Monitoring Procedures

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IDDE BASICS

Illicit Discharges: A discharge into an MS4 that is not composed entirely of stormwater EXCEPT permitted discharges and fire fighting related discharges 40 CFR 122.26(b)(2).

Mode of Entry into MS4

- **Direct:** Discharge is directly connected to the storm drain pipe through a sewage pipe, shop drain, or other kind of pipe.
  - Usually produces discharges that are continuous or intermittent.
- **Types of Direct Entry:**
  - Sewage/waste cross- connections
    - A sewer pipe that is improperly connected to the storm drain system produces a continuous discharge of raw sewage to the pipe.
  - Straight pipes
    - Relatively small diameter pipes that intentionally bypass the sanitary connection or septic drain fields, producing a direct discharge into open channels or streams.
  - Industrial/commercial cross connections
    - Occurs when a drain pipe is improperly connected to the storm drain system producing a discharge of wash water, process water or other inappropriate flows into the storm drain pipe.

Source Examples

Runoff from hydro mulching or landscape/ planting activity

Tracer dye wash-water from industrial site

Construction site concrete washout wash-water

A common industrial cross connection is a floor drain that is illicitly connected to a storm drain

Mode of Entry (Continued)

- **Indirect:** Entry means that flows generated outside the storm drain system enter through storm inlets or by infiltrating through the joints of pipe:
  - **Groundwater seepage**
    - Seepage frequently occurs in storm drains after long periods of above average rainfall.
    - Can be continuous or intermittent
    - Usually consists of relatively clean water that is not an illicit discharge by itself, but can mask other illicit discharges.
  - **Spills**
    - Occur when a spill travels across an impervious surface and enters a storm drain inlet.
  - **Dumping**
    - Created when liquid wastes such as oil, grease, paint, solvents and various automotive fluids are dumped into a storm drain.
  - **Outdoor Washing Activities**
    - Illicit discharge depends on the nature of the generating site that produces wash water.
    - EX:, hosing off individual sidewalks and driveways may not generate significant flows or pollutant lands.
    - Routine washing of fueling areas, outdoor storage areas and parking lots (power washing), and construction equipment cleanouts may result in unacceptable pollutant loads.
  - **“Nuisance” or Non-target water**
    - Irrigation can produce intermittent discharges from over-watering or misdirected sprinklers that send tap water over impervious areas.
    - In some instances, non-target irrigation can produce unacceptable loads of nutrients, organic matter or pesticides.

Table 2: Land Uses, Generating Sites and Activities That Produce Indirect Discharges		
Land Use	**Generating Site**	**Activity that Produces Discharge**
Residential	• Apartments • Multi-family • Single Family Detached	• Car Washing • Driveway Cleaning • Dumping/Spills (e.g., leaf litter and RV/boat holding tank effluent) • Equipment Washdowns • Lawn/Landscape Watering • Septic System Maintenance • Swimming Pool Discharges
Commercial	• Campgrounds/RV parks • Car Dealers/Rental Car Companies • Car Washes • Commercial Laundry/Dry Cleaning • Gas Stations/Auto Repair Shops • Marinas • Nurseries and Garden Centers • Oil Change Shops • Restaurants • Swimming Pools	• Building Maintenance (power washing) • Dumping/Spills • Landscaping/Grounds Care (irrigation) • Outdoor Fluid Storage • Parking Lot Maintenance (power washing) • Vehicle Fueling • Vehicle Maintenance/Repair • Vehicle Washing • Washdown of greasy equipment and grease traps
Industrial	• Auto recyclers • Beverages and brewing • Construction vehicle washouts • Distribution centers • Food processing • Garbage truck washouts • Marinas, boat building and repair • Metal plating operations • Paper and wood products • Petroleum storage and refining • Printing	• All commercial activities • Industrial process water or rinse water • Loading and un-loading area washdowns • Outdoor material storage (fluids)

Table 2: Land Uses, Generating Sites and Activities That Produce Indirect Discharges		
Institutional	• Cemeteries • Churches • Corporate Campuses • Hospitals • Schools and Universities	• Building Maintenance (e.g., power washing) • Dumping/Spills • Landscaping/Grounds Care (irrigation) • Parking Lot Maintenance (power washing) • Vehicle Washing
Municipal	• Airports • Landfills • Maintenance Depots • Municipal Fleet Storage Areas • Ports • Public Works Yards • Streets and Highways	• Building Maintenance (power washing) • Dumping/Spills • Landscaping/Grounds Care (irrigation) • Outdoor Fluid Storage • Parking Lot Maintenance (power washing) • Road Maintenance • Spill Prevention/Response • Vehicle Fueling • Vehicle Maintenance/Repair • Vehicle Washing

Source Samples:

Routine outdoor washing or rinsing

Vehicle fluid release from an accident

Outdoor washing activities

Outdoor washing activities

Discharge Frequency

- The **frequency** of dry weather discharges in storm drains is important, and can be classified as *continuous, intermittent or transitory.*
  - ***Continuous***
    - discharges occur most or all of the time, are usually easier to detect and typically produce the greatest pollutant load.
  - ***Intermittent***
    - discharges occur over a shorter period of time (e.g., a few hours per day or a few days per year), and are hard to detect
  - ***Transitory***
    - discharges occur rarely, usually in response to a singular event, (e.g. an industrial spill, ruptured tank, sewer break, transport accident or illegal dumping episode), and are extremely hard to detect.
- The frequency determines how you can hope to monitor

IDDE Basics- Finding, Fixing, Preventing

- Finding
  - Staff/Citizen reported concerns
  - Outfall Reconnaissance Inventory
  - Indicator Monitoring at storm water outfalls and In-Stream
  - Tracking discharges to their source
- Fixing
  - *Targeted Education/Response*
  - *Establish legal authority for timely correction*
  - *A combination of "carrots and sticks"*
- Preventing
  - "An ounce of prevention is a worth a pound of cure"
    - Transitionary discharges from generating sites can be minimized through pollution prevention practices and well-executed spill management and response plans. (SPCC, SWP3)

Know Your Responsibility & Legal Authority

- Responsibility
  - You may be tasked with finding an illicit discharge, however are you the one to see it through?
- Common Legal Authority
  - **Storm Water Ordinance** that prohibits illicit discharges to the drainage network
  - **Plumbing Code** that prohibits illicit connections to the drainage network
  - **Health Code** that regulates the discharge of harmful substances to the drainage network
  - **Texas Water Code** if all else fails!
- Provisions for Access and Inspection
  - Right-of-entry needed for private property
    - Most will comply, but not all!!
    - If not, you'll need an access warrant
      - Gained via a "Probable Cause Affidavit"- Who, What, When, Where, How?
      - Does your City ordinance/code (s) require active discharge to gain access?

Initial Observations

- **Initial Visit:**
  - Record outfall and site dimensions (pipes, ditches, flumes)
  - Record site building materials (concrete, corrugated metal/plastic, dirt)
- **All Visits:**
  - Record if water is flowing
  - Measure flow depth/levels (or estimate)
    - Record width of flow for estimate of discharge (Q)
      - Width *depth *velocity = Q
- **Record physical, biological and chemical indicators**
  - Odor, color, floatables
  - Pipe damage, deposits/stains abnormal vegetation

Physical Indicators

- Physical indicators can include the presence of unusual flow, color, odor, turbidity and floatable liquids and solids.
  - **Flow-** Record whether there is a presence or absence of flow at the site
    - **NOTE: To measure flow, mark off a fixed flow length (about 5 feet) and drop a floatable object (i.e. stick, cork, leaf etc.) into the flow. Record the time it takes the object to travel the fixed length then calculate velocity (feet per second or ft/s)**
  - **Color-** Collect a sample of the discharge in a clear test tube or sampling bottle.
    - **NOTE: Do not try to access water color by looking directly into the waterway. Water depth, substrate composition, aquatic plants and sky conditions can all influence your perception of the water color.**

Color	Possible Sources
Tan to light brown	• Suspended sediments common after a rainfall • Runoff from construction, roads, agriculture/range land • Soil erosion caused by vegetation water
Pea green, bright green, yellow, brown, brown-green, brown-yellow, blue-green	• Algae or plankton bloom- color depends on type of algae or plankton • Sewage, fertilizer runoff, vehicle wash water
Tea/Coffee	• Dissolved or decaying organic matter from soil or leaves. Commonly associated with tree overhangs, woodlands or swampy areas
Milky White	• Paint, lime, milk, grease, concrete, swimming pool filter backwash
Milky or dirty dishwater gray	• Gray water or wastewater, musty odor present
Milky gray-black	• Raw sewage discharge or other oxygen demanding waste (rotten egg or hydrogen sulfide odor may be present)
Clear black	• Caused from turnover from oxygen-depleted waters or sulfuric acid spill
Orange-red	• Leachate from iron deposits • Deposits on stream beds often associated with oil well operations (check for petroleum odor)
White crusty deposits	• Common in dry/arid areas or during periods of low rainfall where evaporation of water leaves behind salt deposits • Also found in association with brine water discharge from oil production areas (a petroleum odor or an oily sheen may be present along banks

Detecting Odor

- Fill a sample bottle at least halfway with sample water and hold about six inches away from your nose.
- **NOTE:** Never inhale the air directly off the top of a sample as many potential contaminants are harmful to nasal membranes and lung tissue. Make sure the origin of the odor is at the outfall. Sometimes shrubs, trash or even spray paint used to mark the outfalls can confuse noses.

Odor	General Causes
Rotten eggs/hydrogen sulfide (Septic)	• Raw sewage, decomposing organic matter, lack of oxygen
Chlorine	• Wastewater treatment plant discharges, swimming pool overflow, industrial discharges
Sharp, pungent odor	• Chemicals or pesticides
Musty odor	• Presence of raw or partially treated sewage, livestock waste
Gasoline, petroleum	• Industrial discharge, illegal dumping of wastes, waste water
Sweet, fruity	• Commercial wash water, wastewater

Turbidity

- Collect a water sample and use a Secchi tube, turbidity meter or colorimeter to determine water turbidity
  - **Causes of High Turbidity**
    - Soil erosion
    - Runoff from a rain event
    - Algae blooms
    - Bottom sediment disturbances by aquatic life
    - Construction or dredging

  - **If highly turbid (cloudy) water is observed, make sure to look upstream and downstream to see if anything around the site has changed since the last field inspection. An illicit discharge may be present if a highly turbid flow exists.**

Sewage, Sheens & Surface Scum

Contaminated flows may contain floatable solids or liquids. Sewage, oil sheen and suds/foam are examples of floatable indicators. Trash and debris, although more typically known as floatables, "are not generally indicators of illicit flow".

- Sheens can be naturally-produced or synthetic; oil sheens are often mistaken for naturally-produced sheen.
- Sheen from bacteria forms a sheet-like film that breaks if disturbed.
- Suds should be rated based on their foaminess and staying power
- Suds that travel several feet before breaking up should be considered as a possible illicit discharge
- In some cases, foam and suds can give off an odor
- A strong organic or sewage-like odor can indicate a sanitary sewer leak or overflow
- A fragrant or sweet smelling odor can indicate the presence of laundry water or similar wash waters.

Surface Scum	General Causes
Tan foam	• Usually associated with high flow or wave action; wind action plus flow churns water containing organic materials causing harmless foam; produces small patches to very large clumps
White Foam	• Sometimes patchy or covering wide area around wastewater outfall, thin and billowy, mostly due to soap
Yellow, brown, black film	• Pine, cedar and oak pollens form film on surface, especially in ponds, backwater areas or slow moving water in streams
Rainbow film	• If it has a swirling pattern, then likely oil or other fuel type. Check for petroleum odor. If sheet-like and cracks if disturbed, then its natural.

EXAMPLES

Sewage Fungus

Bacteria grown in outfall

Natural Sheen

Synthetic Sheen

Low severity, naturally occurring suds

High severity suds

Outfall Condition

- The physical condition of an outfall can provide strong clues about the history of discharges passing through it.
- Over time, intermittent discharges can cause outfall damage or leave behind remnants in the form of deposits or stains
  - **Structural Damage:**
    - Cracked, deteriorated concrete or peeling surface paint, usually indicates the presence of contaminated discharges
    - Contaminants causing this type of damage, are usually very acidic or basic (alkaline) and originate from industrial processes.
  - **Deposits and Stains (Residues):**
    - Staining may be any color but is characteristically different from the outfall
    - Residues can contain fragments of floatable substances
    - Gray-white deposits can be from illegal dumping of concrete truck washouts
    - Crystalline powder can indicate the discharge of fertilizer wastes.

Outfall Classifications

Classification	Description
Obvious	Flowing outfall where there is an illicit discharge that does not require sample collection for confirmation
Suspect	Flowing outfall with high severity on one or more physical indicators
Potential	Flowing or non-flowing outfall with presence of two or more physical indicators
Unlikely	Non-flowing outfall with no physical indicators of an illicit discharge

The Center for Watershed Protection (CWP)

Biological Indicators

Biological indicators include things that live and grow. During a field inspection, the following should be investigated:

- **Vegetation**
  - Increased or inhibited plant growth, as well as dead and decaying plants near stormwater outfalls is often a sign of pollution
- **Algae**
  - An overabundance of nutrients can cause elevated plant growth or algae blooms. During a bloom, water typically becomes a pea green color, however the color depends on the dominant species of algae present
- **Bacteria**
  - The amount and types of bacteria present can be extremely significant. Although some types can be visible to the naked eye, such as sewage fungus or natural sheen, counts for indicators like *E. coli* are done in the laboratory.
- **Fish Kills**
  - Can be caused by a variety of factors including a decrease in DO, infectious disease, a rise in water temp, toxic algae blooms , parasites, and bacterial or viral infections.
- **Presence or Absence of aquatic life**
  - The presence or absence around a water body can be an indicator of the health of the water body.

Chemical Indicators

- Conductivity
  - Measure of the electrical conductance of water (affected by dissolved ions)
  - <1500us/cm is normal
- Dissolved ions are necessary for life
  - High concentration of ions = Salty/Brackish
  - Low concentration = fresh water
- Measured in us/cm (microsiemens per centimeter)
- Know your watershed! (concrete lined channels will increase conductivity)

REMEMBER: Meter requires calibration!

Temperature, Color, Turbidity

- Temperature (Celsius)
  - Affects rates of reactions in water, solubility, density inversion and mixing, and current movements
    - Small streams more susceptible to changes in temp
  - Measure air temperature (shaded area)
  - Measure water temp (shaded area, don't hold container in hand)

- Color
  - Can show presence of dyes and process chemicals

- Turbidity
  - Affected by soil erosion, urban run-off, algal blooms, main-breaks
  - High turbidity affects sunlight infiltration, decreases photosynthesis, decomposition depletes oxygen

pH

- Logarithmic Scale: 0-14 Standard Units
  - 7 is neutral pH; 0=most acidic; 14=most alkaline
  - 6.5-9su is normal

- NOTE:
  - Algae + high water temp increases pH
  - Regional limestone bedrock increases pH
    - NOTE: pH range should be determined by surface water quality standards for the receiving water segment

Test Strips vs. Probe:

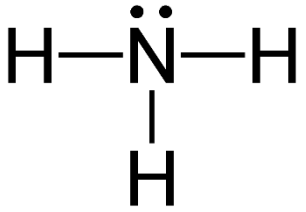
- If using a probe: Calibrate it!!

Chlorine

- Disinfectant in water treatment processes
- Highly toxic to aquatic life
  - Can sterilize surface waters
- Positive chlorine could indicate illicit connection (water supply)
  - OR…Swimming Pools!
  - Process water can range from 1mg/L to 4mg/L Total Chlorine (Denton Average: 3.5)

Ammonia-Nitrogen

- Important nutrient for plants and animals
- Toxic to freshwater organisms from 0.2-4.8ppm
- Sources can be:
  - Illegal connection to sanitary sewer
  - Malfunctioning OSSFs (Onsite Sewage Facilities)
  - Fertilizer run-off
  - Wildlife



Warning: Waste water is **hazardous**; proper disposal is needed!

Detergents, Copper, Phenols

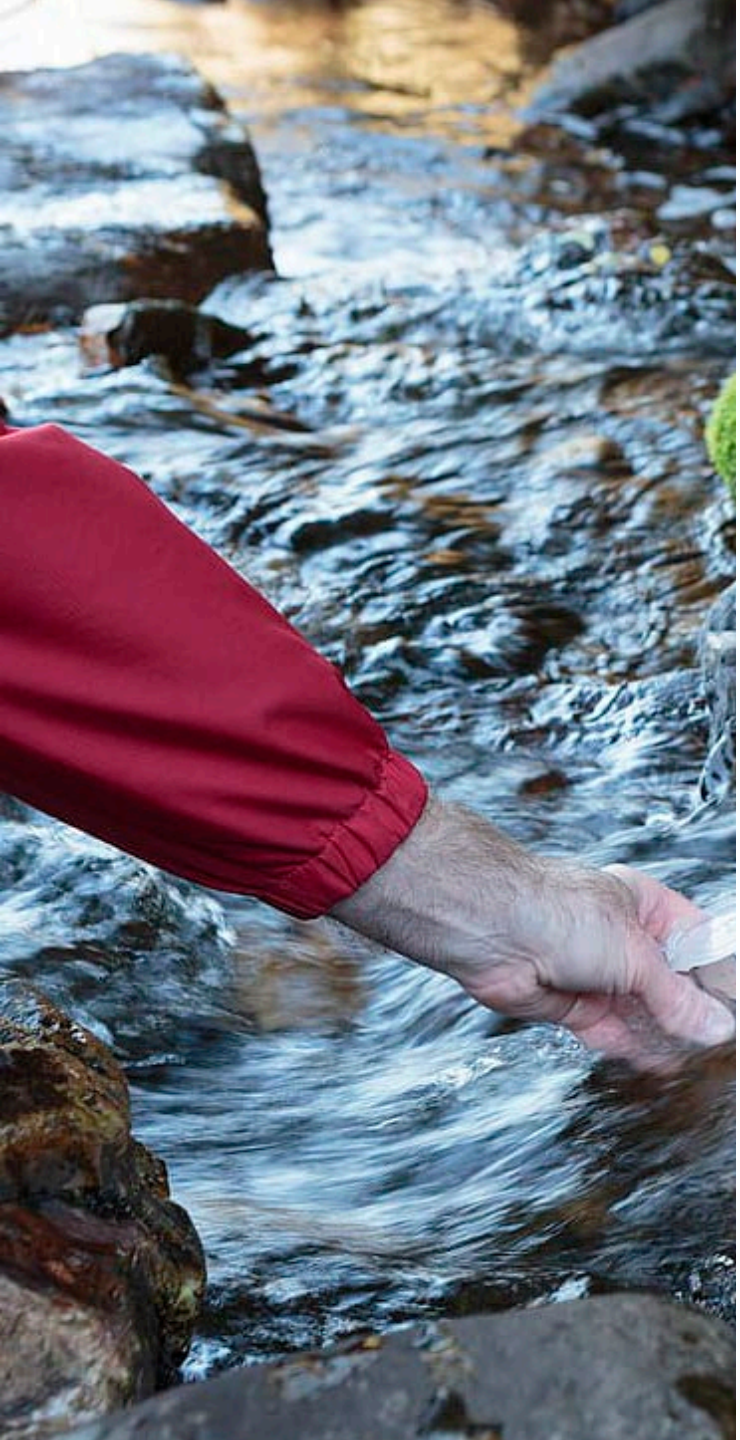
- Detergents: Can be toxic, and can lower dissolved oxygen
  - Possible sources: Car washing, outdoor cleaning, leaking sanitary sewers/OSSFs
  - WARNING: Waste-water is hazardous
- Copper: Essential to human growth and useful in many applications
  - Concentrations >0.025ppm are toxic to most freshwater species
  - Elevated copper could indicate an illicit discharge
- Phenols: Organic compounds, by-products of petroleum refining, tanning/dye operations, also animal waste
  - Low concentrations cause taste/odor issues
  - Higher concentrations can kill aquatic life and humans

Sampling Methods (if flowing)

- **Discharge Grab**
  - Sample flows directly into container
- **Surface Water Grab**
  - Always grab from **below surface** of water!
  - If deep enough: collect 1-foot below surface
    - Or one-third of total depth, whichever is less
- **Bucket Grab**
  - Gently lower bucket and do not disturb sediment at bottom

REMEMBER!!!!!!!

- ✓ Always **rinse your containers,** twice!
- ✓ Always **approach site from downstream** so as not to disturb sample at outfall
- ✓ Always **dispose of sample water downstream** of sample location
- ✓ **Avoid contact with bottom** of channel



Sampling Sequence (suggested)

1. pH meter calibration (and other meters, as needed)
2. Initial site observations: trash, sewage, surface scum, etc.
3. Air temperature
4. Physical and biological observations: flow, color, turbidity, odor, oil sheen
5. Water temperature
6. pH
7. Detergent
8. Phenols
9. Ammonia-Nitrogen
10. Copper
11. Chlorine
12. Conductivity

Individual Test Kits, Probes, Methods will vary…

- Regional, watershed, or even historic outfall specific screening levels will identify incidences of exceedance
- Reproducibility and consistency are very important
- Quality Assurance Programs
  - Dictate proper sample collection, preservation, transportation, submittals
  - Sample Duplication
  - Sample Replication
  - If using probes, proper calibration and maintenance are essential


IT'S
LUNCH
TIME!