JOPLIN
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Illicit Discharge Detection & Elimination (IDDE)

Field Investigation Guide

2023



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Preparing for a Field Inspection

FIELD INPECTION SUPPLY CHECKLIST

- ✓ Sunscreen, first aid kit, poison ivy cream
- ✓ Field sheets/ inspection forms
- ✓ IDDE Field Investigation Guide
- ✓ Outfall, storm drain, stream, and street maps (GPS unit)
- ✓ Camera, clipboard, flashlight, cell phone or two-way radio
- ✓ Waders and/or rubber boots, safety goggles, hard hat
- ✓ Basic field testing kit:
  - Thermometer, pH & ammonia test kits (or meters)
  - Tape measure, stopwatch, and ping pong ball or cork
  - Clear jar of known volume
  - Paper towels or rags
- ✓ Notification of the public and/or property owners, if necessary
- ✓ Contact information of police and emergency response personnel in case of spills or active illicit discharges

IF PERFORMING SAMPLING:

- ✓ Protective gloves for handling chemicals
- ✓ Clear sample bottles and extendable pole with attached sampling cup
- ✓ Bottle of deionized or distilled water for rinsing equipment after sampling
- ✓ Container for bringing back liquid reagent wastes from the field
- ✓ Notification of the public and/or property owners, if necessary
- ✓ Inspection notification letter documenting legal authority to gain access to property during field inspection
- ✓ Tier I & Tier II test kits and meters (conductivity, turbidity, etc.), if reinspecting suspected illicit discharge

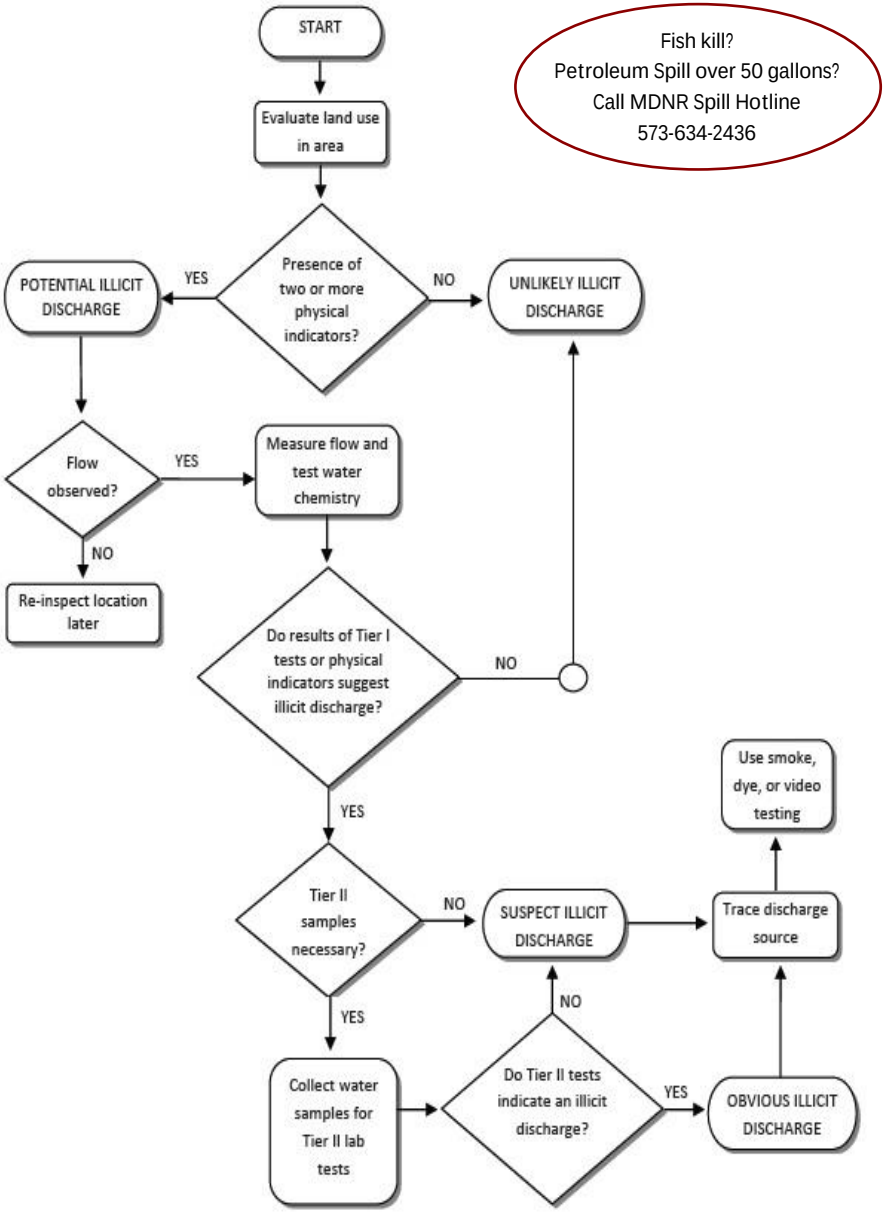
Illicit Flow Detection Process

Dry Weather Screening

- Minimum 48 hours with 0.1 inch or less of rain.
- Purpose is to identify non-stormwater sources in the stormwater system.
- Begin by visually inspecting for physical and biological indicators.

Wet Weather Screening

- Purpose is to identify sources of pollutants that wash into the stormwater system as a result of runoff-producing rain events.



Land Use by Sector	Generating Sites	Discharge-Producing Activities
Residential	• Apartments • Multi-family • Single family	• Car washing • Driveway cleaning • Dumping/spills • Equipment washdowns • Lawn/landscape watering • Septic system maintenance • Swimming pool discharges
Commercial	• Campgrounds/RV parks • Car dealers/ car rentals • Car washes • Commercial laundry/dry cleaning • Gas stations/auto repair • Marinas • Nurseries and garden centers • Oil change shops • Restaurants • Swimming pools	• Building/parking lot maintenance (power washing) • Dumping/spills • Landscaping/grounds care • Outdoor material storage • Vehicle fueling/washing • Vehicle maintenance/repair • Grease trap/equipment cleaning
Industrial	• Auto recyclers/scrap yards • Beverage makers and breweries • Construction vehicle washouts • Distribution centers • Food processing • Garbage truck washouts • Boat building and repair • Metal plating operations • Paper and wood products • Petroleum storage • Printing	• All commercial activities • Industrial process water or rinse water • Loading and unloading area washdowns • Outdoor material storage
Institutional	• Cemeteries • Churches • Corporate campuses • Hospitals • Schools and universities	• Building/parking lot maintenance (power washing) • Dumping/spills • Landscaping/grounds care • Vehicle washing
Municipal	• Airports • Animal shelters • Landfills • Maintenance depots • Municipal fleet storage areas • Public works yards • Streets and highways	• Building/parking lot maintenance (power washing) • Dumping/spills • Landscaping/grounds care • Outdoor materials storage • Road maintenance • Spill prevention/response • Vehicle fueling/washing • Vehicle maintenance/repair

Physical Indicators

Physical indicators are those that can be observed or sensed during dry weather field screenings and routine inspections. They 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.

Estimate Flowrate in cubic feet per second (cfs).

Method # 1: Measure time to fill a container of fixed volume.

Method # 2: Measure flow depth and width in feet to calculate flow area. To measure velocity, measure a fixed length (min. 5 feet) along the flow path and drop a floatable object (i.e. stick, ping-pong ball, or cork) into the flow. Record the time it takes the object to travel the fixed length then calculate velocity (feet per second, ft/s).

Flowrate = Flow Area x Velocity

Color

Collect a sample of the discharge in a clear test tube or sampling bottle.

Note: Do not try to assess 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.

Field Investigation Example

Diesel spill – City of Grand Prairie, TX



Photo courtesy of City of Grand Prairie

Members of Keep Grand Prairie Beautiful noticed a red substance in a ditch coming from an outfall.

The City of Grand Prairie traced the discharge back to a train that had lost approximately 700 gallons of red-dyed diesel when it was being fueled.

	Color	Possible Sources
1	Tan to light brown	• Suspended sediments common after rainfall • Runoff from construction, roads, agricultural/range land • Soil erosion caused by vegetation removal
2	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
3	Tea/coffee	• Dissolved or decaying organic matter from soil or leaves. Commonly associated with tree overhangs, woodlands, or swampy areas
4	Milky white	• Paint, lime, milk, grease, concrete, swimming pool filter backwash
5	Milky or dirty dishwater gray	• Gray water or wastewater, musty odor present
6	Milky gray-black	• Raw sewage discharge or other oxygen-demanding waste (rotten egg or hydrogen sulfide odor may be present)
7	Clear black	• Caused from turnover of oxygen-depleted waters or sulfuric acid spill
8	Dark red, purple, blue, black	• Fabric dyes, inks from paper and cardboard manufacturers
9	Orange-red	• Leachate from iron deposits • Deposits on stream beds often associated with mining operations (check for odor)
10	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)
11	Other (describe)	

Odor

Fill sample bottle at least halfway with sample water and hold about six inches away from your nose. Use your free hand to fan the scent to 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 that the origin of the odor is at the outfall. Sometimes shrubs, trash, or even spray paint used to mark the outfalls can confuse the nose.

	Odor	General Causes
1	Rotten eggs/hydrogen sulfide (septic)	• Raw sewage, decomposing organic matter, lack of oxygen
2	Chlorine	• Wastewater treatment plant discharges, swimming pool overflow, industrial discharges
3	Sharp, pungent odor	• Chemicals, pesticides or mining ops
4	Musty odor	• Mines, presence of raw or partially treated sewage or livestock waste
5	Gasoline, petroleum	• Industrial discharge, illegal dumping of wastes, waste water
6	Sweet, fruity	• Commercial wash water, wastewater
7	Other (describe)	

Field Investigation Example

Discharge of grain and corn
City of Fort Worth, TX

The City of Fort Worth was contacted after a strong septic odor and black liquid was noticed in a sump along the Trinity River. Fort Worth traced the source to an industrial facility violating their Texas Pollutant Discharge Elimination System (TPDES) stormwater permit by discharging grain and corn to the storm drain system.





Photos courtesy of City of Fort Worth

Turbidity

Causes of High Turbidity (cloudy appearance)

- 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.

Note: To measure turbidity, collect a water sample and use a Secchi tube, turbidity meter, or turbidity comparator in the field sampling kit.

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. (See photos page 9)
- 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 a swirling pattern, then likely oil or other fuel type. Check for petroleum odor. If sheet-like and cracks if disturbed, then it is natural.

Field Investigation Example

Manhole overflow - City of Denton, TX

Staff was notified by a resident of high flows, odor, and color changes in the water. The problem was traced to a manhole overflowing upstream that was caused by teens filling the manhole with rocks.



Photo courtesy of City of Denton

Examples

Sewage Discharge



Sewage fungus

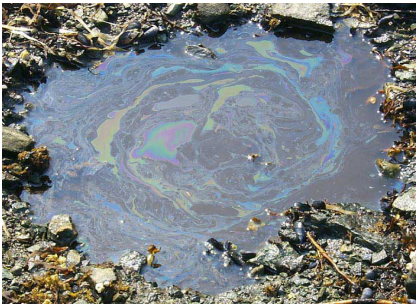


Bacteria growth in outfall

Natural Sheen vs. Synthetic Sheen



Natural sheen



Synthetic sheen

Foam and Suds



Low severity, naturally occurring suds



High severity suds

Sewage fungus photo courtesy of Wayne County Illicit Discharge Elimination Program, natural sheen image courtesy of NOAA's National Ocean Service, synthetic sheen photo courtesy of Jane Thomas, IAN Image Library (ian.umces.edu/imagelibrary/), all others courtesy of the Center for Watershed Protection.

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 which can help an inspector determine what type of discharge traveled through the area.

Field inspectors should document that a deposit or stain is present even if there is no dry weather discharge observed.

Condition	Things to Consider
Structural Damage	• Cracked, deteriorated concrete or peeling surface paint at an outfall 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



Potential outfall issue with presence of at least one physical indicator – paint stains

Photo courtesy of the Galveston County,TX Health District

Outfall Classifications

The Center for Watershed Protection (CWP) developed outfall classifications categorizing outfalls based on their characteristics and likelihood to pose a problem. Use these classifications to record the state of the outfall at the time of inspection.

	Classification	Description
1	Obvious	Flowing outfall where there is an illicit discharge that does not require sample collection for confirmation; exhibits physical indicators and field-measured chemical indicators
2	Suspect	Flowing outfall with high severity on one or more physical indicators
3	Potential	Flowing or non-flowing outfall with presence of two or more physical indicators
4	Unlikely	Non-flowing outfall with no physical indicators of an illicit discharge

Field Investigation Example

Dye discharge – City of Garland, TX

The City of Garland noticed a red color in a creek and traced it back to an outfall discharging from a soap and dye manufacturer. The company's night shift crew had washed down the work area and released the red water through a valve into the storm drain.



Photo courtesy of City of Garland

Biological Indicators

Biological indicators include things that live and grow. The biological indicators that should be investigated during a field inspection are: the condition of the surrounding vegetation, algae growth, amount and types of bacteria, fish kills, and the presence or absence of certain aquatic organisms.

Biological Indicators	Things to Consider
Vegetation	Seasonal and recent weather conditions should be considered to accurately determine if the vegetation near an outfall is normal or abnormal. 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 an algae bloom, the water body 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. Bacteria can be associated with inadequately treated sewage, sanitary sewer overflows, improperly managed waste from livestock, failing septic systems, and pets and wildlife (e.g., birds nesting under a bridge). Although some types of bacteria are 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	Fish kills can be caused by a wide variety of factors including a decrease in dissolved oxygen, infectious disease, a rise in water temperature, toxic algae blooms, parasites, and bacterial or viral infections. The loss of a single fish is typically a natural occurrence and is not usually a cause for concern.
Presence or Absence of Aquatic Life	The presence or absence of aquatic life in and around a water body can be an indicator of the health of the water body. Field inspectors should document whether or not they observe aquatic life at the time of inspection.

Chemical Indicators

Most chemical parameters have a test kit or meter available to determine the level of the pollutant.

Water Temperature

Although not purely chemical, temperature is probably one of the more important parameters to consider.

- Unusual temperature variations can indicate thermal pollution introduced by illegal discharges into the system.
- Household and commercial sewage discharges tend to have consistently warm temperatures year-round.
- Sanitary wastewater and industrial cooling water can substantially influence outfall discharge temperatures.

Celsius and Fahrenheit Conversions

°C	°F	°C	°F	°C	°F
0	32.0	13	55.4	26	78.8
1	33.8	14	57.2	27	80.6
2	35.6	15	59.0	28	82.4
3	37.4	16	60.8	29	84.3
4	39.2	17	62.6	30	86.0
5	41.0	18	64.4	31	87.8
6	42.8	19	66.2	32	89.6
7	44.6	20	68.0	33	91.4
8	46.4	21	69.8	34	93.2
9	48.2	22	71.6	35	95.0
10	50.0	23	73.4	36	96.8
11	51.8	24	75.2	37	98.6
12	53.6	25	77.0	38	100.4

Tier I Chemical Parameters

When conditions warrant (see flow chart on page 2), Tier I parameter testing should be a regular part of a field inspection. Parameter measurements at or above the recommended levels should be investigated further.

Unless otherwise indicated, the levels of concern listed on pages 14 and 15 are based on local experiences for identifying illicit discharges and are meant to serve only as a guide.

Tier I Parameters	Potential Sources	Level of Concern
Ammonia-Nitrogen	Microbial decomposition of animal and plant proteins, sanitary wastewater, raw or partially-treated sewage, petroleum refining and chemical industries, synthetic fibers and dyes, drugs, pesticides, and fertilizer	1.0 mg/L
Chlorine	Used to indicate inflow from potable water sources; used as disinfectant in water and wastewater treatment processes	0.2 mg/L
Conductivity	Used to measure total dissolved solids (TDS); TDS can increase as a result of wastewater discharges, irrigation, and overuse of fertilizers	1500 µS/cm
Copper	Can indicate waste from manufacture of electrical components, coins, bronze, and brass products	0.2 mg/L
Detergent	Can indicate a discharge from wash water or laundry	0.2 mg/L
pH	Extreme pH values (low or high) may indicate commercial or industrial flows	Below 6.0 su or above 9.0 su

Tier II Chemical Parameters

Tier II parameters do not typically need to be tested unless there is an obvious reason to do so. A field test may not be available for Tier II parameters, so samples may need to be taken to a lab for analysis.

Tier II Parameters	Potential Sources	Level of Concern
Bacteria (Fecal coliform; *E. coli*)✦	Can be found in the feces of human and other warm blooded animals from direct discharge	*400 col/100 mL - fecal coliform 394 col/100 mL - *E. coli*
Dissolved Oxygen (DO)✦	Low DO can indicate sewage problem or excessive nutrient load; as water temperature increases, DO generally decreases	**Exceptional - 4.0 mg/L High/Intermediate - 3.0 mg/L Limited - 2.0 mg/L Minimal - 1.5 mg/L
Fluoride	Potable water	0.5 mg/L
Lead	Used in construction material for tank linings, piping, and other equipment for corrosive gasses and liquids	0.1 mg/L
Nickel	Used in making stainless steel and other alloys, coinage, armor plates	0.2 mg/L
Nitrogen Nitrate Nitrite	High levels of nitrate may indicate biological waste or runoff from heavily fertilized areas; nitrites are often used as corrosion inhibitors in industrial process and cooling water and are used in food as preservatives	1.0 mg/L
Phosphates	Found in fertilizer and industrial waste	0.5 mg/L

* Recreation use, single sample criteria.
** Aquatic life use, minimum criteria.
✦Bacteria and DO levels from the Texas Commission on Environmental Quality's 2010 *Draft Guidance for Reporting and Assessing Surface Water Quality in Texas.*

Field Investigation Examples

High ammonia-nitrogen levels – City of Grand Prairie, TX

During routine stream sampling, the City of Grand Prairie detected very high ammonia-nitrogen levels. City staff were able to trace the contamination to a nearby grocery store where wastewater from an organics dumpster was leaking into the storm drain.

Photo right shows leaking from the dumpster and debris accumulation. Photo below shows leaking fluids going toward a nearby storm drain.





Photos courtesy of City of Grand Prairie

Change in pH and iron levels – City of Fort Worth, TX

City of Fort Worth staff noticed red staining and red water in a concrete-lined ditch. Stormwater investigators measured pH at several locations ranging from 5.0 su to 11.0 su. Iron levels exceeded 5.0 mg/L and a layer of fine sediment was found in the waterway. Fort Worth staff were able to trace the discharge back to a nearby bulk tank facility which, in cleaning a rainwater storage tank, released over 150,000 gallons of process water into the storm drain system.



Photo courtesy of City of Fort Worth

Tracing the Source of an Illicit Discharge

Once an illicit discharge has been found, the next step is to trace and remove the source of the discharge.

Storm Drain/Open Drainageway Network Investigations

This technique involves:

- Inspecting components of a storm drain system by using chemical and physical indicators to isolate discharges to specific segments of the network.
- Identifying where to inspect the network and what indicators to use to determine if a manhole or open conveyance is clean or contaminated.
- Developing a strategic plan for inspecting the pipe/drainageway network.

Option 1: Move up the trunk	Option 2: Split the storm drain network
◆ Work progressively up the trunk, or open drainageway, from the outfall and test manholes/open conveyances along the way ◆ Start with the manhole or open conveyance closest to the outfall or place illicit discharge was detected ◆ Goal is to isolate discharge between two storm drain manholes or open conveyances	◆ Split trunk into equal segments and test manholes or open conveyances at strategic junctions in the storm drain system ◆ Particularly suited to larger, more complex drainage areas since it can limit total number of storm system components to inspect



Note: manholes and confined spaces should only be entered by properly trained and equipped personnel. Check with your supervisor for the proper safety procedures.

Photo demonstrating manhole safety

Intermittent Discharges

This technique involves:

- Detecting intermittent discharges – those occurring at different times of the day or year and which do not occur on a frequent or regular basis.
- Using the following methods to capture and detect illicit discharges: sandbags, optical brightener monitoring (OBM) traps, automatic samplers, and the observation of deposits and stains.

Note: refer to the CWP IDDE manual for more detailed information on how to use these techniques.

Field Investigation Example

Glue discharge – City of Denton, TX

The City of Denton was notified by a resident when a white milky liquid was seen flowing down a concrete channel. They discovered that the liquid in question was glue and that local school district maintenance staff were washing out trash cans into the storm drain.

Photo to right shows glue rinse in drainage channel near the school. Photo below shows area of the school where district staff were rinsing trash cans into the storm drain.





Photos courtesy of City of Denton

On-Site Investigations

There are three basic approaches to on-site investigations that will help determine the actual source of an illicit discharge: dye, video, and smoke testing. Note: these techniques should be used when conducting a follow-up investigation once an illicit discharge has been found. Refer to the CWP IDDE manual for more detailed information on how to use these techniques.

Techniques	Best Applications	Limitations
Dye testing	• Discharge limited to very small drainage area (less than 10 properties is ideal) • Discharge probably caused by a connection from an individual property • Commercial or industrial land uses	• May be difficult to gain access to some properties • May require prior notice
Video testing	• Continuous discharge • Discharge limited to a single pipe segment • Entities with their own equipment for other investigations (water supply or sewer pipes)	• Relatively expensive equipment • Cannot capture non-flowing discharges • Often cannot capture discharges from submerged pipes
Smoke testing	• Cross-connection with the sanitary sewer • Identifying other underground sources caused by damage to the storm drain	• Poor notification to public can cause alarm • Cannot detect all illicit discharges

Before performing any dye or smoke testing, make sure to contact other city departments, spill response agencies, and downstream municipalities to let them know when and where these activities will take place.





Dye testing example on the left, video on the right. Both photos courtesy of the Center for Watershed Protection

PLANTS TO AVOID

Poison Ivy

- Common in Missouri
- Leaves can be smooth, toothed, or deeply notched
- New leaves are red in spring and green in summer
- Fall leaves are yellow, orange, and red
- Produces small, greenish-white clusters of flowers in spring and white, waxy berry-like fruits in fall
- Can be a climbing vine, a shrub, or even a small tree



Poison Ivy - Spring



Poison Ivy - Summer



Poison Ivy - Fall

Photos courtesy of www.poison-ivy.org

Poison Sumac



- Not documented in Missouri.
- Leaves are smooth and arranged in pairs of three to six with a single leaf at the terminal end of the stem
- Hanging fruits are whitish-green; non-poisonous varieties have red, upright fruits and jagged leaves

Photo courtesy of the Texas Parks and Wildlife Department © 2006

Poison Oak

- Oak-like leaves usually in clusters of three
- Can have yellow berries
- Grows as a low shrub in sandy soils or as a climbing vine
- Sprouting poison oak leaves can look very much like poison ivy



Photo courtesy of www.poison-ivy.org

VENOMOUS SNAKES TO AVOID

Copperhead

- Chestnut or reddish-brown crossbands
- Found along streams and rivers, as well as weed-covered vacant lots



Copperhead

Timber Rattlesnake

- Tan or yellowish-tan, with dark brown blotches along the back changing to bands near the tail
- Found in wooded areas, often on south facing hillsides and bluffs



Timber Rattlesnake

Cottonmouth (Water Moccasin)

- Dark brown, olive-brown, or almost solid black, may have lighter crossbands on underside
- Found in sluggish waterways, rivers, ponds, and streams



Cottonmouth

Pygmy Rattlesnake

- Small-bodied (15-20in.) greyish-brown. Brown dorsal stripe with black blotches on back.
- Found in glades, second growth forests near rock ledges and in powerline cuts through dense areas of forest.



Pygmy Rattlesnake

Photos courtesy of www.freesnake.com and www.muherpsociety.com

NOTES

If you encounter an illicit discharge and are outside your ability training, or knowledge, call the MDNR Spill Line: 573-634-2436. They are able to help evaluate the situation, offer technical advice, and dispatch help if needed.

NOTES

Important Contacts	
Organization	**Phone**
Missouri Environmental Emergency Response Hotline (Spill Line)	573-634-2436
EPA Region 7 Emergency Response Line	913-281-0991
National Response Center	800-424-8802
Joplin Public Works Department	417-624-0820
Non-emergency numbers for : Joplin Police Department Joplin Fire Department	 417-623-3131 417-623-0403

Create your own list of important local contacts using a waterproof marker or sticker label.

This guidance manual was adapted, with permission, by Allgeier, Martin and Associates, Inc. from a manual developed by the North Central Texas Council of Governments (NCTCOG). The manual is a compilation of several local, state, and national resources and is intended to serve as guidance for the Cities of Carl Junction, Duquesne, Oronogo, Carterville, and Joplin, Missouri to identify and eliminate illicit discharges and connections to their municipal separate storm sewer system (MS4).

For more information on Illicit Discharge Detection and Elimination, visit the Missouri Department of Natural Resources at http://www.dnr.mo.gov/env/wpp/stormwater/sw-local-gov-programs.htm .

HYDRO DIVISION

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