City of Ozark
Illicit Discharge Detection & Elimination Plan

Dry Weather Screening Plan

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GLOSSARY

The words and terms used in this Manual, unless otherwise expressly stated, shall have the following meaning:

Asset Data Base - is a data asset that is comprised of data records in software programs such as Arcview, Beehive, Connect and/or any other program used to access data.

Best Management Practices (BMP) -- are methods that have been determined to be the most effective and practical means of preventing or reducing non-point source pollution to help achieve water quality goals. BMPS include both measures to prevent pollution and measures to mitigate pollution.

Clean Water Act (CWA) – The Federal Water Pollution Control Act (33 U.S.C. 1251 et seq.), commonly referred to as the Clean Water Act, is designed to restore and maintain the chemical, physical, and biological integrity of the nation's waters by preventing point and nonpoint pollution sources, providing assistance to publicly owned treatment works for the improvement of wastewater treatment, and maintaining the integrity of wetlands.

Community – Designated boards, commissions, jurisdictions or representatives.

Cross-Connection - Any arrangement whereby backflow can occur.

Environmental Protection Agency (EPA) – A government agency concerned with the American environment and its impact on human health.

Floatable Material – Any foreign matter that may float or remain suspended in the water column, and includes but is not limited to, plastic, aluminum cans, wood products, bottles, and paper products.

Geographic Information System (GIS) – Any system that captures, stores, analyzes, manages, and presents data that are linked to a location.

Grab Sample - is a snapshot of a creek, stream or river at a specific time.

Hazardous Material – Any material including any substance, waste, or combination thereof, which because of its quantity, concentration, or physical, chemical, or infectious characteristics may cause, or significantly contribute to, a substantial present or potential hazard to human health, safety, property, or the environment when improperly treated, stored, transported, disposed of, or otherwise managed.

Household Sewage Treatment System (HSTS) – A system designed to treat home sewage on-site.

Hydrologic Unit Codes (HUC) – Are a way of identifying all of the drainage basins in the United States in a nested arrangement from largest (Regions) to smallest (Cataloging Units).

Illicit Connection – An illicit connection is defined as either of the following: Any drain or conveyance, whether on the surface or subsurface, which allows an illegal discharge to enter the storm drain system including, but not limited to, any conveyances which allow any non-stormwater discharge including sewage, process wastewater and wash water to enter the storm drain system and any connections to the storm drain system from indoor drains and sinks, regardless of whether said drain or connection had been previously allowed, permitted or approved by an authorized enforcement agency, or

Any drain or conveyance connected from a commercial or industrial land use to the storm drain system which has not been documented in plans, maps or equivalent records and approved by an authorized enforcement agency.

Illicit Discharge - "Any discharge to a municipal separate storm sewer that is not composed entirely of storm water, except discharges pursuant to a state operating permit, other than storm water discharge permits and discharges from fire fighting activities." 10 CSR 20-6.200(1)(D)7.

Illicit Discharge Detection and Elimination (IDDE) – To find, fix and prevent illicit discharges.

Material Safety Data Sheets (MSDS) – A form containing data regarding the properties of a particular substance intended to provide workers and emergency personnel with procedures for handling or working with that substance in a safe manner, and includes information such as physical data (melting point, boiling point, flash point, etc.), toxicity, health effects, first aid, reactivity, storage, disposal, protective equipment, and spill-handling procedures.

Missouri Department of Natural Resources (MODNR) – A government agency put in place to protect our air, land and water; preserve our unique natural and historic places; and provide recreational and learning opportunities

Missouri Department of Natural Resources Division of Environmental Quality (MODNR DEQ) – to help Missourians prevent pollution, protect the public from harmful emissions, discharges and waste disposal practices.

MS4: "A municipal separate storm sewer system" 10 CSR 20-6.200(1)(D)11.
"Municipal separate storm sewer means a conveyance or system of conveyances including roads and highways with drainage systems, municipal streets, catch basins, curbs, gutters, ditches, paved or unpaved channels, or storm drains designated and utilized for routing of storm water which—

1. Does not include any waters of the state as defined in section 644.016, RSMO.
2. Is owned and operated by the state, city, town, village, county, district, association, or other public body created by or pursuant to the laws of Missouri having jurisdiction over disposal of sewage, industrial waste, storm water, or other liquid wastes;
3. Is not a part or portion of a combined sewer system;
4. Is not a part of a publicly owned treatment works." 10 CSR 20-6.200(1)(D)16.

National Pollutant Discharge Elimination System (NPDES) – Storm Water Discharge Permit. Means a permit issued by EPA [or by a State under authority delegated pursuant to 33 USC § 1342(b)] that authorizes the discharge of pollutants to waters of the United States, whether the permit is applicable on an individual, group, or general area-wide basis.

Notice of Intent (NOI) – A notice that an environmental impact statement will be prepared and considered. The notice shall briefly:

1. Describe the proposed action and possible alternatives.
2. Describe the agency's proposed scoping process including whether, when, and where any scoping meeting will be held.
3. State the name and address of a person within the agency who can answer questions about the proposed action and the environmental impact statement.

Publicly Owned Treatment Works (POTW) – A term used in the United States for a sewage treatment plant that is owned, and usually operated, by a government agency.

Pollutant – Anything that causes or contributes to pollution. Pollutants may include, but are not limited to: paints, varnishes, solvents, oil and other automotive fluids, non-hazardous liquid and solid wastes, yard wastes, refuse, rubbish, garbage, litter or other discarded or abandoned objects, floatable materials, pesticides, herbicides, fertilizers, hazardous materials, wastes, sewage, dissolved and particulate metals, animal wastes, residues that result from constructing a structure, and noxious or offensive matter of any kind.

Quality Assurance Management Plans (QAMP) – An organization's quality system or its systematic approach to quality assurance.

Quality Assurance Project Plans (QAPP) – The activities of an environmental data operations project involved with the acquisition of environmental information whether generated from direct measurements activities, collected from other sources, or compiled from computerized databases and information systems.

Quality Assurance Quality Control (QA/QC) – The planned and systematic activities implemented in a quality system so that quality requirements for a product or service will be fulfilled.

Storm water Runoff – The flow of water which results from, and which occurs during and following a rainfall event.

Stormwater Management Plan (SWMP) -- The set of drawings and other documents that comprise all the information and specifications for the programs, drainage systems, structures, BMPs, concepts and techniques intended to maintain or restore quality and quantity of stormwater runoff to pre-development levels.

Stormwater Pollution Prevention Plan (SWPPP) -- The SWPPP is a site-specific written document that should identify industrial operations, and should identify practices that the site-specific industrial facility is implementing to prevent and minimize pollutants from reaching stormwater runoff.

Total Dissolved Solids (TDS) – The total amount of mobile charged ions, including minerals, salts or metals dissolved in a given volume of water.

Wastewater - Any water or other liquid, other than uncontaminated stormwater, discharged from a facility.

ACRONYMS

ABS – Alkyl Benzene Sulfonate
ATC – Automatic Temperature Compensation
BMP – Best Management Practices
CMP – Corrugated Metal Pipe
CWA – Clean Water Act
DEQ – Division of Environmental Quality
DIP – Ductile Iron Pipe
EPA – Environmental Protection Agency
EPD – Environmental Protection Division
FC – Fecal Coliform
GIS – Geographic Information System

GPS – Global Positioning System
HDPE – High Density Polyethylene
HSTS – Household Sewage Treatment Systems
HUC – Hydrologic Unit Code
IDDE – Illicit Discharge Detection and Elimination
LAS – Linear Alkylate Sulfonate
LDR – Land Development Regulation
MS4 – Municipal Separate Storm Sewer System
MODNR—Missouri Department of Natural Resources
NOI – Notice of Intent
NPDES – National Pollutant Discharge Elimination System
MSDS – Material Safety Data Sheets
POTW – Publicly Owned Treatment Works
PPM – Parts Per Million
PVC – Polyvinyl Chloride
QAMP – Quality Assurance Management Plans
QAPP – Quality Assurance Project Plans
QA/QC – Quality Assurance Quality Control
RCP – Reinforced Concrete Pipe
SCA – Standard Calibration Adjust
SWMP—Stormwater Management Plan
SWPPP—Stormwater Pollution Prevention Plan
TDS – Total Dissolved Solids
VCP – Vitrified Clay Pipe

INTRODUCTION

This manual is intended to serve as a guidance manual for the City of Ozark's Illicit Discharge Detection Elimination (IDDE) program, as required by the Missouri Department of Natural Resources (MODNR) and the (EPA) Environmental Protection Agency through a General National Pollutant Discharge Elimination System (NPDES) storm water Phase II permit. This manual profiles the IDDE minimum control measure, which is one of six Phase II regulated small Municipal Separate Storm Sewer System (MS4) measures required to be included in a storm water management program.

MS4

The State of Missouri defines a MS4 as "a conveyance or system of conveyances including roads with drainage systems, municipal streets, catch basins, curbs, gutters, ditches, man-made channels, or storm drains owned or operated by a municipality or other public body, designed or used for collecting or conveying storm water runoff and is not a combined sewer or part of a Publicly Owned Treatment Works (POTW)." 10 CSR 20-6.200(1)(D)16.

BACKGROUND OF PHASE II

Although the quality of the nation's waters has improved greatly since the passage of the Clean Water Act (CWA) in 1972, many water bodies are still impaired by pollution. According to the United States Environmental Protection Agency (EPA), the top causes of impairment include siltation, nutrients, bacteria, metals, and oxygen-depleting substances. Polluted stormwater runoff, including runoff from urban/suburban areas and construction sites are leading sources of impairment. To address this problem, EPA has put into place a program that regulates certain stormwater discharges.

In 1990, the EPA promulgated Phase I of its stormwater program under the NPDES permit provisions of the CWA. Phase I addressed stormwater runoff from "medium" and "large" MS4s generally serving populations of 100,000 or greater, construction activity that would disturb five or more acres of land, and 10 categories of industrial activity. To further reduce the adverse effects of stormwater runoff, the EPA instituted its Stormwater Phase II Final Rule on December 8, 1999.

The Phase II program regulates discharges from small MS4s located in "urbanized areas" (as delineated by the Census Bureau in the most recent census) and from additional small MS4s designated by the permitting authority.

The EPA's Stormwater Phase II Final Rule states that this stormwater management program must include the following six minimum control measures:

- Public education and outreach on stormwater impacts
- Public involvement and participation
- Illicit discharge detection and elimination
- Construction site stormwater runoff control
- Post-construction stormwater management in new development and redevelopment
- Pollution prevention and good housekeeping for municipal operations

WHY ARE ILLICIT DISCHARGE DETECTION AND ELIMINATION EFFORTS NECESSARY

Discharges from MS4s can often include wastes and wastewater from non-stormwater sources, including illicit discharges, which can enter the stormwater system through various means. The result of this is untreated discharges that contribute to high levels of pollutants, including heavy metals, toxics, oil and grease, solvents, nutrients, viruses, and bacteria to receiving water bodies. Pollutant levels from these illicit discharges have been shown in EPA studies to be high enough to significantly degrade receiving water quality and threaten aquatic, wildlife, and human health. Now, more than ever, it is necessary to create an awareness of what illicit discharges are doing.

PURPOSE OF IDDE PROGRAM

The purpose of an IDDE program is to find, fix and prevent illicit discharges, and develop a series of techniques to meet these objectives. This manual is designed to outline the City of Ozark's dry weather outfall screening procedures.

CHAPTER 1: ILLICIT DISCHARGE DETECTION AND ELIMINATION

ILLICIT DISCHARGE

An illicit discharge is defined by the State of Missouri General NPDES Stormwater permit as "any discharge to an MS4 that is not composed entirely of stormwater, except those discharges authorized under NPDES permit (other than the NPDES permit for discharges from the MS4) and discharges resulting from firefighting activities." 10 CSR 20-6.200(1)(D)7.

The general permit received by Phase II regulated communities requires that those communities develop an IDDE program. This program will assist communities in meeting their requirement set forth in their General NPDES Stormwater permits.

Figure 1: Illicit Discharge

TYPES OF ILLICIT DISCHARGES

Illicit discharges can be separated into three (3) categories based on frequency of discharge

- **Transitory Illicit Discharge**: These are typically a one-time event. They can result from spills, dumping, and line breaks and are often the most difficult to investigate and trace back to its source.

- **Intermittent Illicit Discharge**: These are typically discharges that occur occasionally. They can occur several hours per day, week or over the course of a year and can happen as the result of line breaks or cross connections.

- **Continuous Illicit Discharge**: These direct connections into the MS4 can be from sanitary sewers, cross connections, infrastructure problems with a sanitary sewer system, or malfunctioning household sewage treatment systems (HSTS). This type of discharge is the easiest to find, investigate, trace and eliminate from the MS4. This type of discharge also has the greatest impact because of the constant pollutant loading into a water body.

TABLE 1-1
TRANSITORY OR INTERMITTENT ILLICIT DISCHARGES

Land Use	Likely Source Locations	Condition/Activity that Produces Discharge
Residential	• Apartments • Duplex • Multi-Family • Single Family Detached	• Car Washing • Driveway Cleaning • Dumping/Spills • Equipment Wash-Downs • Lawn/Landscape watering • Septic System Maintenance • Swimming Pool Discharges • Sump Pumps • Laundry Wastewater • Improper Plumbing (e.g. garage floor drains)
Commercial	• Campgrounds/RV Parks • Car Dealers/ Rental Car Company • Car Washes • Laundry or Dry Cleaners • Gas Stations/Auto Repair Shops • Nurseries and Garden Centers • Oil Change Shops • Restaurants • Swimming Pools • Service Garages	• Dumping/Spills • Landscaping/Grounds Care (e.g. irrigation) • Outdoor Fluid Storage • Parking Lot Maintenance (e.g. power washing) • Sump Pumps • Vehicle Fueling • Vehicle Maintenance/Repair • Vehicle Washing • Wash-down of Greasy Equipment & Grease Traps • Building Maintenance (power washing)
Industrial	• Beverages and Brewing	• All Commercial Activities

	• Construction Vehicle Washouts • Distribution Centers • Food Processing • Metal Plating Operations • Paper and Wood Products • Petroleum Storage and Refining • Printing	• Industrial Process Water or Rinse Water • Loading and Un-loading Area Wash-downs • Outdoor Material Storage (e.g. fluids)
Municipal	• Landfills • Maintenance Depots • Municipal Fleet Storage Areas • Public Works Yards • Streets and Highways • Golf Courses • Other County and State Facilities	• Building Maintenance (e.g. power washing) • Dumping/Spills • Landscaping/Grounds Care (e.g. irrigation) • Parking Lot Maintenance (e.g. power washing) • Road Maintenance • Emergency Response • Vehicle Maintenance/Repair • Vehicle Washing

Source: Modified from *Illicit Discharge Detection and Elimination: A Guidance Manual for Program Development and Technical Assessments*, Center for Watershed Protection, 2004, p. 12, Table 2.

TABLE 1-2
CONTINUOUS ILLICIT DISCHARGES

Land Use	Condition or Activity that Produces Discharge
Residential	• Failed sanitary sewer infiltrating into stormwater system • Sanitary sewer connection into stormwater system • Failed septic systems discharging stormwater system
Commercial/Industrial	• Failed sanitary sewer infiltrating into stormwater system • Process water connections into stormwater system • Sanitary sewer connection into stormwater system
Municipal	• Failed sanitary sewer infiltrating into stormwater system • Sanitary sewer connection into stormwater system

Source: *Guidelines and Standard Operating Procedures for Stormwater Phase II Communities in Maine*, Casco Bay Estuary Partnership.

The tables outlined above examine the likely source locations that contribute illicit discharges to an MS4. Land use can predict the potential for these discharges. By understanding the possible discharges emanating from land use activities, it allows for the IDDE program manager to thoroughly utilize this knowledge in identifying illicit discharges and their potential sources.

MODE OF ENTRY

Illicit discharges can also be classified based on how they enter the stormwater system. This entry can be direct or indirect.

1. **Direct entry**: The discharge is directly connected to the stormwater system via a pipe. This type of entry will produce discharges that are either continuous or intermittent. Direct entry usually occurs when there are sewage cross-connections, or where there are industrial and commercial cross-connections.

2. **Indirect entry**: Flows, which are generated outside the stormwater system, enter through stormwater inlets or by infiltrating through the joints of the pipe. Generally, indirect modes of entry produce intermittent or transitory discharges. This type of entry can include groundwater seepage into the stormwater pipe, spills, dumping, outdoor washing activities, and irrigation from landscaping or lawns that reaches the stormwater system.

WHAT ARE THE ELEMENTS OF AN EFFECTIVE IDDE PROGRAM

At a minimum, the MODNR requires the permittee to incorporate the following:

1. The MS4 Operator shall implement, and enforce a program to detect and eliminate illicit discharges (as defined in 10 CSR 20-6.200 at 40 CFR 122.26(b)(2)) into the regulated MS4.

2. Develop a storm sewer system map showing the location of all MS4 outfalls, and the names and location of all receiving waters of the state that receive discharges from those outfalls. This also must include the boundary of the regulated MS4 area.

3. To the extent allowable under law, effectively prohibit, through ordinance or other regulatory mechanism, non-stormwater discharges into your storm sewer system and implement appropriate enforcement procedures and actions.

4. Develop and implement a plan to detect and address non-stormwater discharges, including illegal dumping to your system, as well as a program for dry weather inspections.

5. Inform public employees, businesses, and the general public of hazards associated with illegal discharges and improper disposal of waste.

6 .Develop and implement or maintain a training program for all municipal field staff, who, as part of their normal job responsibilities, may come into contact with or otherwise observe an illicit discharge or illicit connection to the storm sewer system.

DOES THE IDDE PROGRAM ADDRESS ALL ILLICIT DISCHARGES

The IDDE program is specifically directed towards addressing pollution within the MS4. Under the EPA rules for Phase II IDDE Program, Non- Stormwater discharges examples that are exempt;

- Water line flushing
- Landscape irrigation
- Diverted stream flows
- Rising ground waters
- Uncontaminated ground water infiltration
- Uncontaminated pumped ground water
- Discharges from potable water sources
- Foundation drains
- Air conditioning condensation

- Irrigation water
- Springs
- Sump pumps
- Footing drains
- Lawn watering
- Individual residential car washing
- Flows from riparian habitats and wetlands
- Dechlorinated swimming pool discharges
- Street wash water
- Non-stormwater discharges covered by a National Pollution Discharge Elimination System (NPDES) Permit and/or State Waste Discharge General Permit
- Dust control materials that are applied in compliance with local and state policy and/or law.

Discharges or flows from firefighting activities are excluded from the effective prohibition against non stormwater and need only be addressed where they are identified as significant sources of pollutants to the waters of the State of Missouri.

CHAPTER 2: MAPPING / INVENTORY

MAPPING

The Missouri MOR04C permit requires MS4's to "develop, if not already completed, a storm sewer system map showing the location of all outfalls and the names and location of all surface waters of the State receiving discharges from those outfalls". The City of Ozark completed mapping the stormwater system in 2015, using Geographic Information System (GIS) data supplied by Midland GIS. The inventory is maintained on our asset database and updated by the GIS departments as as-built drawings are submitted to the city.

The City of Ozark's GIS Department created an updated outfall map (2021) of the cities entire MS4. See Appendix A, Outfall Locations and Appendix B, Outfall Maps

Figure 2: City Outfall Map

INVENTORY

The stormwater infrastructure data for the MS4 was collected by City staff and Midland GIS staff using a Global Positioning System (GPS) unit. The data features collected included catch basins, junction boxes, manholes, storm pipes, outfalls, flared end sections, culverts, valves, valve stands water lines, sewer mains, forced mains, etc. For each feature, specific information was gathered including size, material, type, length, date and the GPS' location, comments, reference number, condition, ownership, etc.

The GIS information is used to update our asset database (Beehive), which is used by the Public Works employees on a daily basis for various tasks including inspections and cleaning of the MS4. As a result of the City maintaining a very extensive GIS database, including roads, parcels, addresses, etc., the GIS Department is able to digitally map inspections, cleanings, complaints, etc. By digitally mapping this type of information (e.g. outfall inspections), the City is able to ensure that all outfalls are inspected within a five year timeframe.

To ensure that the City meets the Notice of Intent (NOI) annual requirements of inspecting 20% of the MS4 outfalls, staff is provided a monthly goal. Outfall inspections are dependent on the weather so if the monthly goal is not met, staff must ensure that the inspections are met in the upcoming months and plan accordingly.

CHAPTER 3: INSPECTION AND DEVELOPING PRIORITY AREAS

Another mandatory requirement of a Phase II IDDE program states, "Each Permittee shall develop, implement and enforce a program to detect and eliminate illicit discharges into the MS4". This plan includes the following components:

1. Locate priority areas within your community;
2. Field assessment of high priority water bodies;
3. Characterize the nature of the outfall and potential public or environmental threat;
4. Trace the source of an illicit discharge;
5. Remove the source of the illicit discharge;
6. Program evaluation and assessment

Developing priority areas is vital to any community IDDE program. This process can be broken down into three fundamental steps:

1. Use all available information to identify the potential "hot spots" in the community
2. Conduct dry weather field screenings to locate non-stormwater discharges
3. Conduct water quality sampling and analysis to determine what non-stormwater discharges are present

HOT SPOTS

The first step in locating priority areas is to identify possible hot spots within the City of Ozark. These hot spots are areas where there is a potential for illicit discharges to occur. These can be broken down into a list of commonly high probability locations where illicit discharges may be occurring.

1. Locations where there have been repeated problems in the past. This includes locations with known water quality data, as well as locations where numerous complaints have been received.
2. Older areas of a community may indicate possible locations where there will be illicit discharges

detected. These locations in a community may have a higher percentage of illegal connections and/or have deteriorating utility infrastructure leading to infiltration problems.

3. The commercial and/or industrial areas of the community.

DETECTION AND INSPECTIONS

Dry weather screening inspections must be conducted on all known MS4 outfalls. Dry weather inspections are a visual inspection of the outfall location. Dry weather is defined as a minimum of 72 hours of no rainfall (0.1”) within an area. When performing an effective dry weather screening process, be sure to do the following:

- Utilize the information obtained in the mapping component. (Arcview, Beehive, Connect or the Stormwater Map)
- Fill out the Detention/Retention Pond / Structure Inspection (Appendix C). The following is a list of observations needed for this component, and are listed on the field format:
- Date
- Time
- Address
- Inspector/Signature
- Outfall location/ID
- Type of inspection
- Structural Components
- Pond Conditions
- Comment section for: Flow, odor, color, turbidity, floatables

The above information is for dry weather visual inspections only.

PHYSICAL INDICATORS

During dry weather visual inspections, it is important to indicate the conditions observed at an outfall location. This includes: flow, odor, color, turbidity, and if floatables are present at the location. The information obtained from the physical characteristics observed are indicators and cannot be fully relied upon by themselves. Floatables are the best physical indicator. The most common floatables are sewage, suds, and oil sheens. The observation of sewage at an outfall location indicates that there is a severe problem with that MS4 and should be looked at as to where the source for the sewage is originating from. Suds can indicate a variety of things. Some suds are naturally formed by the movement of the water. If the suds are located at water drop off and break up quickly, this may only be water turbulence related. If the suds have a fragrant odor, this can indicate the presence of laundry water or wash water in the waterbody. Oil sheens need to be looked at to try and determine the source of the oil sheen. Some oil sheens are common and occur naturally by in-stream processes. This occurs when an iron bacteria forms a sheet-like film. This can be determined by looking at the sheen and seeing if it cracks when disturbed. Synthetic oil sheens, on the other hand, will swirl when disturbed. If this occurs, then the sheen is from an oil source.

When dry weather flows are observed at an outfall, the flow is considered non-stormwater related. This flow can be an illicit discharge, but it may also be a flow being generated from another action that is not considered illicit (See Chapter 1). Likewise, if no flow is observed at an outfall, it does not mean that there is not a problem at that specific outfall. In Chapter 1, different types of illicit discharges including continuous, intermittent and transitory, were discussed. The continuous flows are the easiest to locate while the other two are not. That is why it is important to observe the area at each outfall’s location for any type of observable pollution problem that may be the result of an intermittent or transitory illicit discharge.

It is extremely important for IDDE staff to recognize that during field inspections, the outfall is observed as a snapshot in time. To ensure that the City has an effective IDDE program, at a minimum, 20% of the outfalls will be inspected on an annual basis, so that in five years the entire outfall inventory will be inspected. Since the total number of outfalls change due to improvements and/or new development, contact your supervisor for the most accurate number and your monthly goals.

WATER QUALITY SAMPLING AND TESTING

When dry weather flows are observed, it will be difficult to determine if there is a problem with that flow. Obvious problems, such as strong sewage odor, or the presence of raw sewage or toilet paper, will indicate a bacterial problem at that location coming from sanitary sewers, cross connections or septic systems. However, in most circumstances, water that is observed during dry weather conditions will not have those visual indicators. That is why water quality testing and sampling is a vital component for an IDDE program.

Certain water quality parameters can serve as indicators of the likely presence or absence of a specific type of discharge. Some of these parameters can be measured in the field with specific instrumentation and field sample kits, while others will need to be analyzed at a laboratory. The City of Ozark uses the following parameters:

Table 3-1: Water Quality Test Parameters And Uses		
Water Quality Test	**Use of Water Quality Test**	**Comments (see: WAC 173-201A)**
Conductivity	Used as an indicator of dissolved solids	- Typically field measured with a probe
Bacteria (fecal coliform, *E. coli* and/or *enterococci*)	Used to indicate the presence of sanitary wastewater	- Potential health hazard
Ammonia (NH3-N)	High levels can be an indicator of the presence of sanitary wastewater	- Potential heath hazard - TMDL wasteload allocation
Surfactants	Indicate the presence of detergent (e.g., laundry, car washing)	- Pitt et al. 1993 suggested parameter; EPA Phase II regulations recommended parameter
pH	Extreme pH values (low or high) may indicate commercial or industrial flows; not useful in determining the presence of sanitary wastewater (which, like uncontaminated base flows, tends to have a neutral pH, i.e., close to 7)	- Typically measured in the field or lab with a probe
Temperature	Sanitary wastewater and industrial cooling water can substantially influence outfall discharge temperatures. This measurement is most useful during cold weather.	- Measured in the field with a thermometer or probe - TMDL wasteload allocation
Turbidity (or TSS)	Indicates the amount of solids suspended in water.	- Measured in the field with a turbidity meter
Total Chlorine	Used to indicate inflow from potable water sources; not a good indicator of sanitary wastewater because chlorine will not exist in a "free" state in water for long	- Pitt et al. 1993 suggested parameter
Potassium	High levels may indicate the presence of sanitary wastewater	- Pitt et al. 1993 suggested parameter
Optical Brighteners (Fluorescence)	Used to indicate presence of laundry detergents (can contain fabric whiteners, which cause substantial fluorescence)	-Pitt et al. 1993 suggested parameter
CBOD (Dissolved Oxygen)	Low DO can indicate high Phosphorus, or other potential problems	- TMDL wasteload allocation - Measured with probe
Copper, Total	May indicate urban runoff or industrial flows	-TMDL wasteload allocation
Zinc, Total	May indicate urban runoff or industrial flows	- TMDL wasteload allocation
TP (Total Phosphorus)	High phosphorus can indicate sewage and/or illegal gray water connections, fertilizer or other contamination	- TMDL wasteload allocation

Source: ***Table Modified from Illicit Discharge Detection and Elimination Manual: A Handbook for Municipalities*, New England Interstate Water Pollution Control Commission**

The above table indicates that there are a number of water quality parameters that can be used to look for specific problems in communities. When deciding on what water quality parameters to use, the IDDE program manager must be aware of the community makeup and the possible sources of illicit discharges as well as how much money is available to complete water quality sampling. It is not necessary to do lab analysis on every sample

When developing the IDDE program protocol for sampling, it is important to have a monitoring plan in place. This can involve the utilization of Standard Methods reference documents as well as a Quality Assurance Project Plan (QAPP), or Quality Assurance Management Plan (QAMP). These plans will provide for proper quality assurance and quality control of proper sampling procedures. This will be important to validate your data. This will include proper calibration of field equipment and meters, how to properly take samples and keep them cold for the proper amount of time until delivered to the lab, and it will indicate how you will ensure the samples are valid (field blanks and replicate samples).

Also, it is important to take into account the resources that are available for the IDDE sampling portion of their program. During the sampling phase, utilizing a meter to obtain some of this information is a worthwhile endeavor. There are a series of meters that can be used for temperature, turbidity, pH, and conductivity. The lab analysis of samples is where there can be a high cost for communities. When determining what you want to sample for, look at the community as a whole and the potential problems within that community. In many circumstances, the problems may be with infrastructure. Where there are older sanitary and storm sewer lines, the problems may be with infiltration from the sanitary to the storm sewer. In most cases, the first sampling parameter should be for bacteria. Fecal coliform is an indicator organism found in the intestines of warm blooded mammals. When it is found in high quantities, this is an indicator of a bacterial problem.

The dry weather inspections and the water quality testing will provide valuable information for an effective IDDE program. By establishing a consistent protocol for these inspection strategies, IDDE managers will acquire quality data that will support the elimination of illicit discharges. Also, by performing long term dry weather inspections, a protocol will be set in place to view MS4 outfalls and ensure they are not discharging pollutants into the surface waters of the state. By starting a sampling protocol and continuing this protocol on a yearly basis, an IDDE Program will develop baseline data relating to outfall discharges. This will allow staff to efficiently work on problem areas by directing their resources wisely by utilizing the sampling data. It will also allow staff to evaluate their MS4s over a long period of time and make decisions that will promote improvements in problem areas.

There is no single indicator parameter that is perfect. Table 3-2 summarizes the parameters that meet most of the indicator criteria, compares their ability to detect different flow types, and reviews some of the challenges that may be encountered when measuring them.

The Data in Table 3-2 is based on research by the Center for Watershed Protection and Robert Pitt conducted outside of the northwestern United States. Therefore, the percentages shown to distinguish "hits" for specific flow types should be viewed as representative and may shift for the City of Ozark. Also, in some instances, indicator parameters were "downgraded" to account for regional variation or dilution effects. For example, both color and turbidity are excellent indicators of sewage based on discharge fingerprint data, but both can vary regionally depending on the composition of clean groundwater." (Center for Watershed Protection and Pitt, 2004)

Table 3-2. Indicator Parameters Used to Detect Illicit Discharges					
	Discharge Types It Can Detect				
Parameter	Sewage	Wash water	Tap Water	Industrial or Commercial Liquid Wastes	Laboratory/Analytical Challenges
Ammonia	#	*	x	*	Can change into other nitrogen forms as the flow travels to the outfall
Boron	*	*	x	N/A	
Chlorine	x	x	x	*	High Chlorine demand in natural waters limits utility to flows with very high chlorine concentrations
Color	*	*	x	*	
Conductivity	*	*	x	*	Ineffective in saline waters
Detergents-Surfactants	#	#	x	*	Reagent is a hazardous waste
E. coli Enterococci Total Coliform	*	x	x	x	24-hour wait for results. Need to modify standard monitoring protocols to measure high bacteria concentrations
Copper or Zinc	x	x	#	*	Analytical Method: EPA 200.8
Hardness	*	*	*	*	
pH	x	*	x	*	Meter/Paper[3]
Potassium	*	x	x	#	May need to use two separate analytical techniques, depending on the concentration
Turbidity	*	*	x	*	Analytical Method: EPA 180.1 Meter

\# Can almost always (>80% of samples) distinguish this discharge from clean flow types (e.g., tap water or natural water). For tap water can distinguish from natural water.
* Can sometime (>50% of samples) distinguish this discharge from clean flow types depending on regional characteristics, or can be helpful in combination with another parameter
x Poor indicator. Cannot reliably detect illicit discharges, or cannot detect tap water.
N/A Data are not available to assess the utility of this parameter for this purpose.
Data Source: Pitt (this study)
[3] Use either a calibrated pH meter or narrow-range pH indicator paper with a resolution not greater than ± 0.5 SU.

SOURCE: *Table modified from Illicit Discharge Detection and Elimination: A Guidance Manual for Program Development and Technical Assessments*, Center for Watershed Protection

QUALITY ASSURANCE PROJECT PLANS (QAPP)

Developing a Quality Assurance Project Plan (QAPP) is important to ensure that water samples are obtained using a consistent and approved protocol. This is to ensure that the data collected is accurate. The QAPP will dictate where to collect samples, when to collect, how to collect, calibration of equipment (meters), storage of samples, chain of custody, and transportation of samples to lab. It is important to have all field staff properly trained for sample collecting.

EQUIPMENT FOR WATER SAMPLING

When performing water quality sampling, it is important to have adequate equipment. This includes, but not limited to:

- Cooler;
- Ice;
- Bottles: These will depend on the parameter being sampled for. The lab that you utilize for analysis may provide you the bottle that is required. Keep bottles in a safe environment to prevent cross contamination from occurring;

- Labels for bottles: In many circumstances, the lab will have the bottles pre-labeled. If not, obtain the labels that the lab recommends for labeling the bottles;
- Permanent marker for bottles;
- Field forms;
- Latex gloves;
- Meters: depends on what parameters and what type of meter purchased for use; and
- Test kits.

Whenever a water sample is taken at a MS4 outfall location, fill out the "Inspection Form" from Appendix D and make sure the time of sample is indicated. This is important when delivering samples to the lab. Use a lab that has a Quality Assurance/Quality Control policy in place and one that routinely performs this type of analysis for consistency purposes.

SPECIAL MONITORING

Some of the monitoring that will be required will involve different techniques. If an outfall location shows physical signs of a problem, but no flow is observed, then that illicit discharge is either an intermittent or transitory discharge. These do not flow continuously and may be difficult to observe.

Once an outfall is determined to have a possible illicit discharge associated with it and no flow is observed, then an alternate inspection and sampling program must be used. This can include the following:

- **Odd hours of monitoring:** Perform inspections either later in the evening or early morning hours or on the weekends. Since many types of intermittent discharges probably occur when residents are home, then the inspection needs to be performed during these time**s** as well. Make sure that if samples will be collected during odd times, the lab needs to be notified to ensure they can accept and analyze the sample since there are specific holding times for each type of parameter.

- **Sampling at the outfall plunge pool:** A sample would be collected directly from the plunge pool below the outfall, if one is present. An upstream sample will also be taken to compare the results. This can be affected by dilution and time so it may not be completely accurate. The plunge pool test will however, determine if additional investigation is warranted

SAMPLING PROCEDURES AND SUBMISSION

Field Screening

The field screening part of dry weather monitoring consists of a series of qualitative field observations and field analyses of selected water quality parameters. General site observations (e.g. weather conditions, outfall type/material, etc.) are recorded on the Detention/Retention Pond/ Structure Inspections form.(Appendix   Field measurements will be taken and recorded on the data sheet where there is flowing water, provided there has been no rain event during the last 72 hours. If no flow is observed during the outfall screening, the “Flow from outfall” field should be checked “No” and the screening is complete. This result will be counted towards the total number of outfalls screened. If flow is observed during the outfall screening, the “Flow from Outfall” field should be checked “yes” and both the Field Observations and Measurements and the Water Quality Sampling portions of the screening form should be completed.

Field Sample Collection

Water quality sampling of a dry weather flow is performed to look for chemical indicators which may detect, characterize or confirm the presence of an illicit discharge or illegal connection. Sampling may be undertaken either using field test kit equipment or by collecting grab samples for laboratory analysis. Follow the kit manufacturer's procedures for obtaining a test sample and completing the field analysis. Record the field analysis results on the screening form.

<u>Performing a grab sample</u>

- Label sample containers before sampling event
- Take a cooler with ice to the sampling point
- Put on latex gloves before taking sample
- Take the grab from the horizontal and vertical center of the channel
- Avoid stirring up bottom sediments in the channel
- Hold the container so the opening faces upstream
- Avoid touching the inside of the container to prevent contamination
- Keep the sample free from uncharacteristic floating debris
- Transfer samples into proper containers (e.g., from bucket to sample container), however, FC should remain in original containers
- If taking numerous grabs, keep the samples separate and labeled clearly
- Use safety precautions

FIELD TESTING PROCEDURES

Temperature

Although temperature may be one of the easiest measurements to perform, it is probably one of the more important parameters to be considered. It dramatically affects the rates of chemical and biochemical reaction within the water. Many biological, physical, and chemical principles depend on the temperature. Some of the most common of these are the solubility of compounds in water, distribution and abundance of organisms living in the water, rates of chemical reactions, density inversions and mixing, and current movements.

Shallow bodies of water, such as small streams and stormwater ditches are much more susceptible to temperature changes because their capacity to store heat over time is also relatively small.

In a stormwater system, unusual temperature variations could indicate thermal pollution introduced by illegal discharges into the system.

Measuring for Temperature

When you have collected the water sample in the appropriate container, remove the container from direct sunlight and wind. Do not hold the body of the bottle in your hands because your hands might begin to warm the water, instead hold it by its lid. Put the conductivity meter in the container to record the value to the nearest 0.5 degrees C. Record reading in the space provided on your data form. The temperature should be near or below ambient conditions for groundwater or stormwater runoff.

TABLE 3-2
CELSIUS / 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

PH

PH is a measure of how acidic or basic (alkaline) a solution is. The pH scale ranges from 0 to 14 and is a means of showing which ion has the greater concentration. At a pH 7.0, the concentration of both ions is equal and the water is said to be neutral, neither acidic nor alkaline. Pure water has a pH of 7.0. When the pH is less than 7.0, there are more hydrogen ions than hydroxyl ions and the water is said to be acidic. When the pH is greater than 7.0, there are more hydroxyl ions than hydrogen ions and the water is said to be basic or alkaline.

Water's ability to resist changes in pH, or its buffering capacity, is critical to aquatic life. Generally, an aquatic organism’s ability to complete a life cycle greatly diminishes as pH becomes greater than 9.0 or less than 5.0. There are several activities in water that can severely affect the pH. Mineral substances are dissolved, aerosols and dust from the air are picked up, and manmade wastes are dumped into the water.

A pH meter is an electronic instrument used to measure the pH of a liquid. A typical pH meter consists of a special measuring probe (a glass electrode) connected to an electronic meter that measures and displays the pH reading. The pocket pH meter is most appropriate for use out in the field. It is a small handheld device that can be easily transported from place to place. This type of meter provides quick and accurate pH readings.

Calibrating the pH Meter

These steps should be performed at least 24 hours before pH testing is performed. Prior to testing, calibrate your meter using the method recommended by the manufacturer of your particular meter.

Surfactants

Detergents contain synthetic or organic surface active agents called surfactants, which are derived from petroleum product precursors. They have the common property of lowering the surface tensions of water thus allowing dirt or grease adhered to various articles to be washed off. Industrial facilities use detergents to clean machinery. Soap manufacturers and households will also discharge anionic detergents into the surface water. The problem with these types of discharges is that surfactants can present significant environmental pollution problems. In aquatic environments, surfactants may form a surface film and reduce oxygen transfer at the water surface. Some surfactants may be acutely toxic to aquatic organisms. Detergents can damage fish gills by stripping them of their natural oils, thus interrupting oxygen transfer. Surfactants and detergents may also cause suds or foam to form on surface waters, which is aesthetically displeasing. Furthermore, this foam often contains nutrients such as nitrogen and phosphorous which can, in turn, provoke algae blooms. Surfactants can also alter the hydraulic characteristics of soils, affecting the movement of contaminants through soils and into groundwater. Surfactants are very slow to biodegrade and have carcinogenic and reproductively toxic byproducts such as nonylphenol, which is currently regarded as a potent endocrine disrupter.

Analytical Laboratory Sample Collection

The remaining samples to be collected include FC and Surfactants (if the reading is greater than 0.2 mg/l). Use appropriate containers for the parameter being tested, as directed by the POTW laboratory.

Complete the following tasks:

- Fill out the chain-of custody form making sure that all sample bottles are correctly labeled
- Carefully pack the sample bottles in the cooler
- Transport the samples to the POTW laboratory
- Complete the chain-of-custody form

Sampling for Bacteria - Fecal Coliform or E. Coli

Bacteria samples are collected from water flowing directly from the discharging outfall by leaving the lid on the sample bottle and lowering the bottle to the mid-depth position, then removing the lid and allowing the container to fill. Store samples in an ice chest at ≤ 6˚ C until custody is transferred to the POTW laboratory. Samples collected for laboratory analysis should be submitted to the POTW as soon as possible after collection. **Bacteria samples must be delivered to the laboratory within 6 hours of collection**. The grab sample bottle type, preservation requirements, and holding time requirements should be met for each sample collected. If the results from the sample are greater than 1,000 per 100mL, begin investigation.

Sampling for Surfactants

Samples are collected from water flowing directly from the discharging outfall by leaving the lid on the sample bottle and lowering the bottle to the mid-depth position, then removing the lid and allowing the container to fill. Store samples in an ice chest at ≤ 4˚ C until custody is transferred to the contracted laboratory. **Surfactant samples must be delivered to the laboratory within 48 hours of collection**.

Recording Data

Record all qualitative observations and field testing results on the Dry Weather Outfall Screening Form (Appendix C) and the Sample Data Tracking Form (Appendix D). If a discharge is found, record investigation procedures on the Investigation Notes section of the Dry Weather Outfall Screening Form (Appendix C). Also note any changes to standard procedures, for whatever reason, and describe any unusual or noteworthy conditions or results in detail on the bottom of the form.

Disposal

Dispose of all spent reagents, reacted samples, and rinse solutions in the appropriate waste containers. Upon returning to the office or laboratory, pour these wastes into the sanitary sewer system of the office or laboratory. Be sure to clean all equipment, recheck calibration if any results were questionable, and restock reagents if necessary.

SPECIAL MONITORING

If an outfall location shows physical signs of a problem, but no flow is observed, then that illicit discharge is either an intermittent or transitory discharge. These do not flow continuously and may be difficult to observe.

Once an outfall is determined to have a possible illicit discharge associated with it and no flow is observed, then an alternate inspection and sampling program must be used. This can include the following:

<u>Odd hours of monitoring</u>: Perform inspections either later in the evening, early morning, or on the weekends. Since many types of intermittent discharges probably occur when occupants are present, then the inspection needs to be performed during these times as well. Make sure that if samples will be collected during odd times, the POTW laboratory needs to be notified to ensure they can accept and analyze the sample since there are specific holding times for each type of parameter.

<u>Sampling at the outfall plunge pool</u>: A sample would be collected directly from the plunge pool below the outfall, if one is present. An upstream sample will also be taken to compare the results. This can be affected by dilution and time so it is not always that accurate and effective.

EQUIPMENT MAINTENANCE

In order to ensure the quality of field results, maintenance of equipment must be given a high priority.

- All equipment must be cleaned and serviced at the end of a field shift.
- All water quality meters must be calibrated in the laboratory or office before field use. Calibration solutions should remain uncontaminated and not be used after their expiration dates.
- Field meters and cameras must be in proper working order. Make sure that batteries have sufficient voltage to power the equipment for the entire field trip. Recharge or replace them as necessary. Keep extra batteries in case they are needed. Probes should be inspected, cleaned and reconditioned regularly.
- Clean and rinse all other sampling equipment after returning from the field. Store clean equipment in storage cases.
- Glassware used in the field (e.g. graduated cylinders for sample dilutions, test kit flasks and/or beakers) should be cleaned immediately after usage. Rinse three to four times with deionized water and wipe the outside of the glassware dry with a white paper towel. Dry in an inverted position.

HEALTH AND SAFETY

Dry weather water sampling may occur when the sampling environment and discharges create hazardous conditions. Use safety precautions at all times when conducting dry weather monitoring.

• Keep a first aid kit and fire extinguisher in the vehicle.
• Watch out for traffic along the access road when sampling or making observations.
• Park vehicle off-road, if possible, and turn hazard lights on.
• Do NOT remain in open areas or stand under trees if lightning is occurring in the vicinity.
• Watch your step. The ground may be wet, slippery, steep, or unstable. Do not attempt to climb down unsafe slopes.
• Always wear clean latex rubber gloves when sampling.
• Protect eyes and skin against contact with acids and preservatives.
• Wear appropriate attire (i.e., hat, safety boots, gloves, safety glasses and long pants).
• Be aware of your environment. Watch for snakes, ticks, bees, poison ivy, etc.
• Use common sense when deciding whether to sample during adverse weather conditions. This program is intended to assess dry weather conditions. Do not sample during dangerous conditions such as high winds, lightning storms, or flooding conditions that might be unsafe.
• Do not enter channels during periods of high flow. The general rule of thumb is: If the product of the water depth in feet and the velocity in feet per second is greater than 10, or the level is above your waist, don't go in.
• Do not enter confined spaces.
• Follow all analytical procedures as prescribed in the equipment manuals. Give careful attention to warnings and precautionary statements.
• Be familiar with Material Safety Data Sheets (MSDS) for all chemicals used in the field and when calibrating instruments. Know the health hazards and emergency medical treatments, and follow proper disposal instructions.

Safety Equipment

The following safety equipment is recommended for use during dry weather sampling:

• First aid kit
• Latex gloves
• Rubber boots or waders
• Safety vest

CHAPTER 4: TRACING FOR THE SOURCE OF AN ILLICIT DISCHARGE

Once an illicit discharge has been identified and detected, the next step is to locate the source of discharge. The development of a plan to locate and address illicit discharges is required under the Phase II Stormwater Rules. "EPA recommends that the plan include the following five components:"

1. Locate the priority areas
2. Sample or screen the outfall
3. Trace the source of an illicit discharge
4. Remove the source of the illicit discharge
5. Program evaluation and assessment

During the inspection process, illicit discharges may be located and detected. Once these outfall locations are determined to have an illicit discharge, staff must start the tracing protocol to determine where the source of illicit discharge is originating from. Once located, this discharge needs to be eliminated from the community's MS4 system.

TRACING TECHNIQUES

There are a number of different techniques that can be utilized to trace for an illicit discharge. When a dry weather flow or illicit discharge is documented, the City will initiate source tracing. Each technique listed must be fully understood and its limitations.

Visual Inspections of Stormwater Network

Once a dry weather flow is observed and it has been determined to be an illicit discharge, inspections along the specific MS4 conveyance system must occur. Typically, if the conveyance system is an open ditch, this is an easier process then if it is within an enclosed stormwater system. The inspection process utilizing this method needs to start at the initial detection location – the MS4 outfall where the illicit discharge has been observed and noted. The next step is to work "upstream" from this location – that is moving up the stormwater system to the first stormwater junction box. Check this junction box to see if there is evidence of flow. If flow is present, you may wish to sample the junction box; however, it is not required. If flow is observed at this junction box, move to the next upstream junction box. Keep moving upstream until no flow or low flow is observed. Keep in mind that as you move upstream, there may be junction lines entering the stormwater system at other locations. Utilize the stormwater maps to determine if this is the case. In these circumstances, you will need to check these junction boxes as well.

During this inspection process, key observations are necessary, including:

- Presence of flow
- Odors
- Colors/clarity
- Stains or deposits on the bottom of structure(s)
- Oil sheen, scum or foam on any standing water

Figure 3: Dye at outfall location

Dye Testing

Once the area has been determined where the potential illicit discharge source is located, the utilization of dye testing will assist in determining the exact location of the illicit discharge. Permission is required on private property prior to starting a dye test procedure. If a dye test is needed on the inside of a building, permission is required. Once permission is granted, the dye testing will begin. The dye needs to be put into the suspect location. This is done by pouring the dye into sinks, toilets, etc. and then flushed through the sanitary sewer system. The stormwater and sanitary sewers need to be monitored to observe where the dye discharges to. This procedure is effective in determining direct connections of sanitary lines to storm lines.

Televising/Video Inspection

Another method in determining where the illicit discharge source is located, is televising the storm line. Video cameras can be used by either pushing or using a mobile video unit. Both cameras will provide detailed information as to where the infiltration or connection is located within the MS4 system.

Indicator Monitoring / Sampling

When dry weather flow is observed at an outfall location, and the sample reveals that there is a problem with this flow, further monitoring can be done to assist in the location of the illicit discharge. As junction boxes are opened and dry weather flow is observed, samples can be taken and analyzed. During this process, we are looking for a pattern within the sample analysis, depending on the parameter sampled for. During this type of tracing, monitoring will allow staff to determine if the dry weather flow observed is the source of the flow at the outfall location. There can be circumstances where dry weather flow occurs and it is not "illicit" due to its source (See Chapter 1). This flow can combine with an illicit source in the stormwater system making it difficult to trace. By monitoring the water observed, it will assist in the tracing of the illicit source discharging into the stormwater system.

Automatic Samplers can also be used during the investigation of intermittent flows. These samplers can be placed at specific locations within the stormwater system of a community. These samplers can be triggered by dry weather flows. This type of sampling and monitoring is not the best method for most communities due to the cost of the sampling equipment. This type of monitoring can be effective however, in areas with a large intermittent discharge problem and/or very complex stormwater system. These samplers will provide the date and time the sample was collected which will assist the community in locating the source of this discharge.

Smoke Testing

This method should be used during special circumstances when a good storm sewer map is not available for a location and there are known problems of connection issues. Smoke is introduced into the storm drainage system and will emerge at locations that are connected to that system. It is recommended that qualified personnel be used for this method to ensure accurate test results.

CHAPTER 5: THE OUTFALL RECONNAISSANCE INVENTORY

This chapter describes a simple field assessment known as the Outfall Reconnaissance Inventory (ORI). The ORI is designed to fix the geospatial location and record basic characteristics of individual storm drain outfalls, evaluate suspect outfalls, and assess the severity of illicit discharge problems in a community. Field crews should walk all natural and manmade streams channels with perennial and intermittent flow, even if they do not appear on available maps. The goal is to complete the ORI on every stream mile in the MS4 within the first permit cycle, starting with priority sub watersheds identified during the desktop analysis. The results of the ORI are then used to help guide future outfall monitoring and discharge prevention efforts.

BEST TIMES TO START

Timing is important when scheduling ORI field work. In most regions of the country, spring and fall are the best seasons to perform the ORI. Other seasons typically have challenges such as over-grown vegetation or high groundwater that mask illicit discharges, or make ORI data hard to interpret.

Table 31: Preferred Climate/Weather Considerations for Conducting the ORI

Preferred Condition	Reason	Notes/Regional Factors
Low groundwater (e.g., very few flowing outfalls)	High groundwater can confound results	In cold regions, do not conduct the ORI in the early spring, when the ground is saturated from snowmelt.
No runoff-producing rainfall within 48 hours	Reduces the confounding influence of storm water	The specific time frame may vary depending on the drainage system.
Dry Season	Allows for more days of field work	Applies in regions of the country with a "wet/ dry seasonal pattern." This pattern is most pronounced in states bordering or slightly interior to the Gulf of Mexico or the Pacific Ocean.
Leaf Off	Dense vegetation makes finding outfalls difficult	Dense vegetation is most problematic in the southeastern United States. This criterion is helpful but not required.

EQUIPMENT

Basic field equipment needed for the ORI includes boots, a measuring tape, watch, camera, GPS unit, and surgical gloves (see Table 30). Cell phones can be utilized for GPS coordinates and a camera function, conventional cameras can also work, as long as they have flashes. Handheld data recorders and customized software can be used to record text, photos, and GPS coordinates electronically in the field. While these technologies can eliminate field sheets and data entry procedures, they can be quite expensive. Field crews should always carry basic safety items, such as cell phones, surgical gloves, and first aid kits.

Table 30: Resources Needed to Conduct the ORI		
Need Area	**Minimum Needed**	**Optional but Helpful**
Mapping	• Roads • Streams	• Known problem areas • Major land uses • Outfalls • Specific industries • Storm drain network • SIC-coded buildings • Septics
Field Equipment	• 5 one-liter sample bottles • Backpack • Camera (preferably digital) • Cell phones or hand-held radios • Clip boards and pencils • Field sheets • First aid kit • Flash light or head lamp • GPS unit • Spray paint (or other marker) • Surgical gloves • Tape measure • Temperature probe • Waders (snake proof where necessary) • Watch with a second hand	• Portable Spectrophotometer and reagents (can be shared among crews) • Insect repellant • Machete/clippers • Sanitary wipes or biodegradable soap • Wide-mouth container to measure flow • Test strips or probes (e.g., pH and ammonia)
Staff	• Basic training on field methodology • Minimum two staff per crew	• Ability to track discharges up the drainage system • Knowledge of drainage area, to identify probable sources. • Knowledge of basic chemistry and biology

STAFFING

The ORI requires at least a two-person crew, for safety and logistics. Three person crews provide greater safety and flexibility, which helps divide tasks, allows one person to assess adjacent land uses, and facilitates tracing outfalls to their source. All crew members should be trained on how to complete the ORI and should have a basic understanding of illicit discharges and their water quality impact. ORI crews can be staffed by trained volunteers, watershed groups and college interns. Experienced crews can normally expect to cover two to three stream miles per day, depending on stream access and outfall density

COMPLETING THE ORI

Field crews conduct an ORI by walking all streams and channels to find outfalls, record their location spatially with a GPS unit and physically mark them with spray paint or other permanent marker. Crews also photograph each outfall and characterize its dimensions, shape, and component material, and record observations on basic sensory and physical indicators. If dry weather flow occurs at the outfall, additional

OUTFALLS TO SURVEY

The ORI applies to all outfalls encountered during the stream walk, regardless of diameter, with a few exceptions noted in Table 32. Common outfall conditions seen in communities are illustrated in Figure 4 As a rule, crews should only omit an outfall if they can definitively conclude it has no potential to contribute to a transitory illicit discharge. While EPA's Phase I guidance only targeted major outfalls (diameter of 36 inches or greater), documenting all outfalls is recommended, since smaller pipes make up the majority of all outfalls and frequently have illicit discharges (Pitt et al., 1993 and Lalor, 1994). A separate ORI field sheet should be completed for each outfall.

Table 32: Outfalls to Include in the Screening

Outfalls to Record	Outfalls to Skip
• Both large and small diameter pipes that appear to be part of the storm drain infrastructure • Outfalls that appear to be piped headwater streams • Field connections to culverts • Submerged or partially submerged outfalls • Outfalls that are blocked with debris or sediment deposits • Pipes that appear to be outfalls from storm water treatment practices • Small diameter ductile iron pipes • Pipes that appear to only drain roof downspouts but that are subsurface, preventing definitive confirmation	• Drop inlets from roads in culverts (unless evidence of illegal dumping, dumpster leaks, etc.) • Cross-drainage culverts in transportation right-of-way (i.e., can see daylight at other end) • Weep holes • Flexible HDPE pipes that are known to serve as slope drains • Pipes that are clearly connected to roof downspouts via above-ground connections

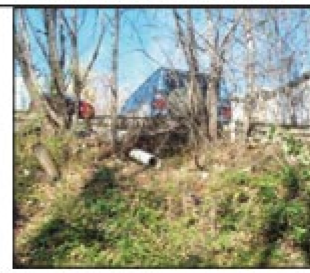
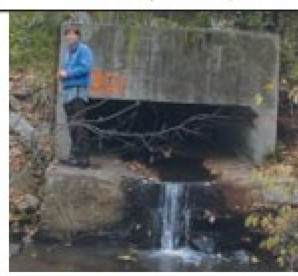
 Ductile iron round pipe	 4-6" HDPE; Check if roof leader connection (legal)	 Field connection to inside of culvert; Always mark and record.
 Small diameter (<2") HDPE; Often a sump pump (legal), or may be used to discharge laundry water (illicit).	 Elliptical RCP; Measure both horizontal and vertical diameters.	 Double RCP round pipes; Mark as separate outfalls unless known to connect immediately up-pipe
 Culvert (can see to other side); Don't mark as an outfall	 Open channel "chute" from commercial parking lot; Very unlikely illicit discharge. Mark, but do not return to sample (unless there is an obvious problem).	 Small diameter PVC pipe; Mark, and look up-pipe to find the origin.
 CMP outfall; Crews should also note upstream sewer crossing.	 Box shaped outfall	 CMP round pipe with two weep holes at bridge crossing. (Don't mark weep holes)

Figure 4: Typical Outfall Types Found in the Field

OBVIOUS DISCHARGES

Field crews may occasionally encounter an obvious illicit discharge of sewage or other pollutants, typified by high turbidity, odors, floatables and unusual colors. When obvious discharges are encountered, field crews should STOP the ORI survey, track down the source of the discharge and immediately contact the appropriate water pollution agency for enforcement. Crews should photo-document the discharge, estimate its flow volume and collect a sample for water quality analysis (if this can be done safely). All three kinds of evidence are extremely helpful to support subsequent enforcement.

These include material, and presence of flow at the outfall, as well as the pipe's dimensions. These measurements are used to confirm and supplement existing storm drain maps (if they are available).

Below are some photos that illustrate how to characterize relative submergence, deposition and flow at outfalls.

Figure 5: Characterizing Submersion and Flow

PHYSICAL INDICATORS FOR FLOWING OUTFALLS ONLY

There are 4 sensory indicators associated with flowing outfalls—odor, color, turbidity and floatables. Sensory indicators can be detected by smell or sight, and require no measurement equipment. Sensory indicators do not always reliably predict illicit discharge, since the senses can be fooled, and may result in a “false negative” (i.e., sensory indicators fail to detect an illicit discharge when one is actually present). Sensory indicators are important, however, in detecting the most severe or obvious discharges.

ODOR

Since noses have different sensitivities, the entire field crew should reach consensus about whether an odor is present and how severe it is. A severity score of one means that the odor is faint or the crew cannot agree on its presence or origin. A score of two indicates a moderate odor within the pipe. A score of three is assigned if the odor is so strong that the crew smells it a considerable distance away from the outfall.

COLOR

The color of the discharge, which can be clear, slightly tinted, or intense, is recorded next. Color can be quantitatively analyzed in the lab, but the ORI only asks for a visual assessment of the discharge color and its intensity. The best way to measure color is to collect the discharge in a clear sample bottle and hold it up to the light. Field crews should also look for downstream plumes of color that appear to be associated with the outfall. Figure 6 illustrates the spectrum of colors that may be encountered during an ORI survey, and offers insight on how to rank the relative intensity or strength of discharge color. Color often helps identify industrial discharges.

TURBIDITY

The ORI asks for a visual estimate of the turbidity of the discharge, which is a measure of the cloudiness of the water. Like color, turbidity is best observed in a clear sample bottle, and can be quantitatively measured using field probes. Crews should also look for turbidity in the plunge pool below the outfall, and note any downstream turbidity plumes that appear to be related to the outfall. Field crews can sometimes confuse turbidity with color, which are related but are not the same. Remember, turbidity is a measure of how easily light can penetrate through the sample bottle, whereas color is defined by the tint or intensity of the color observed. Figure 6 provides some examples of how to distinguish turbidity from color, and how to rank its relative severity.

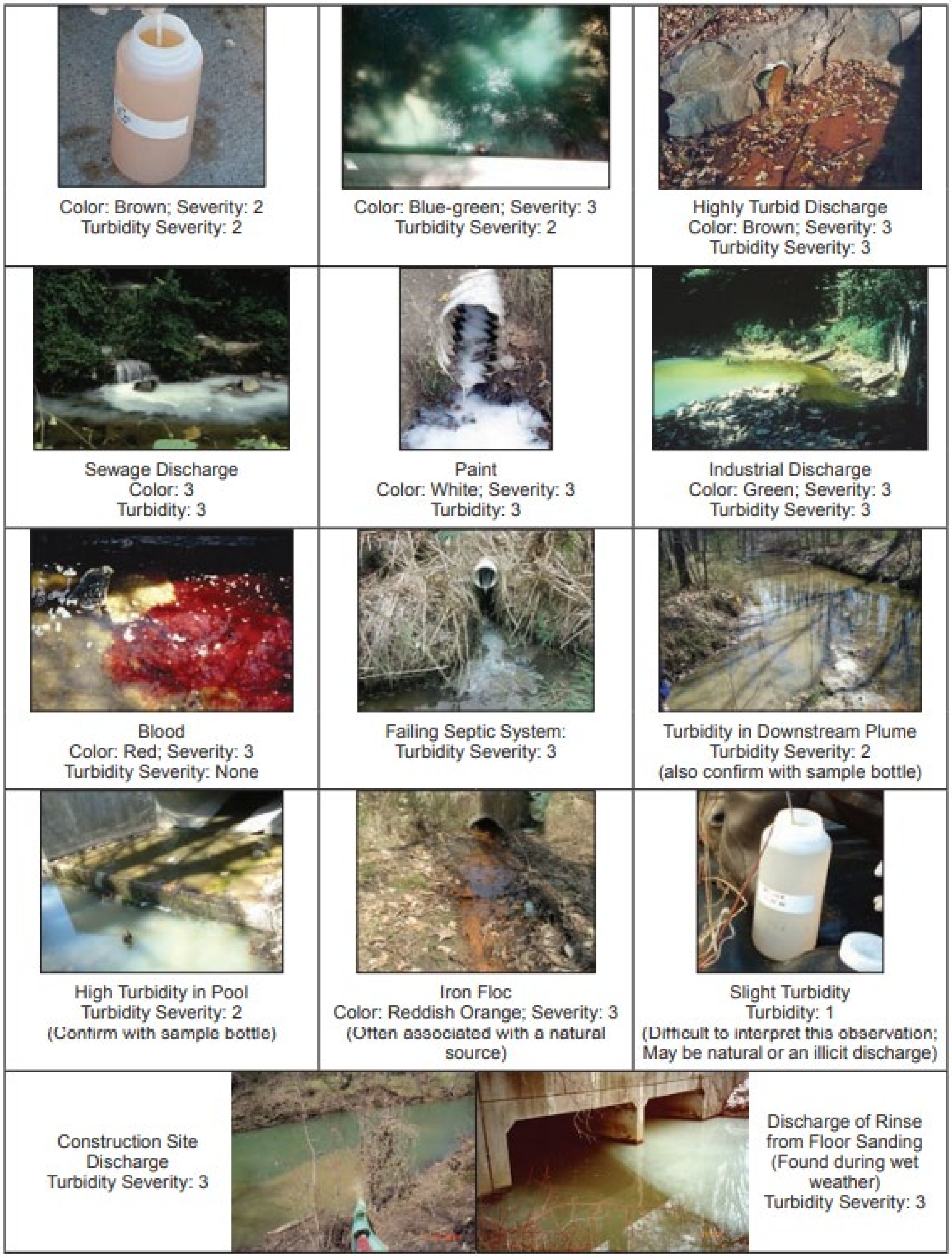


Figure 6: Interpreting Color and Turbidity

FLOATABLES

The last sensory indicator is the presence of any floatable materials in the discharge or the plunge pool below. Sewage, oil sheen, and suds are all examples of floatable indicators; trash and debris are generally not in the context of the ORI. The presence of floatable materials is determined visually, and some guidelines for ranking their severity are provided in Figure 6, and described below.

Suds that break up quickly may simply reflect water turbulence, and do not necessarily have an illicit origin. Indeed, some streams have naturally occurring foams due to the decay of organic matter. On the other hand, suds that are accompanied by a strong organic or sewagelike odor may indicate a sanitary sewer leak or connection. If the suds have a fragrant odor, they may indicate the presence of laundry water or similar wash waters.

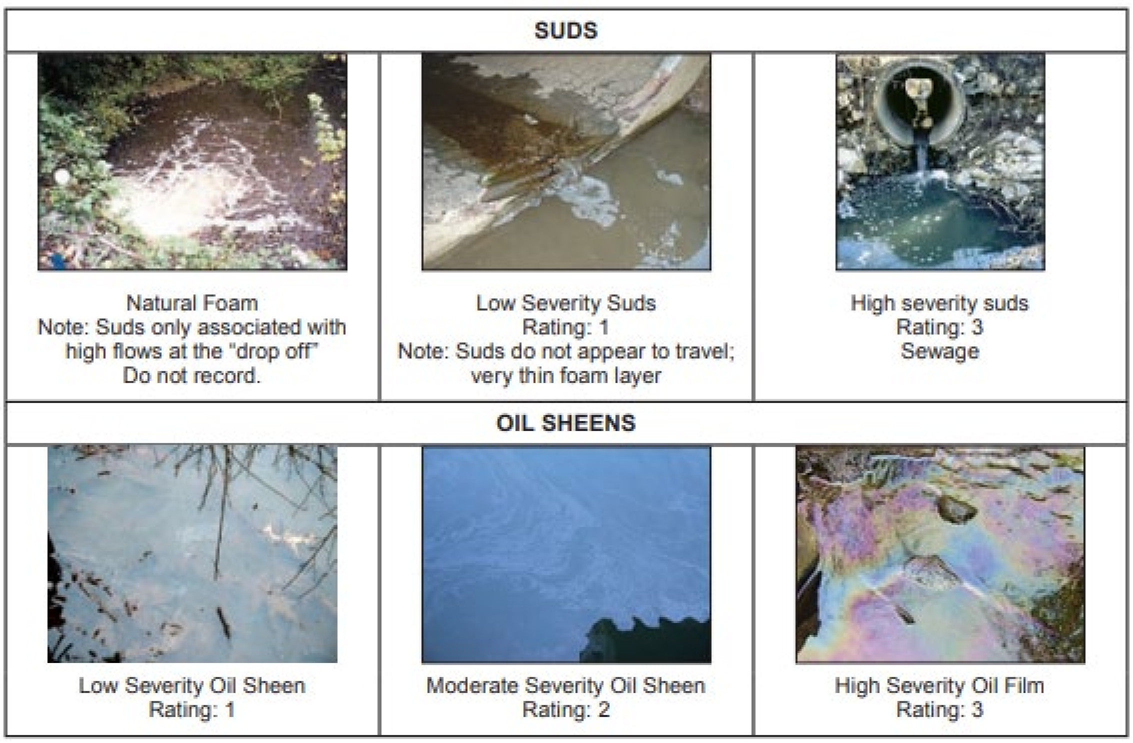


Figure 7: Determining the Severity of Floatables

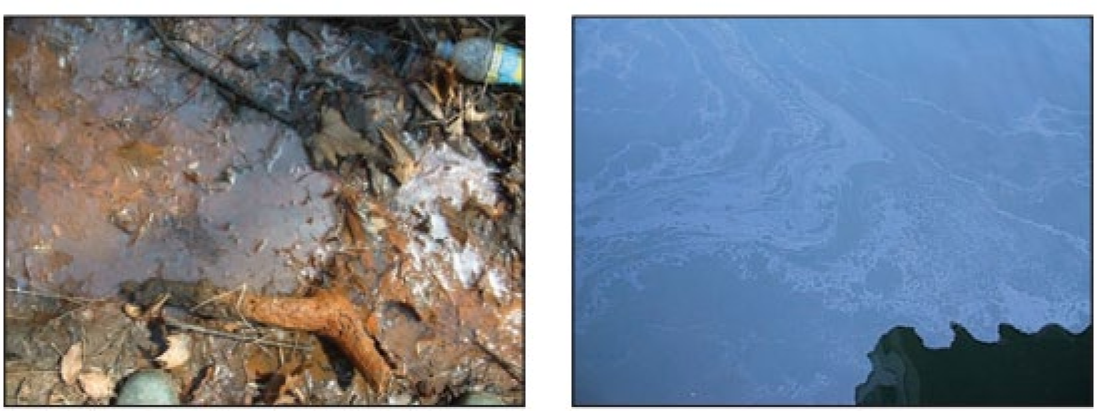
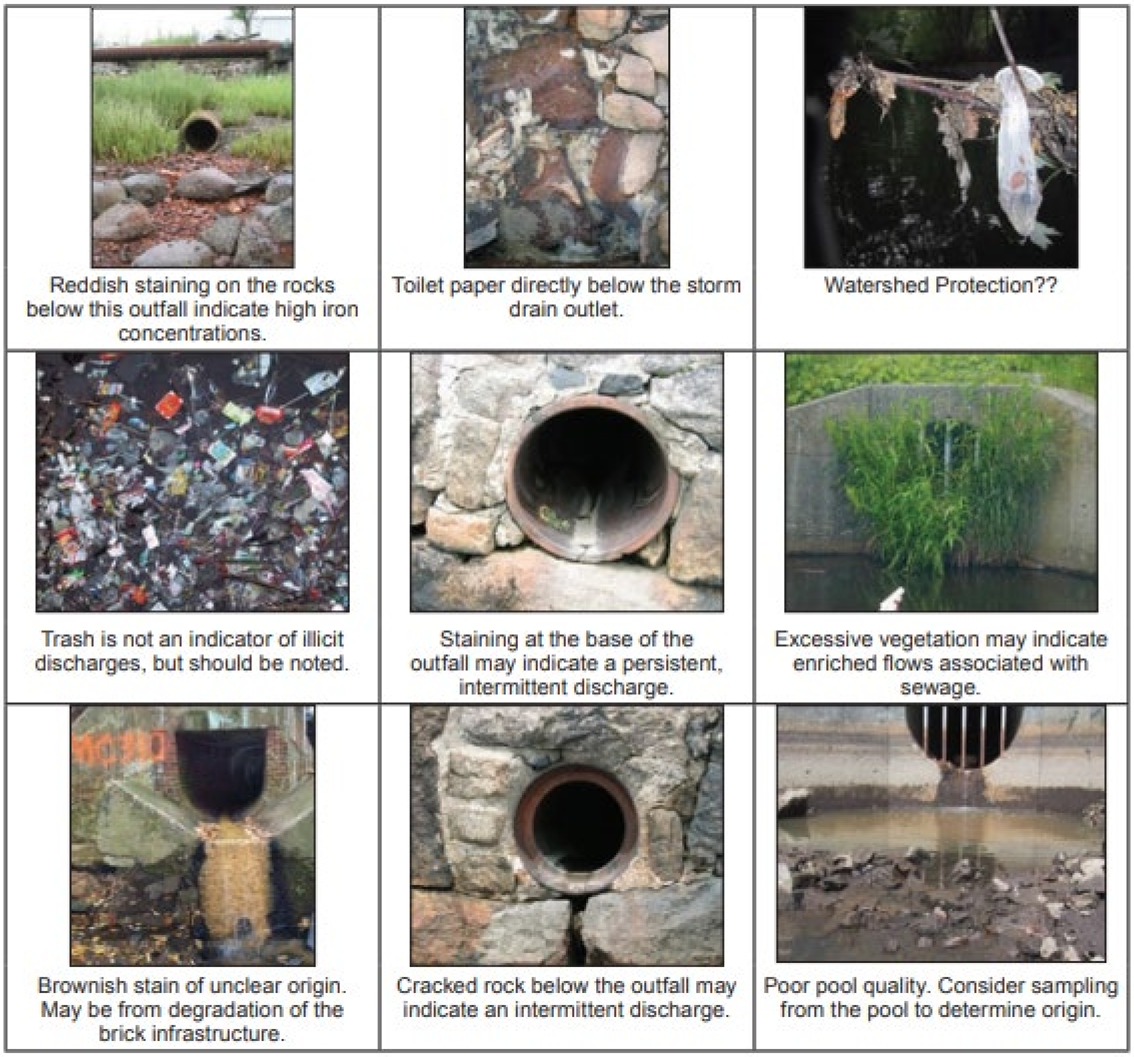


Figure 8: Synthetic versus Natural Sheen (a) Sheen from bacteria such as iron floc forms a sheet-like film that cracks if disturbed (b) Synthetic oil forms a swirling pattern

PHYSICAL INDICATORS FOR BOTH FLOWING AND NON-FLOWING OUTFALLS

Physical indicators include outfall damage, outfall deposits or stains, abnormal vegetation growth, poor pool quality, and benthic growth on pipe surfaces. Common examples of physical indicators are portrayed in Figures 9 and 10. Many of these physical conditions can indicate that an intermittent or transitory discharge has occurred in the past, even if the pipe is not currently flowing. Physical indicators are not ranked according to their severity, because they are often subtle, difficult to interpret and could be caused by other sources. Still, physical indicators can provide strong clues about the discharge history of a storm water outfall, particularly if other discharge indicators accompany them.

Figure 9: Interpreting Benthic and Other Biotic Indicators



Reddish staining on the rocks below this outfall indicate high iron concentrations.

Toilet paper directly below the storm drain outlet.

Watershed Protection??

Trash is not an indicator of illicit discharges, but should be noted.

Staining at the base of the outfall may indicate a persistent, intermittent discharge.

Excessive vegetation may indicate enriched flows associated with sewage.

Brownish stain of unclear origin. May be from degradation of the brick infrastructure.

Cracked rock below the outfall may indicate an intermittent discharge.

Poor pool quality. Consider sampling from the pool to determine origin.

Figure 10: Typical Findings at Both Flowing and Non-Flowing Outfalls

OPEN CHANNELS

Field crews face special challenges in more rural communities that have extensive open channel drainage. The ditches and channels serve as the primary storm water conveyance system, and may lack storm drain and sewer pipes. The open channel network is often very long with only a few obvious outfalls that are located far apart. While the network can have illicit discharges from septic systems, they can typically only be detected in the ORI if a straight pipe is found. Some adaptations for open channel systems are suggested in Table 33.

Table 33: Special Considerations for Open Channels/Submerged Outfalls	
OPEN CHANNELS	
Challenge	**Suggested Modification**
Too many miles of channel to walk	Stop walking at a given channel size or drainage area
Difficulty marking them	Mark on concrete or adjacent to earth channel
Interpreting physical indicators	For open channels with mild physical indicators, progress up the system to investigate further.
SUBMERGED/TIDALLY INFLUENCED OUTFALLS	
Challenge	**Suggested Modification**
Access for ORI – Tidal Influence	Access during low tide
Access for ORI – Always submerged	Access by boat or by shore walking
Interpreting physical indicators	For outfalls with mild physical indicators, also inspect from the nearest manhole that is not influenced by tides
Sampling (if necessary)	Sample "up pipe"

INTERPRETING ORI DATA

The ORI generates a wealth of information that can provide managers with valuable insights about their illicit discharge problems, if the data are managed and analyzed effectively. The ORI can quickly define whether problems are clustered in a particular area or spread across the community. This section presents a series of methods to compile, organize and interpret ORI data, including:

1. Basic Data Management and Quality Control
2. Outfall Classification
3. Simple Suspect Outfall Counts
4. Mapping ORI Data
5. Sub watershed and Reach Screening
6. Characterizing IDDE Problems at the community Level

The level of detail for each analysis method should be calibrated to local resources, program goals, and the actual discharge problems discovered in the stream corridor. In general, the most common conditions and problems will shape your initial monitoring strategy, which prioritizes the sub watersheds or reaches that will be targeted for more intensive investigations

Program managers should analyze ORI data well before every stream mile is walked in the community, and use initial results to modify field methods. For example, if initial results reveal widespread potential problems, program managers may want to add more indicator monitoring to the ORI to track down individual discharge sources. Alternatively, if the same kind of discharge problem is repeatedly found, it may be wise to investigate whether there is a common source or activity generating it (e.g., high turbidity observed at many flowing outfalls as a result of equipment washing at active construction sites).

CHAPTER 6: ELIMINATION OF AN ILLICIT DISCHARGE

Once an illicit discharge has been identified, staff must then determine who is responsible for the removal of the discharge. Ultimately, it is the property owner or the Jurisdiction. Examples include the following:

- Internal Plumbing Connection: Generally, it is the building owner;
- Service Lateral: This is also generally the building owner. However, in some

circumstances, communities may fix the problem and share in the cost with the building owner depending on the policy and procedures communities have developed;

- Infrastructure Failure: This type of discharge is the community's responsibility if within the dedicated right of way;
- Transitory Discharge: Again, the building owner is responsible to correct; and
- Educating residents about illegal dumping, etc. Once the removal of the illicit discharge has occurred, it must be confirmed to ensure the correction has been made.

There are various methods that can be used to remove an illicit discharge and to fix the problem, see Table 5-1.

TABLE 5-1
METHODS TO ELIMINATE DISCHARGES

Technique	Application	Description
Service Lateral Disconnection/ Reconnection	Lateral is connected to the wrong line	Lateral is disconnected and reconnected to appropriate line
Cleaning	Line is blocked or capacity diminished	Flushing (sending a high pressure water jet through the line); pigging (dragging a large rubber plug through the lines); or rodding
Excavation and Replacement	Line is collapsed, severely blocked, significantly misaligned or undersized	Existing pipe is removed, new pipe placed in same alignment; Existing pipe abandoned in place, replaced by new pipe in parallel alignment
Manhole Repair	Decrease ponding; prevent flow of surface water into manhole; prevent groundwater infiltration	Raise frame and lid above grade; install lid inserts; grout, mortar or apply shotcrete inside the walls; install new precast manhole
Corrosion Control Coating	Improve resistance to corrosion	Spray- or brush-on coating applied to interior of pipe
Grouting	Seal leaking joints and small cracks	Seals leaking joints and small cracks
Pipe Bursting	Line is collapsed, severely blocked, or undersized	Existing pipe used as guide for inserting expansion head; expansion head increases area available for new pipe by pushing existing pipe out radially until it cracks; bursting device pulls new pipeline behind it

TABLE 5-1 (CONTINUED)
METHODS TO ELIMINATE DISCHARGES

Slip Lining	Pipe has numerous cracks, leaking joints, but is continuous and not misaligned	Pulling of a new pipe through the old one
Fold and Formed Pipe	Pipe has numerous cracks, leaking joints	Similar to slip lining but is easier to install, uses existing manholes

		for insertion; a folded thermoplastic pipe is pulled into place and rounded to conform to internal diameter of existing pipe
Inversion Lining	Pipe has numerous cracks, leaking joints; can be used where there are misalignments	Similar to slip lining but is easier to install, uses existing manholes for insertion; a soft resin impregnated felt tube is inserted into the pipe, inverted by filling it with air or water at one end, and cured in place

Source: Modified from *Illicit Discharge Detection and Elimination: A Guidance Manual for Program Development and Technical Assessments*, Center for Watershed Protection, 2004

If the illicit discharge is originating from outside the Ozark city limits, it is important that the community where the discharge is coming from be notified by the appropriate supervisor. This should be done in a letter format where you can document that it was sent. The letter should include where the illicit discharge was detected and where it was traced to by staff. Keep records of all actions, and ask the neighboring community to inform you when the correction has been made. Include all of your documentation with your annual Phase II Stormwater Report to the Missouri DNR.

PREVENTING ILLEGAL DUMPING

One source of illicit discharge to a MS4 system is illegal dumping. This is often difficult to identify and locate. Because of the potential problem that this type of discharge presents, it is important to consider illegal dumping as a potential illicit discharge source. Strategies for preventing illegal dumping include:

- Site maintenance and controls: This includes cleaning areas where illegal dumping has occurred and to utilize specific controls to prevent further dumping. These controls can include signage or restricting access to the area;

- Targeted Enforcement: Utilization of an ordinance that prohibits illegal dumping; and

- Public Education and Outreach: Public Education and Outreach is vital to any successful IDDE program. This includes a variety of programs that can assist the community in meeting their requirements under this component of the Phase II Permit;

- Educate general public, municipal employees and businesses about water quality issues and how illegal dumping has a direct impact on these water quality issues.
- Educate the public about proper ways to dispose of waste.

- Provide a way for citizens to get involved in reporting and preventing illegal dumping, such as storm drain marking that indicates: No dumping – drains directly to river, creek, lake, wetland or other water body.

- Develop materials/brochures for the public and businesses. This should include businesses that handle hazardous materials as well as restaurants, auto repair shops and others that may have an impact on possible sources of an illicit discharge.

- The City of Ozark currently has a "Public Works Emergency/After Hours" line that can be used by the public, businesses and municipal employees to report illicit discharges.

CHAPTER 7: EDUCATION TO CITY EMPLOYEES, GENERAL PUBLIC AND BUSINESSES

MODNR requires that communities must inform public employees, businesses and the general public of hazards associated with illegal discharges and improper disposal of waste. This chapter provides some suggestions as to how to provide this information to the targeted audience.

CITY EMPLOYEES

The Phase II Stormwater rules require that municipal employees be trained on pollution prevention techniques. This is located under Minimum Control Measure # 6: “Pollution Prevention/Good Housekeeping for Municipal Operations” of the City of Ozark’s Storm Water Management Plan.

Public Works department employees can look for signs of illegal dumping in catch basins and other locations. Building inspectors can ensure that illegal connections to the storm sewer system do not take place during construction projects. Staff whose jobs keep them outside and mobile can help spot illegal dumpers. Fire and police department personnel who respond to hazardous material spills can help keep these spills out of the storm sewer system and adjacent water bodies.

GENERAL PUBLIC AND BUSINESSES

It is important to get the public involved and educated on environmental and water quality issues. Some examples of what can be done include:

- Provide outreach materials
- Encourage the public to report illicit discharges/dumping when they are observed
- Partner with local volunteers to conduct storm drain stenciling projects
- Promote household hazardous waste disposal/recycling program
- Speak at public/private engagements

CHAPTER 8: IDDE PROGRAM EVALUATION

The MO-R04C000 Permit (4.3 L) requires that permittees, shall maintain a database, or other centralized system, to track dry weather field screenings, spills, incidents, and investigations.

1. Tracking mechanisms shall be used for incidents, investigations, enforcement and follow up. This data shall be used to continuously evaluate the effectiveness of the IDDE program. This data shall be reviewed to determine if there is a new priority area.
   The MS4 Operator shall record annually at a minimum:

    - Number of outfalls screened;

- Number of complaints received and investigated; and
- Number of illicit discharges removed.

2. The MS4 Operator shall document all investigations to track at a minimum:

   - The date(s) the illicit discharge was observed and investigated;
   - Summary of procedures used to investigate the illicit discharge;
   - The outcome of the investigation including sample results and findings;
   - Any follow-up of the investigation including cleanup, enforcement actions, visits to confirm the illicit discharges have been removed; and
   - The date the investigation or issue was closed or resolved.

The IDDE program should be evaluated at the end of each year to assess if it has been effective and efficient.

EVALUATING THE IDDE PROGRAM

To effectively evaluate the IDDE Program, a number of questions need to be asked and analyzed.

1. To effectively evaluate the IDDE Program, a number of questions need to be asked and analyzed.

   - Were these areas identified initially?
   - Are these areas still appropriately considered a priority?
   - Have illicit discharges been located in these areas?

   Once the questions have been answered, determine if the IDDE Program properly identifies and evaluates priority areas

2. Detection Program

   - Is the program effective? Reassess the program by determining what has been achieved. Look at the number of outfalls inventoried, the number visually inspected, the number that had dry weather flows and look at the overall percentages of these flows as part of the overall storm sewer system for your community.
   - Cost effectiveness: What aspects of the program had the highest quality of effectiveness in relationship to cost?
   - Number of illicit discharges detected utilizing each detection method (will assist to see what method is more effective).

   Once the questions have been answered and evaluated, determine the success of the Detection Program.

3. Tracing Program

   - What techniques were used?
   - Were these methods successful?
   - Which techniques that were not used would be beneficial for next year?

   Once the questions have been answered, determine if the Tracing Program has been successful. If not, determine what revisions are necessary to improve the program.

4. Removing the Sources of Illicit Discharges

    - What techniques were used?
    - Were these methods successful?
    - Which techniques not used would be beneficial for next year?
    - How many illicit sources were identified and eliminated?

5. Other

    - If using water quality sampling, resample areas within community to determine effectiveness of the removal of illicit discharges.
    - Determine how much time was spent by employees and expenses to determine overall cost for achieving given results.

TRACKING AND REPORTING IDDE

Spills and illicit discharges will be identified and tracked using GIS. The individual inventory and inspection forms can be linked to individual outfalls within the GIS.

Reports will be generated using GIS data as well as inventory.

REFERENCES

Center for Watershed Protection and Robert Pitt. 2004. Illicit Discharge Detection and Elimination: A Guidance Manual for Program Development and Technical Assessments.

City of Valadosta. 2016. Illicit Discharge Detection and Elimination Guidance Manual.

Spokane County, Washington. 2010. Illicit Discharge Detection and Elimination Guidance Manual.

Guidelines and Standard Operating Procedures for Stormwater Phase II Communities in Maine, Casco Bay Estuary Partnership.

APPENDIX

APPENDIX A
OUTFALL LOCATIONS

ID	ADDRESS	SUBDIVISION	NORTHING (FT)	EASTING (FT)	MAINTENANCE	CONDITION
OUTF-1	1100 BLOCK E LLOYD ST	SHANACLAIRE	449,440.217	1,437,935.716	HOMEOWNERS ASSCO.	
OUTF-2	N 10TH AVE	SHANACLAIRE	450,400.859	1,437,334.545	HOMEOWNERS ASSCO.	
OUTF-3	E LLOYD ST & PHEASANT RD	MOUNTAIN VALLEY	449,583.105	1,438,487.152	HOMEOWNERS ASSCO.	
OUTF-4	5489 N NEWPORT DR	GRAND HAVEN	450,825.909	1,440,173.047	HOMEOWNER ASSO.	
OUTF-5	5716 N 6TH AVE	WATERFORD	452,078.472	1,436,216.796	HOMEOWNERS ASSO.	
OUTF-6	W STATE HWY NN		451,530.565	1,434,023.277	PRIVATE	
OUTF-7	N 9TH AVE	WATERFORD	450,857.032	1,437,139.811	HOMEOWNERS AS	
OUTF-8	N BLUESTEM RD		451,456.508	1,433,448.272	PRIVATE	
OUTF-9		NORTH OF WILLOW TERRACE	452,371.619	1,432,317.732	PRIVATE	
OUTF-10	W STATE HWY J & HWY 65	SIXTY-FIVE MARKET PLACE	451,307.562	1,428,609.906	CITY OF OZARK	
OUTF-11	6000 N CABINET DR	DEERBROOK	453,159.270	1,425,806.599	HOME OWNERS ASSO.	
OUTF-12	W STATE HWY CC & US HWY 65	FREMONT TOWN CENTRE	450,732.263	1,427,358.720	HOME OWNERS ASSO	GOOD
OUTF-13	NORTH OF MCGUFFEY	NORTH OF MCGUFFEY	445,631.995	1,433,283.838	PRIVATE	
OUTF-14	1003 W MCGUFFEY ST	MCGUFFEY	430,209.804	1,438,514.453	HOME OWNER ASSO.	
OUTF-15	3211 N 10TH ST	MCGUFFEY	443,482.619	1,432,530.042		
OUTF-16	2301 W LAKESIDE CT	OZARK HEIGHTS	441,792.058	1,425,590.105	HOMEOWNERS ASSO.	
OUTF-17	2806 W HEIGHTS	OZARK HEIGHTS	440,791.224	1,423,779.827	HOMEOWNERS ASSO.	
OUTF-18			444,305.912	1,424,129.017		
OUTF-19	W GARTON RD & E THISTLE DR	ROLLING PRAIRIE	445,994.446	1,424,370.104		
OUTF-20		MULBERRY RIDGE	438,116.822	1,426,342.502		
OUTF-21	N 17TH ST	HOPEDALE HEIGHTS	438,116.822	1,426,342.502		
OUTF-22	1425 S NITRO DR	SENECA HILLS	427,806.340	1,431,431.631		
OUTF-23	1409 S NITRO DR	PINECREST	428,423.498	1,431,457.154		
OUTF-24	2092 S THOMAS DR	LAUREL HILLS	424,823.272	1,440,417.274		
OUTF-25		TURNBERRY	448,557.283	1,432,567.455		
OUTF-26		TURNBERRY	448,392.750	1,431,331.807		
OUTF-27		TURNBERRY	449,752.569	1,431,199.642		
OUTF-28	N BROOKSHIRE ST	TURNBERRY	448,798.299	1,433,128.106		
OUTF-29	W RIVERBLUFF DR	ROLLING PRAIRIE	444,132.652	1,423,597.085		
OUTF-30		GRAND HAVEN	451,837.968	1,440,328.941		
OUTF-31	1600 N 19TH ST		452,738.892	1,429,209.262		
OUTF-32	1600 N 19TH ST		452,612.347	1,427,975.800		
OUTF-33	1600 N 19TH ST		453,285.265	1,427,848.388		
OUTF-34	203 N FARMER BRANCH RD		454,725.154	1,428,937.899		
OUTF-35	203 N FARMER BRANCH RD		454,494.503	1,429,055.368		
OUTF-36	6092 N 25TH ST		453,777.078	1,425,541.460		
OUTF-37	5801 N 21ST ST		452,576.233	1,427,142.220		
OUTF-38	2381 N 22ND ST		452,098.489	1,426,481.902		
OUTF-39	2381 N 22ND ST		452,098.360	1,426,673.919		
OUTF-40	5533 N 22ND ST		451,524.257	1,426,513.611		
OUTF-41	1305 W STATE HWY CC		451,189.381	1,422,911.432		

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OUTF-42	3550 W STATE HWY CC		451,867.723	1,421,970.990
OUTF-43	5501 N 13TH AVE	WATERFORD	450,781.860	1,438,182.330
OUTF-44	4806 N 13TH ST	TURNBERRY	448,718.669	1,431,665.233
OUTF-45		TURNBERRY	450,053.856	1,431,890.440
OUTF-46	N FENWICKE ST & W IVY DR	VILLAGE HILLSTONE	444,837.490	1,433,744.906
OUTF-47	W RIVERBLUFF RD & N 3RD ST	VILLAGE HILLSTONE	443,590.102	1,434,339.436
OUTF-48	3608 N STATE HWY NN		444,881.500	1,431,439.484
OUTF-49	3608 N STATE HWY NN		444,948.766	1,432,010.390
OUTF-50	W MCGUFFEY ST & N 12TH ST	MCGUFFEY PARK	445,556.341	1,432,057.038
OUTF-51	4083 N STATE HWY NN		446,020.606	1,430,608.624
OUTF-52	W FROSTY DR	CANTERBURRY	446,931.017	1,429,840.840
OUTF-53		THE BAPTIST HOME	446,730.101	1,429,590.330
OUTF-54	1649 W LIFECARE CIR	THE BAPTIST HOME	446,912.934	1,428,941.504
OUTF-55		HOPEDALE HEIGHTS	448,181.372	1,429,086.502
OUTF-56			448,169.220	1,429,089.974
OUTF-57			452,308.890	1,423,031.874
OUTF-58		PLEASANT VALLEY	447,105.237	1,434,006.785
OUTF-59			447,370.694	1,430,017.067
OUTF-60	N CLEARWATER CIR		437,465.200	1,429,085.987
OUTF-61	W VALLEY DR		438,634.499	1,428,895.907
OUTF-62	N 14TH ST		436,577.908	1,430,337.726
OUTF-63	W UNDER SHOT CT	HOOVER'S MILL	438,213.695	1,430,431.284
OUTF-64	W BLUFF DR	HOOVER'S MILL	437,780.843	1,431,194.000
OUTF-65			449,507.922	1,425,474.678
OUTF-66		OLDE WORLD	449,304.831	1,425,413.765
OUTF-67		OLDE WORLD	448,494.662	1,425,317.451
OUTF-68			449,290.642	1,426,701.910
OUTF-69	4910 N TOWN CENTRE DR		449,392.782	1,427,792.583
OUTF-70	4272 N 22ND ST		447,084.551	1,427,085.736
OUTF-71	4271 N 20TH ST		447,060.151	1,427,715.277
OUTF-72	W CHRIS CT & N GRASSLAND DR	ROLLING PRAIRIE	447,002.116	1,425,121.466
OUTF-73	4204 N MEAD DR	ROLLING PRAIRIE	447,270.008	1,424,057.002
OUTF-74		ROLLING PRAIRIE	444,054.129	1,422,664.903
OUTF-75	W LONGVIEW & N EAGLESPRINGS	EAGLE SPRINGS	443,395.992	1,423,847.350
OUTF-76	W MIRAMAR RD & N MARLIN DR	EAGLE SPRINGS	443,325.715	1,425,014.729
OUTF-77	W TRENTON TR & N FREMONT RD	KALI SPRINGS	441,518.231	1,422,520.693
OUTF-78	W SCENIC DR & N 25TH ST	OZARK HEIGHTS	441,545.396	1,425,245.515
OUTF-79	2210 REGAN CIR	STONEGATE	440,608.239	1,424,957.895
OUTF-80		CREEK BRIDGE	440,511.586	1,425,207.401
OUTF-81	1725 RIVER RUN LN		438,138.815	1,436,350.276
OUTF-82	N RIVERSIDE RD & E COUNTRY CREST	UNION HILL	437,811.277	1,435,653.919
OUTF-83	E CROSSLAND ST & N 7TH AVE	COUNTRY CREST	437,069.212	1,435,970.331

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OUTF-126 2012 S 6TH AVE	VILLAGE PARK	425,090.990	1,435,232.609
OUTF-127 2005 S REDBUD CT	VILLAGE PARK	425,077.137	1,434,677.580
OUTF-128 603 E WINDMILL DR	MILL POINTE	424,873.243	1,435,564.147
OUTF-129 701 E WARREN AVE	MILL POINTE	424,529.805	1,435,768.894
OUTF-130 S 9TH AVE & E APRIL DR		427,073.024	1,436,134.271
OUTF-131 1812 E MARICOPA AVE	LAUREL HILLS	424,859.487	1,439,679.258
OUTF-132 1805 E COSTA MESA CT	LAUREL HILLS	425,663.264	1,439,370.357
OUTF-133 1750 S THOMAS DR	LAUREL HILLS	426,128.580	1,440,544.154
OUTF-134 2301 E HWY 14		427,231.344	1,441,870.117
OUTF-135 E CHANDLER ST & S 14TH AVE		427,585.426	1,438,075.317
OUTF-136 2010 E JAY ST	KNOLL RIDGE	430,449.524	1,440,885.868
OUTF-137 965 S 21ST AVE		430,000.524	1,440,901.619
OUTF-138 1800 BLOCK E SAMUEL J ST		429,148.075	1,440,182.542
OUTF-139 1162 S 14TH AVE		430,209.804	1,438,514.453
OUTF-140 1203 E JAY ST		430,571.933	1,437,610.968
OUTF-141 S 2ND AVE & E HARTLEY RD		428,249.747	1,434,765.573
OUTF-142 S 2ND AVE & E HARTLEY RD		428,049.898	1,434,767.120
OUTF-143 S 2ND AVE & E HARTLEY RD		427,946.548	1,434,761.911
OUTF-144 2799 S 14TH AVE	WINDRIDGE	422,308.090	1,438,234.169
OUTF-145 2800 S 17TH AVE	WINDRIDGE	422,263.006	1,438,900.295
OUTF-146 S 14TH ST & W DANIELS ST		425,278.85	1,431,346.532
OUTF-147 1166 S 14TH AVE	FOREST RIDGE	429,813.282	1,438,609.457
OUTF-148 E SOUTH ST & S 13TH AVE		426,896.283	1,437,664.038
OUTF-149 1616 E BAIN ST		425,562.770	1,439,153.251
OUTF-150 1431 W SOUTH ST		427,254.881	1,430,715.794

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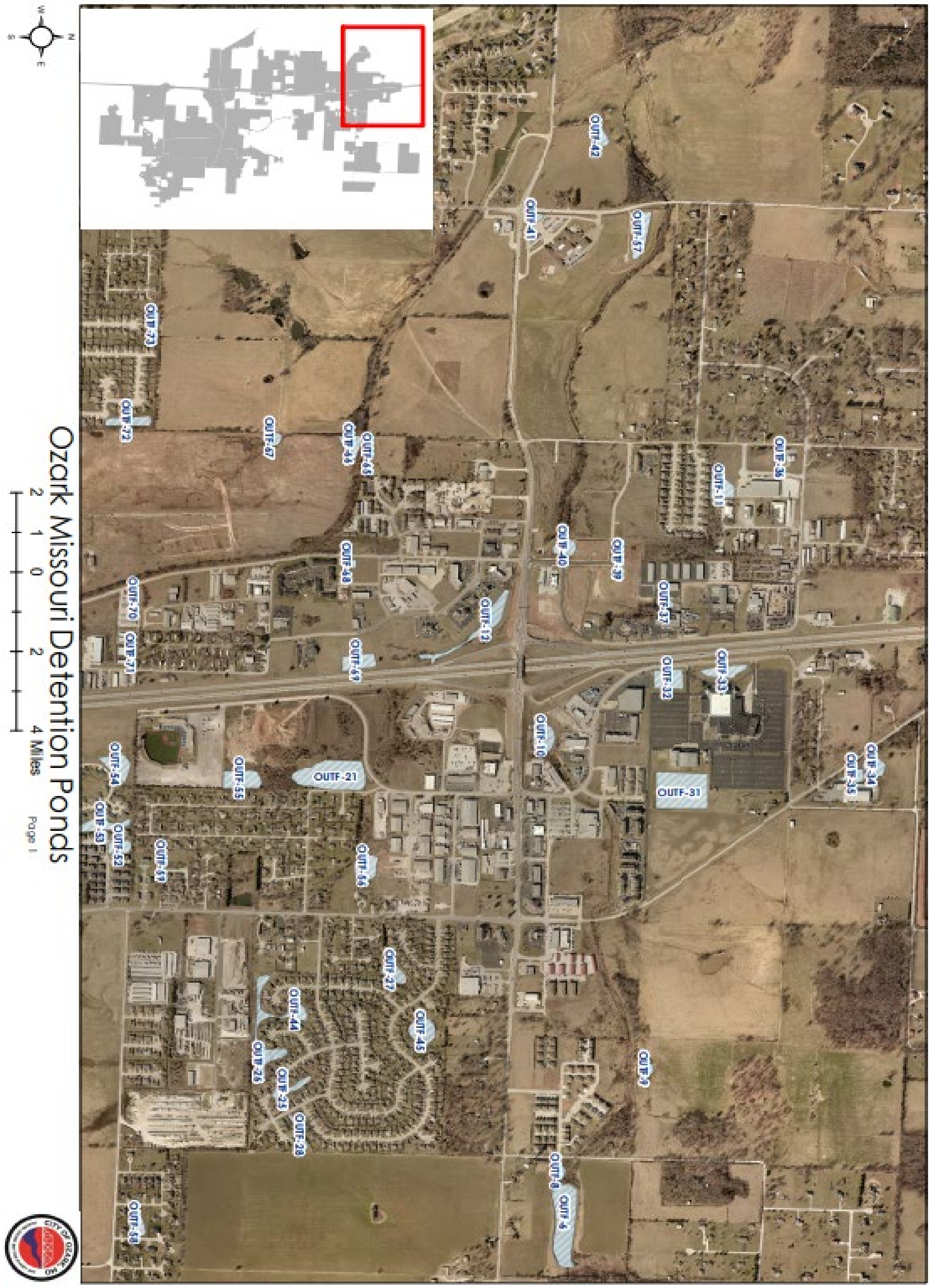
APPENDIX B
OUTFALL MAP

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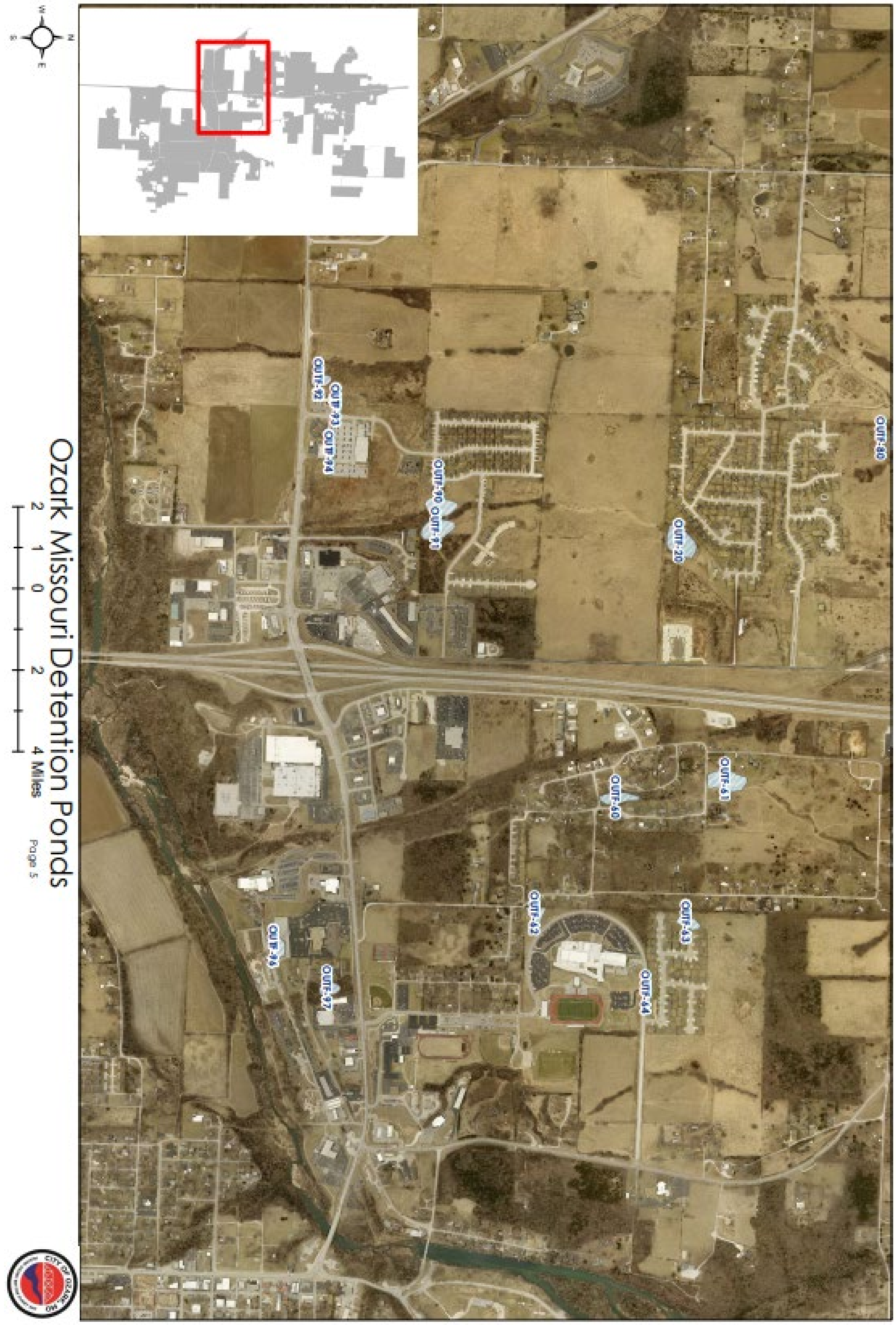
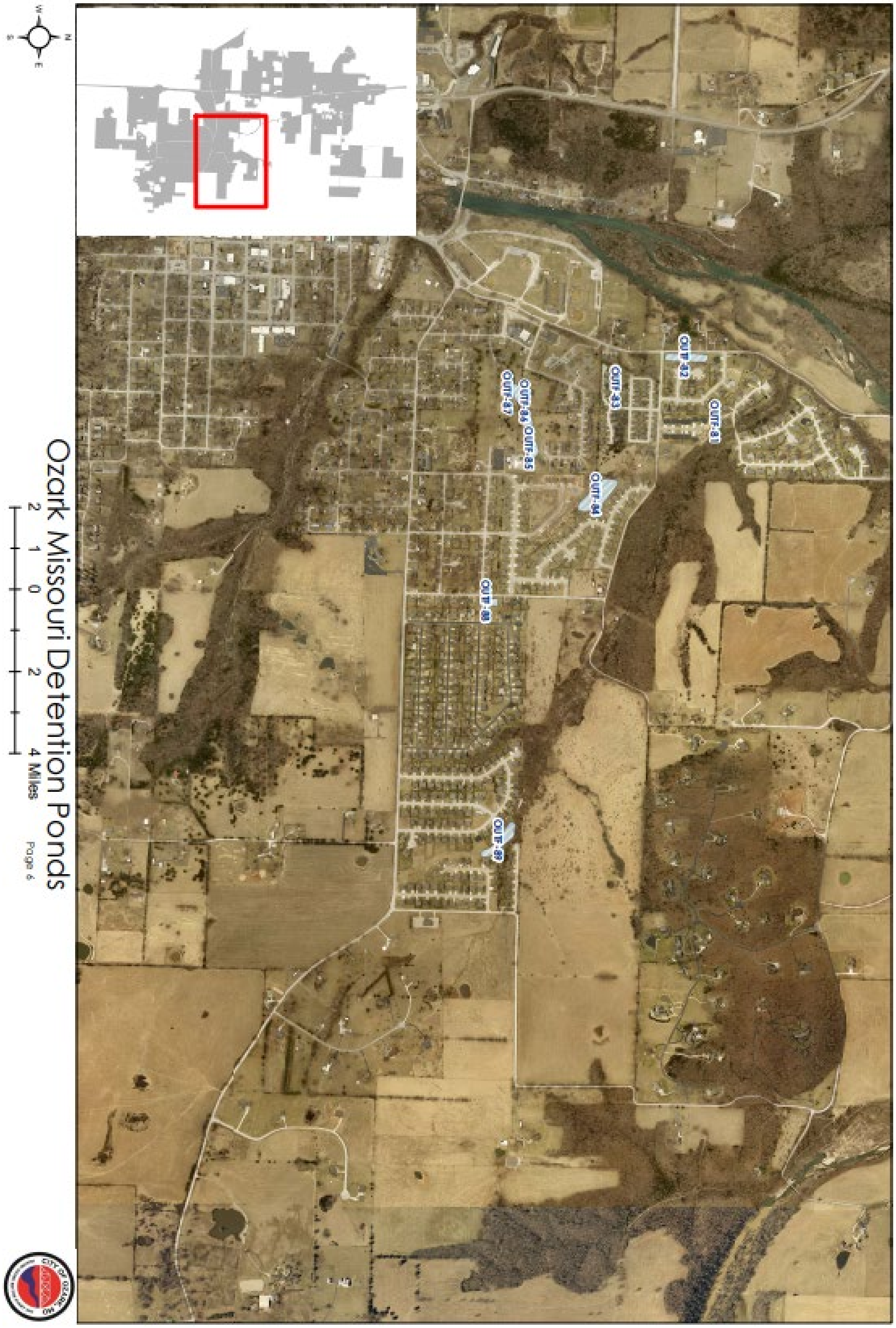
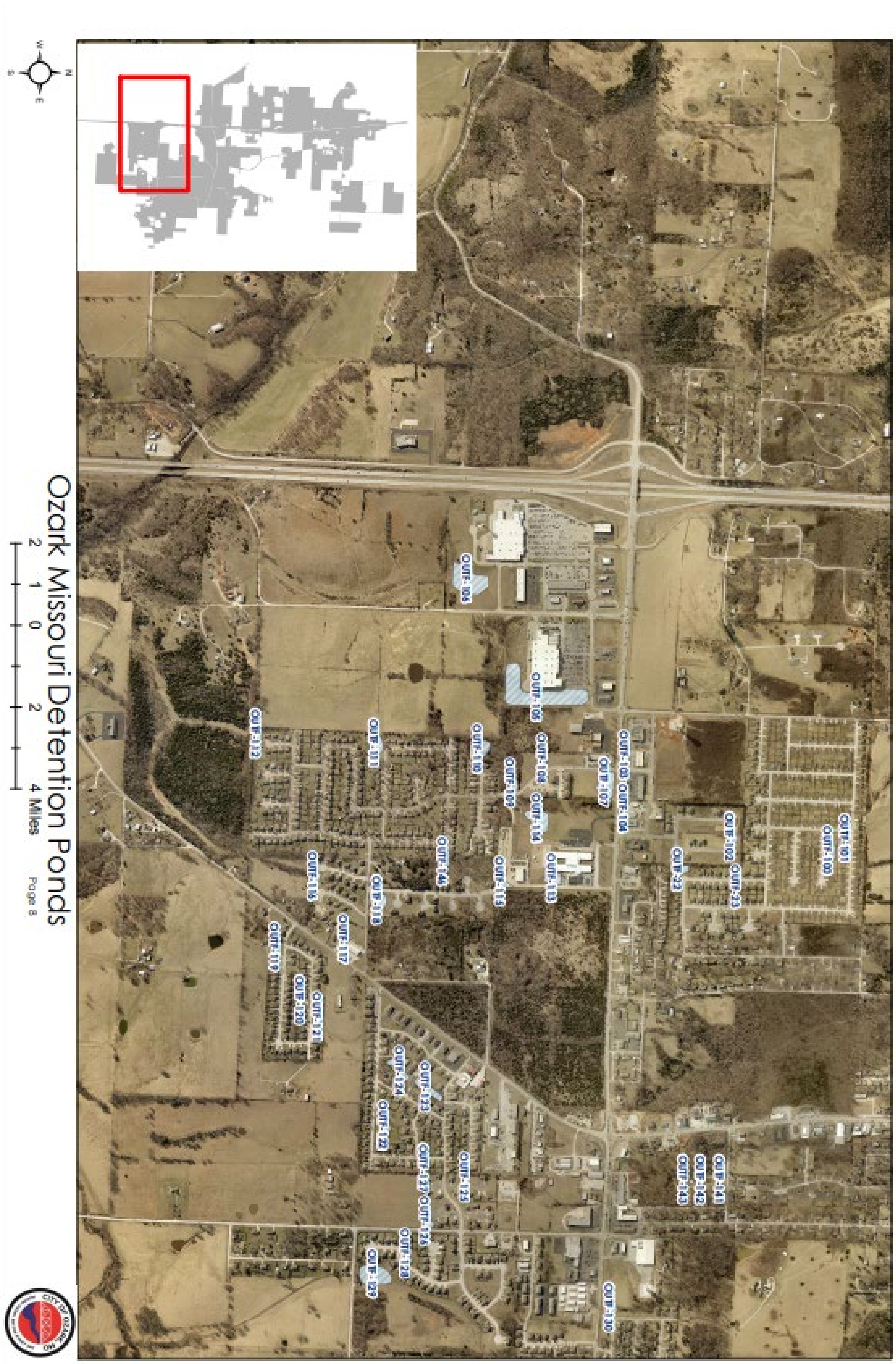
CITY OF OZARK MO


Ozark Missouri Detention Ponds
2 1 0 2 4 Miles
Page 5
OUTF-92
OUTF-93
OUTF-94
OUTF-90
OUTF-91
OUTF-20
OUTF-80
OUTF-60
OUTF-61
OUTF-62
OUTF-63
OUTF-64
OUTF-96
OUTF-97


Ozark Missouri Detention Ponds
Page 6
2 1 0 2 4 Miles
OUTF-82
OUTF-83
OUTF-81
OUTF-86
OUTF-85
OUTF-87
OUTF-84
OUTF-88
OUTF-89


Ozark Missouri Detention Ponds
Page 7
2 1 0 2 4 Miles


Ozark Missouri Detention Ponds
2 1 0 2 4 Miles
Page 8

APPENDIX C

DRY WEATHER OUTFALL SCREENING FORM

City Of Ozark

Storm Water Outfall/Detention/Retention Pond/Structure Inspection Form

Outfall ID:___________ Address:_________________________________ Date:__________ Time:_____________

Rainfall last 72 Hours ☐ Yes ☐ No Rainfall Amount:__________ Weather Condition:________________________

LOCATION	MATERIAL	SHAPE		DIMENSION	SUBMERGED
☐ Closed Pipe	☐ RCP ☐ CMP ☐ PVC ☐ HDPE ☐ Other:	☐ Circular ☐ Elliptical ☐ Box ☐ Other:	☐ Single ☐ Double ☐ Triple ☐ Other:	Dimensions: __________	In Water: ☐ No ☐ Partially ☐ Fully With Sediment:
☐ Open Channel	☐ Concrete ☐ Earthen ☐ Rip-rap ☐ Other:	☐ Trapezoid ☐ Parabolic ☐ Other:		☐ Depth:________ ☐ Top Width_____ ☐ Bottom Width ____________	☐ No ☐ Partially ☐ Fully
Flow	☐ None ☐ Trickle ☐ Moderate ☐ Substantial				

Structural Components:

Are the pipes/inlets going into or out of the pond clogged or obstructed? ☐ Yes ☐ No ☐

Is the outfall channel from the pond functioning appropriately? ☐ Yes ☐ No

Is the inflow trickle channel working properly? ☐ Yes ☐ No

Is the orifice and/or trash rack obstructed? ☐ Yes ☐ No

Is the outfall channel, trickle channel or other conveyance in need of repair? ☐ Yes ☐ No

Are manholes, frames, and covers associated with the outfall channel in appropriate condition? ☐ Yes ☐ No

Do any safety features, such as fences, gates or locks need repair or replacement? ☐ Yes ☐ No

Comments:____

INDICATOR	COMPONET	DESCRIPTION	COMMENTS
Pipe Condition	☐ Outlet ☐ Inlet	☐ Chip/Cracked ☐ Corrosion ☐ Peeling Paint ☐ Other	
Odor		☐ Gas ☐ Sewage ☐ Sulfide ☐ Other	
Deposits/Stains		☐ Oily ☐ Trash ☐ Flow Line ☐ Paint ☐ Foam ☐ Iron	
Vegetation		☐ Normal ☐ Inhibited ☐ Excessive	
Pipe Algae/Growth		☐ Brown ☐ Orange ☐ Green ☐ Other:____	
Pool Quality		☐ Good ☐ Oils ☐ Algae ☐ Suds ☐ Odor ☐ Colors	

Pond Conditions:

INDICATOR	✓ if Present	DESCRIPTION	COMMENTS
Outfall Damage	☐	☐ Chip/Cracked ☐ Corrosion ☐ Peeling Paint ☐ Other	
Pond	☐	☐ Erosion ☐ Trash ☐ Debris ☐ Animal Burrowing ☐ Encroachment	
Vegetation	☐	☐ Need mowing ☐ Needs Revegetated ☐ Vegetate need thinning	

Work Order Entered ☐Yes ☐No

Work Order #______________

Date__________ Time_________

Signature____________________

Inspectors Signature_________________________ Date______________

APPENDIX D

CHAIN OF CUSTODY RECORD

PDC LABORATORIES, INC.
1805 W. SUNSET
SPRINGFIELD, MO 65807

PHONE # 417-864-8924
FAX # 417-864-7081

CHAIN OF CUSTODY RECORD

State where samples collected ______MO________

ALL HIGHLIGHTED AREAS MUST BE COMPLETED BY CLIENT (PLEASE PRINT)

1 CLIENT	PROJECT NUMBER	P.O. NUMBER	MEANS SHIPPED	3 ANALYSIS REQUESTED	4 (FOR LAB USE ONLY)
ADDRESS	PHONE NUMBER	FAX NUMBER	DATE SHIPPED		LOGIN # ______
CITY, STATE ZIP	SAMPLER (PLEASE PRINT)		MATRIX TYPES: WW- WASTEWATER, DW- DRINKING WATER, GW- GROUND WATER, WWSL- SLUDGE, NAS- SOLID, LCHT-LEACHATE, OTHER:		LOGGED BY: ______
CONTACT PERSON	SAMPLER'S SIGNATURE				LAB PROJ. # / TEMPLATE: / PROJ. MGR.: CHAD COOPER

2 SAMPLE DESCRIPTION AS YOU WANT ON REPORT	DATE COLLECTED	TIME COLLECTED	SAMPLE TYPE GRAB	SAMPLE TYPE COMP	MATRIX TYPE	BOTTLE COUNT	REMARKS

5 TURNAROUND TIME REQUESTED (PLEASE CIRCLE) NORMAL RUSH
(RUSH TAT IS SUBJECT TO PDC LABS APPROVAL AND SURCHARGE)
RUSH RESULTS VIA (PLEASE CIRCLE) FAX PHONE
FAX # IF DIFFERENT FROM ABOVE: PHONE # IF DIFFERENT FROM ABOVE:
DATE RESULTS NEEDED

6 *The sample temperature will be measured upon receipt at the lab. By initialing this area you request that the lab notify you, before proceeding with analysis, if the sample temperature is outside of the range of 0.1-6.0°C. By not initialing this area you allow the lab to proceed with analytical testing regardless of the sample temperature.* ______

7 RELINQUISHED BY: (SIGNATURE)	DATE / TIME	RECEIVED BY: (SIGNATURE)	DATE / TIME
RELINQUISHED BY: (SIGNATURE)	DATE / TIME	RECEIVED BY: (SIGNATURE)	DATE / TIME
RELINQUISHED BY: (SIGNATURE)	DATE / TIME	RECEIVED BY: (SIGNATURE)	DATE / TIME

8 COMMENTS: (FOR LAB USE ONLY)

SAMPLE TEMPERATURE UPON RECEIPT ______°C
CHILL PROCESS STARTED PRIOR TO RECEIPT Y OR N
SAMPLE(S) RECEIVED ON ICE Y OR N
PROPER BOTTLES RECEIVED IN GOOD CONDITION Y OR N
BOTTLES FILLED WITH ADEQUATE VOLUME Y OR N
SAMPLES RECEIVED WITHIN HOLD TIME(S) (EXCLUDES TYPICAL FIELD PARAMETERS) Y OR N
DATE AND TIME TAKEN FROM SAMPLE BOTTLE ______

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