined space entry needs before heading into the field. Staff should carry a current ID and business cards when conducting field work.
- Review GIS field maps of the drainage basin or subbasin that will be investigated.
- Identify the storm drainage mainline and drainage monitoring nodes/intersections where several branch lines connect to the mainline.
- Select monitoring nodes where field inspection and sampling, if needed, might quickly substitute for portions of the drainage basin.

**Notes:**

- 1) Only staff with identified upper training should enter manholes or other confined spaces.
- 2) Use traffic control and orange cones near catch basin/manhole to protect you and pedestrian from harm.



Manhole inspection (Photo Credit: City of Seattle)

- Field Screening Methodology Pullout Sections
  - Methods (SOP format)

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### Section 3 - Field Screening Methodologies


**Pros and Cons**

Pros	Cons
<ul style="list-style-type: none"> <li>Quick and inexpensive</li> <li>Can determine location of a storm drainage network from screening if no flow or small inflow are present</li> <li>Can map multiple storm drainage system branches that flow to a single outfall</li> <li>Efficient if storm drainage network is already mapped</li> <li>Highly efficient if used in combination with modern remote sensing technologies</li> </ul>	<ul style="list-style-type: none"> <li>Some methods will take time continuously year round due to groundwater inflow</li> <li>Traffic hazards and danger to pedestrians when accessing some catch basins/interceptors</li> <li>Prone to bias or incomplete capture and accuracy if confined space entry is necessary</li> <li>Can be time consuming and difficult if storm drainage map is unavailable or incomplete</li> <li>Less effective in wet weather than dry weather</li> </ul>

**References to Other Sections**

Primary Field Screening Indicators	Follow-up Indicators	Field Screening Methodologies
<ul style="list-style-type: none"> <li>Ammonia</li> <li>Color</li> <li>Odor</li> <li>pH</li> <li>Temperature</li> <li>Turbidity</li> <li>Visual Indicators</li> </ul>	<ul style="list-style-type: none"> <li>Chlorine &amp; Fluoride</li> <li>Detergents/Surfactants</li> <li>Fecal Coliform Bacteria</li> <li>Hardness</li> <li>Iron</li> <li>Nitrate</li> <li>Potassium</li> <li>Specific Conductivity</li> </ul>	<ul style="list-style-type: none"> <li>Biological Assessments</li> <li>Chemical Assessments</li> <li>Direct Inspections</li> <li>Discharge BMP Inspections</li> <li>Video Inspections</li> </ul>

- Field Screening Methodology Pullout Sections
- Pros and Cons
- References to Other Sections (hyperlinks in electronic version of the manual)



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### Section 4 - Indicators

- **Selecting an Indicator**
  - Figures 2 and 3 – Indicator Sampling Flow Charts of Potential Illicit Discharge Sources in Urban and Rural Land Use Settings
- **General Guidelines**
  - Field Quality Assurance/Quality Control
  - Laboratory Analysis Quality Assurance/Quality Control
  - Safety Considerations
  - Costs

- **Indicator Pullout Sections**
  1. Flow
  2. Ammonia
  3. Color
  4. Odor
  5. pH
  6. Temperature
  7. Turbidity
  8. Visual Indicators



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### Section 4 - Indicators

- **Indicator Pullout Sections (continued)**
  9. Chlorine & Fluoride
  10. Detergents/Surfactants
  11. Fecal Coliform Bacteria
  12. Hardness
  13. Nitrate
  14. Potassium
  15. Specific Conductivity
- **Other Indicators**






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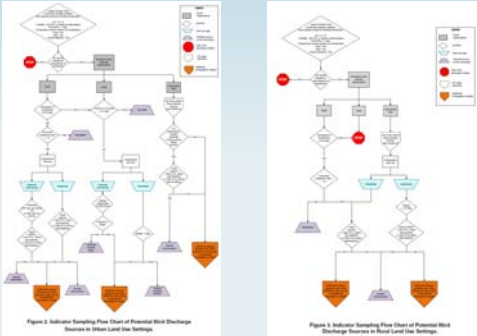
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### Section 4 - Indicators




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### Section 4 - Indicators

Collect Primary Field Screening indicator samples and evaluate the following:  
 pH, Turbidity, Ammonia, Temperature, Color, Odor, Visual Indicators

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### Section 4 - Indicators

#### Thresholds – Primary Field Screening Indicators

- pH: < 5, > 9
- Turbidity: > 50 NTU or visible/ cloudy/opaque
- Ammonia: > 1 mg/L
- Temperature: Above ambient air temperature
- Color: Yes
- Odor: Yes
- Visual Indicators: Yes




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## Section 4 - Indicators


Low and high pH values can be caused by the following sources:

Low pH*	High pH**
<ul style="list-style-type: none"> <li>• Dairy products</li> <li>• Fertilizers</li> <li>• Feedlot effluent</li> <li>• Pharmaceutical manufacturers</li> <li>• Paper processing companies</li> <li>• Tannery effluent</li> <li>• Wastewater</li> </ul>	<ul style="list-style-type: none"> <li>• Disinfectants and sanitizers</li> <li>• Limes</li> <li>• Lime sludge</li> <li>• Lime water</li> <li>• Phosphoric acid</li> <li>• Phosphoric acid sludge</li> <li>• Phosphoric acid wastewater</li> <li>• Phosphoric acid wastewater</li> <li>• Soda ash</li> <li>• Soda ash sludge</li> <li>• Tannery effluent</li> </ul>

\*Low pH values are caused by the following sources: Dairy products, Fertilizers, Feedlot effluent, Pharmaceutical manufacturers, Paper processing companies, Tannery effluent, Wastewater. \*\*High pH values are caused by the following sources: Disinfectants and sanitizers, Limes, Lime sludge, Lime water, Phosphoric acid, Phosphoric acid sludge, Phosphoric acid wastewater, Soda ash, Soda ash sludge, Tannery effluent.

References to Other Sections

Primary Field Screening Indicators	Field Screening Methodologies
<ul style="list-style-type: none"> <li>• Ammonia</li> <li>• Color</li> <li>• Odor</li> <li>• Temperature</li> <li>• Turbidity</li> <li>• Visual indicators</li> </ul>	<ul style="list-style-type: none"> <li>• Business Inspections</li> <li>• Catch Basin/Manhole Inspections</li> <li>• Ditch Inspections</li> <li>• Dye Testing</li> <li>• Optical Brightener Monitoring</li> <li>• Sand Bagging</li> </ul>

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## Section 5 – Source Tracing Methodologies

- **Selecting a Source Tracing Methodology**
  - Figure 1 – Field Screening and Source Tracing Methodology Flow Chart
- **General Guidelines**
  - Data Management Recommendations
  - Safety Considerations
  - Costs
- **Source Tracing Methodology Pullout Sections**
  1. Business Inspections
  2. Catch Basin/Manhole Inspections
  3. Ditch Inspections
  4. Dye Testing
  5. Optical Brightener Monitoring
  6. Sand Bagging

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## Section 5 – Source Tracing Methodologies

- **Source Tracing Methodology Pullout Sections (continued)**
  7. Septic System Inspections
  8. Smoke Testing
  9. Vehicle/Foot Reconnaissance
  10. Video Inspections
- **Other Source Tracing Methodologies**



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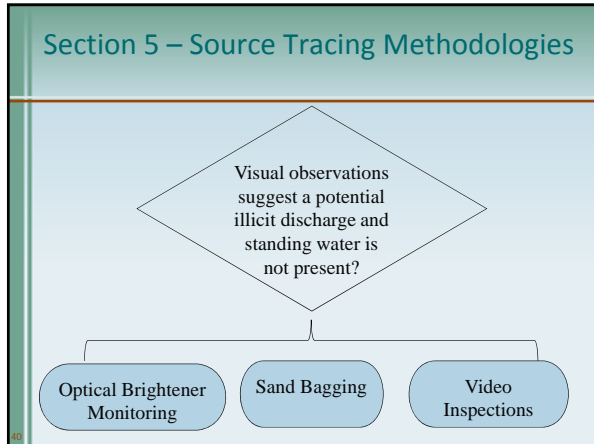
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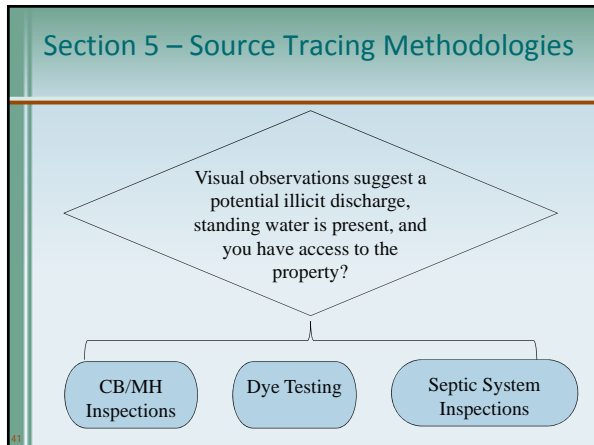
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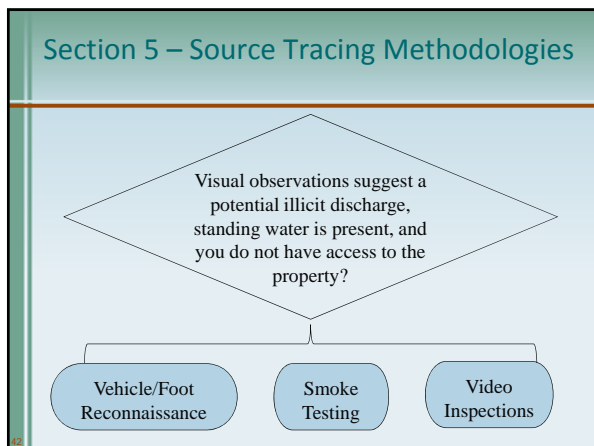
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### Appendix A – Field Screening and Source Tracing Equipment Costs

- Preliminary assessment of equipment vendors and suppliers for informational purposes only
- Not an exhaustive list of costs; does not include standard items
- Tables A-1 through A-4 contain the following information:
  - Methodology/indicator name
  - Quantity/Description
  - Equipment Cost (range)
  - Vendor Name(s)
  - URL



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### Appendix A – Field Screening and Source Tracing Equipment Costs

- Tier 1 – Minimum Level Field Screening and Source Tracing Equipment List
  - Primary field screening indicators (turbidity = visual observations only)
  - One follow-up indicator (detergents/surfactants)
  - One source tracing technique (dye testing)
  - Approximate equipment cost = \$1,100 to \$1,600



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### Appendix A – Field Screening and Source Tracing Equipment Costs

- Tier 2 – Intermediate Level Field Screening and Source Tracing Equipment List
  - Primary field screening indicators (turbidity = turbidity meter)
  - Two follow-up indicators (detergents/surfactants and potassium)
  - Three source tracing techniques (dye testing, sand bagging, and smoke testing)
  - Approximate equipment cost = \$2,600 to \$6,300



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## Appendix A – Field Screening and Source Tracing Equipment Costs

- Tier 3 – Advanced Level Field Screening and Source Tracing Equipment List
  - Primary field screening indicators (turbidity = turbidity meter, multimeter for several indicators)
  - Multiple follow-up indicators (detergents/surfactants, potassium, chlorine & fluoride, and *E. coli*; multimeter for several indicators)
  - Three source tracing techniques (dye testing, smoke testing, and video inspections)
  - Approximate equipment cost = \$17,000 to \$490,000




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## Appendix B – Example Field Forms

General Category	Methodology/Indicator Name	Source
Field Screening Methodology	Outfall Inspections	<ul style="list-style-type: none"> <li>• King County</li> <li>• Snohomish County</li> <li>• Center for Watershed Protection</li> </ul>
Source Tracing Methodology	Dye Testing	King County
Source Tracing Methodology	Optical Brightener Monitoring	Dave Sargent and Wayne Castonguay
Source Tracing Methodology	Septic System Inspections	<ul style="list-style-type: none"> <li>• University of Minnesota</li> <li>• New Hampshire</li> <li>• Kitsap County</li> </ul>
Source Tracing Methodology	Smoke Testing	City of Baton Rouge
Indicators	General Water Quality Indicator Sampling	<ul style="list-style-type: none"> <li>• King County</li> <li>• Snohomish County</li> </ul>




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## Appendix C – Case Studies

- Ten 1-page case studies from the City of Bellevue, King County, Federal Way, Bothell, and Seattle
1. Foaming Outfall
  2. Sewage Smell
  3. High Fecal Coliform Bacteria
  4. Side Sewer Cross Connection
  5. Latex Paint Discharge
  6. Utility Sink Illicit Connection
  7. Commercial Grease Build Up
  8. Commercial Grease Blockage
  9. Coolant Leak
  10. Dialysis Cross Connection




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## Team Exercise

- Work together in teams (8 teams total)
- Conduct inspections, water quality testing, or take other actions to identify the most likely causes of the discharge(s)
- Refer to the color, visual indicators, detergents/surfactants, and fecal coliform bacteria sections of the manual
- The team that tracks down the most discharges with the most money left wins
- You have 30 minutes



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## Break



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### Field Equipment Demo Stations

- Split into 10-15 groups; there are 10 total stations
- Follow the instructions at each station with your team
- Record your results (don't forget units!) on your data sheet
- Move with your team to an open station when finished

Station # and Indicator/Source Tracing Methodology Name	
Station #1 – Ammonia	Station #6 – Detergents/surfactants
Station #2 – Color	Station #7 – Hardness
Station #3 – pH	Station #8 – Nitrate/Nitrite
Station #4 – Turbidity	Station #9 – Dye Testing
Station #5 – Chlorine & Fluoride	Station #10 – Smoke Testing




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### Review of Learning Objectives

- Become familiar with the content of the Illicit Connection and Illicit Discharge Field Screening and Source Tracing Guidance Manual
- Understand how to use the manual when investigating an illicit discharge
- Learn how to use some common field equipment for indicator sampling

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### Questions?

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