CITY OF KEMAH
STORM WATER MANAGEMENT PROGRAM

AUGUST 2024

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Acronyms and Abbreviations

BMP	Best Management Practices
CFR	U.S. Code of Federal Regulations
CRZ	Critical Root Zone
CWA	Clean Water Act
EPA	Environmental Protection Agency
JTF	Joint Task Force
MCM	Minimum Control Measure
MPN	Most Probable Number
MS4	Municipal Separate Storm Sewer System
NEC	No Exposure Certificate
NOC	Notice of Change
NOI	Notice of Intent
NPDES	National Pollutant Discharge Elimination System
O&M	Operation and Maintenance
SWMP	Storm Water Management Program
TCEQ	Texas Commission on Environmental Quality
TMDL	Total Maximum Daily Load
TPDES	Texas Pollutant Discharge Elimination System

1.0 INTRODUCTION

1.1 REGULATORY BACKGROUND

In 1972, Congress amended the Federal Water Pollution Control Act (commonly referred to as the Clean Water Act ["CWA"]) to prohibit the discharge of any pollutant to waters of the United States from a point source unless the discharge is authorized by a National Pollutant Discharge Elimination System ("NPDES") permit. The NPDES program is designed to track point sources and requires the implementation of controls necessary to minimize the discharge of pollutants.

In 1987, Congress amended the CWA to require implementation, in two phases, of a comprehensive national program for addressing storm water discharges. The first phase of the program, commonly referred to as "Phase I", was promulgated by the Environmental Protection Agency ("EPA") on November 16, 1990 (*Federal Register*, Volume 55, Page 47,990 [55 FR 47990]). Phase I requires NPDES permits for storm water discharge from a large number of priority sources, including municipal separate storm sewer systems ("MS4's") generally serving populations of 100,000 or more, and several categories of industrial activity, including construction sites that disturb 5 or more acres of land.

The EPA promulgated the second phase of the storm water regulatory program, commonly referred to as "Phase II," on December 8, 1999 (64 FR 68722). Phase II regulations address storm water discharges from certain MS4's serving populations of less than 100,000 people (called "small MS4's"). In summary, the regulations, which may be found in Title 40, Part 122, of the Code of Federal Regulations ("CFR") (40 CFR 122), require that all small MS4 operators located in *Urbanized Areas* (as defined by the latest U.S. census) must "develop, implement, and enforce controls to reduce the discharge of pollutants from municipal separate storm sewers which receive discharges from areas of new development and significant redevelopment."

The EPA has delegated authority to issue MS4 storm water discharge permits to the State of Texas. Under the authority of the Texas Water Code and the CWA, the Texas Commission on Environmental Quality ("TCEQ") is the regulatory body responsible for issuing permits to discharge waste from small MS4 systems to waters of the state.

Since the City of Kemah (hereinafter, the "City") is a regulated small MS4 operator, it must obtain a permit from the TCEQ for the discharge of storm water runoff.

In summary, the permit requires the City to comply with a number of administrative and legal requirements and to develop, implement, and enforce a storm water management program designed to reduce the discharge of pollutants from the MS4 to the maximum extent practicable to protect water quality. The SWMP must address six areas (called "Minimum Control Measures") as follows:

- Public Education and Outreach
- Public Involvement/Participation
- Illicit Discharge Detection and Elimination (IDDE)
- Construction Site Stormwater Runoff Control
- Post Construction Stormwater Management in New Development and Redevelopment
- Pollution Prevention and Good Housekeeping for Municipal Operations

For each minimum control measure ("MCM") the City must:

- Select appropriate Best Management Practices ("BMP's"), which are various methods of reducing pollutants in storm water runoff
- Define clear, measurable goals for each BMP
- Establish an implementation schedule
- Assign a responsible person or persons for implementing all activities

1.2 THE PURPOSE OF THIS DOCUMENT

This document serves as the City's SWMP. It includes all selected BMP's for each of the minimum control measures (MCM's), measurable goals for each BMP, an implementation schedule, and a listing of the person responsible for implementation of all activities. This document provides a clear road map for implementing storm water quality management activities to improve runoff quality and to maintain permit compliance.

1.3 ENTITIES ASSISTING WITH THE DEVELOPMENT OF THIS DOCUMENT

The City of Kemah was assisted by Schaumburg and Polk, Inc., a private consulting firm, in the development of this SWMP.

1.4 ORGANIZATION OF THIS DOCUMENT

This document is organized into various sections as follows:

Section 1 – Introduction: This section provides background information on the storm water regulatory program, defines the purpose of this document, and describes document organization.

Section 2 – City Background: This section provides general information about the city, including setting and character, form of government, and legal authority.

Section 3 – Public Education and Outreach: This section describes the regulatory requirements, permit requirements, current city programs, selected BMP's, measurable goals, implementation schedule, and responsible parties pertaining to MCM-1.

Section 4 – Public Involvement/Participation: This section describes the regulatory requirements, permit requirements, current city programs, selected BMP's, measurable goals, implementation schedule, and responsible parties pertaining to MCM-2.

Section 5 – Illicit Discharge Detection and Elimination (IDDE): This section describes the regulatory requirements, permit requirements, current city programs, selected BMP's, measurable goals, implementation schedule, and responsible parties pertaining to MCM-3.

Section 6 – Construction Site Storm Water Runoff Control: This section describes the regulatory requirements, permit requirements, current city programs, selected BMP's, measurable goals, implementation schedule, and responsible parties pertaining to MCM-4.

Section 7 – Post-Construction Storm Water Management in New Development and Redevelopment: This section describes the regulatory requirements, permit requirements, current city programs, selected BMP's, measurable goals, implementation schedule, and responsible parties pertaining to MCM-5.

Section 8 – Pollution Prevention/Good Housekeeping for Municipal Operations: This section describes the regulatory requirements, permit requirements, current city programs, selected BMP's, measurable goals, implementation schedule, and responsible parties pertaining to MCM-6.

Section 9 – Record-Keeping and Reporting: This section describes the annual reporting requirements of the permit.

2.0 CITY BACKGROUND

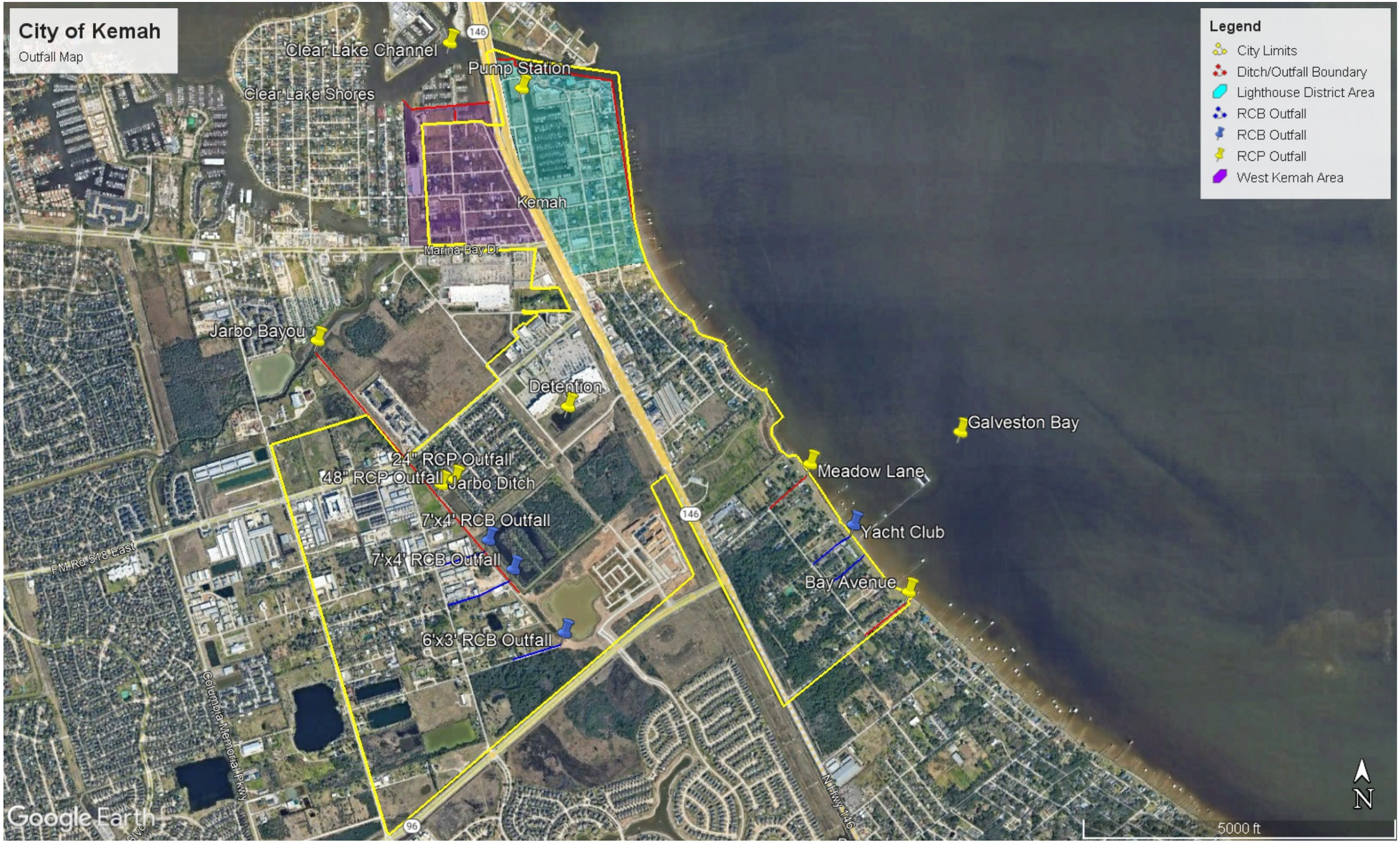
2.1 SETTING AND CHARACTER

The city of Kemah is located in the northeast corner of Galveston County by Galveston Bay. The city is bordered by Seabrook to the north across the Clear Creek Channel, by League City to the south and west, and Clear Lake Shores to the northwest.

The city is approximately 7 feet above mean sea level. The most predominant soil type found in the area is the Mocarey rarely flooded-Leton occasionally flooded complex (Md). This soil is a deep, well drained and moderately slow permeable soil mainly used for pasture, crops, and range. The Verland silty clay loam (Ve) is also present in the area. This is a deep, poorly drained, slow permeable soil. The Verland series is typically used in pastures for growing native vegetation, rice, and soybeans. (USDA, 2023). (National Cooperative Soil Survey, 2024).

The 2020 U.S. Census identifies a total population of 1,800 individuals within the city, and current estimates place the population at 2,562. This population results in the city being designated a Level 1 Small MS4. Shipping is a primary industry for the area, though residents are also employed within the Greater Metropolitan Houston area. The City maintains a status as a tourist destination for restaurants and attractions, focused in the Entertainment District, the Kemah Boardwalk.

Figure 2-1 City of Kemah Vicinity Map and Storm Sewer Map



RECEIVING WATERBODIES

Storm water runoff from the city drains to Clear Lake Channel (Segment 2421), an estuary flowing from nearby Clear Lake to Galveston Bay. Clear Lake Channel is located to the north of the city area.

The State of Texas routinely monitors receiving water quality and assesses receiving water conditions. This information is summarized by TCEQ in two reports required under the CWA. Section 305(b) of the CWA requires each state to provide the following information: a description of the water quality of all navigable waters in the state; an assessment of the status of waters of the state with regard to their support of recreational activities and fish and wildlife propagation; an assessment of the state's water pollution control activities toward achieving the CWA goal of having water bodies which support recreational activities and fish and wildlife propagation; an estimate of the costs and benefits of implementing the CWA; and a description of the nature and extent of non-point sources of pollution and recommendations for programs to address non-point source pollution. Section 303(d) directs states to identify and prioritize waters for which point source effluent limits required by the CWA and the state are not stringent enough to allow those waters to meet water quality standards.

The major City of Kemah receiving waters are summarized in Table 2-1 below. Clear Lake Channel appears on the 303(d) list of impaired waters as being impaired by dioxin and PCBs in edible tissue.

Table 2-1
List of Waters within the City of Kemah

Name	Segment ID	Drains To	Listed In 303(d)	303(d) Impairment Parameter
Clear Lake Channel	2421A	Upper Galveston Bay	Yes	Dioxin in edible tissue PCBs in edible tissue
Upper Galveston Bay	2421_02		Yes	
Upper Galveston Bay (Oyster Waters)	2421OW_01		No	Bacteria in oyster waters
Jarbo Bayou	2425B_01	Clear Lake	Yes	Dioxin in edible tissue PCBs in edible tissue

According to the *Six Total Maximum Daily Loads for Bacteria in Waters of the Upper Gulf Coast*, the City of Kemah is not assigned or responsible for the maximum daily loads for the Clear Lake Channel (Segment 2421). Segment 2421A is not listed as having any bacteria impairments. According to the *One Total Maximum Daily Load for Bacteria in Jarbo Bayou*, TPDES permittees are responsible for addressing unauthorized sanitary sewer overflows (SSOs) that can contribute to the source of bacteria loads in the watershed area.

The (TMDL) for the Upper Gulf Coast segments are expressed using shellfish harvesting criteria as the concentration of fecal coliform organisms, as shellfish harvesting is the most sensitive beneficial use of

the Upper Gulf Coast watershed. This proposed TMDL requires that the water quality of the R Harvesting Zones in the bay be maintained to ensure a median of 14 cfu/100 mL of fecal coliform with no more than 10 percent of the samples in the Bay exceeding 43 cfu/100 mL.

The (TMDL) for the Jarbo Bayou segment is calculated to estimate the maximum allowable loads of Enterococci that will ensure the contact recreation standard is met. The final TMDL calculations show a TMDL of 184.993 billion MPN/day, and allocations to regulated stormwater, designated as WLA_{sw}, of 175.3301 billion MPN/day.

The City of Kemah does not own or maintain any sanitary sewer facilities, and therefore has no jurisdiction over wastewater effluents. Furthermore, there are no on-site sewage facilities within the city limits. However, in order to maintain adherence to standards set forth for the Galveston Bay area, the City has enacted measurements as part of MCM's 1 through 6 to address the control of effluents. These include public education materials to increase general awareness and volunteer opportunities for water quality monitoring and cleaning.

2.2 FORM OF GOVERNMENT

The City is operated by an elected Mayor and five City Council Members and has a City Administrator. The City Council, Building and Permitting Department, and Public Works Department regulate development within the City. The City does not have an Engineering Department; rather, the City contracts with consultants and contractors to perform many of these duties.

2.3 LEGAL AUTHORITY

In accordance with Local Government Code §5.001(3), the City is a Type A general-law municipality.

2.4 CONSTRUCTION AND DEVELOPMENT

The city is essentially fully built-out. There are no significant natural resources in the area. While the City does have a fair amount of construction activities, these are mostly either redevelopments or expansions, intended for existing structures.

2.5 EXISTING PROGRAMS

Existing activities include previously qualified Best Management Practices (BMPs) such as public education brochures for residents and facilities, participation in public outreach events, and ordinances for the detection and elimination of illicit discharges. Complete listings and detailed descriptions of each existing program are listed in Sections three through eight.

2.6 RATIONALE STATEMENT FOR SWMP

During the development of this SWMP, the City considered BMP's that would protect water quality, comply with the Phase II storm water regulations, and ensure program costs that would not create undue hardship on city residents and businesses. Established Phase I storm water programs, the City's existing SWMP, and proposed Phase II programs for other MS4 operators, were reviewed and evaluated. A variety of BMP's for each minimum control measure were considered and compared. BMPs' were ultimately selected based on an evaluation of overall effectiveness, affordability, and suitability to the community. The program will allow continual adjustment and refinement through City implementation experience and feedback from all sectors of the residential and business community.

3.0 MCM-1 PUBLIC EDUCATION AND OUTREACH

The following section describes regulatory requirements, permit application requirements, current City programs, selected BMP's, measurable goals, implementation schedule, and responsible parties pertaining to MCM-1. Table 3-4, found at the end of this section, summarize the measurable goals, implementation schedule, and responsible party for each BMP.

3.1 REGULATORY REQUIREMENTS

40 CFR 122.34 (b)(1) – *The permit must identify the minimum elements and require implementation of a public education program to distribute educational materials to the community or conduct equivalent outreach activities about the impacts of storm water discharges on water bodies and the steps that the public can take to reduce pollutants in storm water runoff.*

3.2 PERMIT APPLICATION REQUIREMENTS

[From The General Permit to Discharge Under the Texas Pollutant Discharge Elimination System dated August 2024.]

The small MS4 operator shall implement a public education and outreach program to distribute educational materials to the community and conduct equivalent outreach about the impacts of stormwater discharges on water bodies and the steps that the public can take to reduce pollutants in stormwater runoff.

The public education and outreach program shall at a minimum include the following target audiences, as applicable:

1. *Traditional MS4s and counties shall address the residents being served;*
2. *Non-traditional MS4s (other than counties) shall address the community served by the MS4 as listed below:*
    a. *Universities shall target the faculty, other staff, and students;*
    b. *Military bases shall target military personnel (and dependents), and employees (including contractors);*
    c. *Military bases shall target military personnel (and dependents), and employees (including contractors);*

d. Municipal Utility Districts and other special districts shall target staff and contractors; and

e. Transportation authorities shall address staff, contractors, and users.

3. Small ms4 operators shall address additional target audiences within the small MS4 service area (such as but not limited to, those listed in Table 2) as listed below:

a. Levels 1, 2a, and 2b: No requirement for additional audiences;

b. Level 3: A minimum of one additional audience; or

c. Level 4: A minimum of two additional audiences.

Table 3-1: Additional Target Audiences

Additional Target Audiences
Schools, educational organizations, or youth service and youth groups
Businesses, including commercial facilities, home-base and mobile businesses
Institutions or formal organizations such as churches, hospitals, and service organizations
Developers or construction site operators
Homeowner or neighborhood associations
Industrial facilities
Visitors/tourists

Small MS4 operators shall target specific pollutant(s) in the permittee's education program (such as, but not limited to, those listed in Table 3). Each small MS4 shall have a minimum of one target pollutant for each target audience from Part IV.D.1(a)(1).a-c of this permit. Small MS4s may implement more than one target pollutant where desired or appropriate to address pollutants in stormwater discharges to the MEP. The target pollutant must be appropriate for the target audience. The same pollutant may be used for more than one target audience and the target pollutant(s) may change annually as needed.

Table 3-2: Pollutants and Sources

Pollutants and Sources
Grass clippings and leaf litter
Fertilizer and pesticides
Litter, trash containment, balloon releases
Dumping of solid waste
Illegal disposal of household hazardous waste
Pet waste
Failing septic systems
Swimming pool discharge, including saltwater pools
De-icing/rock salt usage/storage
Oil, grease, fluids from vehicles
Sediment runoff from construction activities
Unauthorized discharge of restaurant waste
Vehicle Washing
Washwater/grey water

Small MS4 operators must use appropriate educational resources as BMPs (materials, events, activities, etc.) in conjunction with the selected pollutants for the selected audiences. The message delivered by these BMPs must be applicable to the target audience and relate to the target pollutant (such as a newsletter article about updated illegal dumping and discharge ordinances distributed to auto mechanic businesses or a hazardous household waste disposal flyer when applying for trash or recycling services). BMPs which are ongoing throughout the year or permit term may be counted as one annual BMP. Permittees shall explain how each BMP relates to the target pollutant and target audience. Small MS4 operators may change BMPs during the permit cycle if determined appropriate through annual reviews and a different BMP may be more effective for the small MS4's target

pollutant or target audience. Any changes shall be reflected in the SWMP and explained in the annual report.

1. *If the permittee has a public website, the permittee shall post its SWMP and the annual reports required under Part V.B.2 or a summary of the annual report on the permittee's website.*

    a. *The SWMP must be posted no later than 30 days after the NOI or NOC approval date; and*

    b. *The annual report no later than 30 days after the due date.*

2. *Over the permit term, small MS4 operators shall implement a minimum number of public education and outreach BMPs from Table 4, as follows:*

    a. *Level 1: three BMPs;*

    b. *Levels 2a and 2b: four BMPs; or*

    c. *Levels 3 and 4: five BMPs.*

Table 3-3: Required Public Education and Outreach BMPs

Activity/BMP	**Measurable Goals**
Information on the MS4 operator's website.	Maintain a webpage with current and accurate information and working links. • All links shall be checked, and the page shall be updated as necessary at a minimum of once annually. • Must be maintained for the full year, each year.
Social Media posts, social media campaign.	Post a minimum of four times each year on a minimum of one social media platform. • The message shall address ways attendees can minimize or avoid adverse stormwater impacts or practices to

	improve the quality of stormwater runoff. • The messages shall be seasonally appropriate. • Must make a minimum of one post per quarter and all quarterly posts must be visible by attendees for the full year, each year.
Maintain or mark storm drains and inlets with, "No Dumping – Drains to Creek" or a similar message.	Placard, stencil, or paint a minimum of 10% of all known stormwater inlets in the MS4 area each year. Where all known stormwater inlets have been marked, inspect, and maintain the markers for a minimum of 15% of all known stormwater inlets in the MS4 area each year.
Media/advertising campaign/public service announcements in areas of high visibility; Billboard/poster; Bus shelter/bench; radio/television/movie theatre; and kiosks.	Develop topics that address activities or pollutants of concern. Advertisement must be active for a minimum of three weeks each year; or must have an estimated public exposure for the duration of the advertising campaign that is equal to twice the population for the small MS4 area (based on the most recent U.S. Census Bureau decennial population value for the small MS4 area).
Publish articles in local newspaper or newsletter, may be electronic.	Develop article topics that are group specific and address activities or pollutants of concern at a seasonally appropriate time. A minimum of two articles must be published or emailed to target audience groups each year.
Fact sheets/brochures/utility bill inserts/door hangars.	Develop material topics that are group specific and address activities or pollutants of concern. The number of fact sheets, brochures, bill inserts,

	door hangars, or handouts distributed each year shall at a minimum be enough to reach at least 75% of the intended audience.
Permanent stormwater related signage.	Place signage in a location where the message is relevant, and highly visible to target audience. Signage will count as an annual BMP for the year it was put in place and for each subsequent year of this permit cycle as long as each of those years, the permittee inspects and maintains, as necessary, 100% of the signage once annually.
Promote, host, or develop educational meetings, seminar, or trainings.	Hold, host, or promote a minimum of two events annually. • The events shall address ways attendees can minimize or avoid adverse impacts to stormwater or practices to improve the quality of stormwater runoff. • These events may address different pollutants and audiences.
Targeted education campaign via mail, email, or in person.	Minimum of one campaign annually or with a specific event to reach at least 75% of the intended audience. (Examples: Sediment control with small building permit; leaf litter email during street sweeping season, or education brochure to all businesses conducting certain activity)

1. *Small MS4 operators shall create or support the public education and outreach BMP(s) in Part Iv.D.1.(a)(3). To be considered support given to the coordinating groups, the small MS4 operator shall at minimum conduct the following or similar:*

    a. *Plan, or assist with planning, the distribution of materials;*

b. Coordinate volunteers;

c. Contribute supplies, materials, tools, or equipment;

d. Provide assistance from MS4 staff to distribute the materials; or

e. Provide financial support.

2. Small MS4 operators may partner with other MS4 operators to maximize the program and cost effectiveness of the required outreach.

3.3 DISCUSSION OF CURRENT BMP PROGRAMS

3.3.1 INFORMATION ON THE MS4 OPERATOR'S WEBSITE

Description: The City maintains an informational website. The website has been expanded to include storm water program information. Information to be posted on the website may include: digital copies of educational brochures; downloadable copies of storm water forms (e.g., construction site pollution prevention plan form); contact information for plan review and inspection programs; and customer service phone intake number. Additionally, a link to the TCEQ MS4 website will be added for easy access to regulatory information. The site will be reviewed and updated annually.

Measurable Goals, Implementation Schedule, and Responsible Party: See Table 3-4.

Status: Ongoing; website is reviewed and updated annually.

3.3.2 SOCIAL MEDIA POSTS, SOCIAL MEDIA CAMPAIGN

Description: The City will post a minimum of four times each year on a minimum of one social media platform. The message shall address ways that attendees can minimize or avoid stormwater impacts or practices to improve the quality of stormwater runoff. The messages shall be seasonally appropriate. The City must make a minimum of one post per quarter and all quarterly posts must be visible by attendees for the full year, each year.

Measurable Goals, Implementation Schedule, and Responsible Party: See Table 3-4.

Status: Ongoing; posts are reviewed and created periodically.

3.3.3 FACT SHEETS/BROCHURES/UTILITY BILL INSERTS/DOOR HANGARS

Description: Educational brochures are procured from third-party sources (Joint Task Force, EPA, TCEQ, Harris County, etc.) and customized for City use. Brochures address various storm water issues and include information such as the impacts polluted storm water runoff can have on water quality, hazards associated with illegal dumping and discharges, phone numbers to report dumping activities, information about bacteria to address impairments in order to raise wastewater effluent awareness, and other steps residents can take to reduce pollutants in storm water runoff. New brochures are posted on the City's website, and copies are made available to visitors in the City of Kemah City Hall lobby and at city council meetings. Digital copies of new brochures are posted on the City's website at www.kemahtx.gov. A copy of each item distributed and a locations and times they are made available is maintained by the City. The City will use the announcements made to estimate the percentage of its intended audience reached by the brochures to determine the effectiveness of the BMP.

Measurable Goals, Implementation Schedule, and Responsible Party: See Table 3-4.

Status: Ongoing; brochures are periodically distributed and uploaded to the City's website.

Table 3-4 BMPs for Public Education and Outreach (MCM-1)			
BMP	**Measurable Goals**	**Due Date**	**Responsible Party**
Information on the MS4 Operator's Website	1. Maintain a webpage with current and accurate information and working links. Maintain for the full year, each year.	Years 1-5, Months 1-12	Schaumburg & Polk, Inc.
	2. Check all links and update page as necessary at a minimum of once annually.	Years 1-5, Month 5	Schaumburg & Polk, Inc.
Social Media Posts, Social Media Campaign	Post a minimum of four times each year on a minimum of one social media platform. The message shall address ways attendees can minimize or avoid adverse stormwater impacts or practices to improve the quality of stormwater runoff. The messages shall be seasonally appropriate. A minimum of one post per quarter. All quarterly posts must be visible by attendees for the full year, each year.	Year 1-5, Months 3, 6, 9, 12	Schaumburg & Polk, Inc.
Fact Sheets/ Brochures/ Utility Bill Inserts/ Door Hangars	1. Develop material topics that are group specific and address activities or pollutants of concern. Fact sheets, brochures, bill inserts, door hangars, or handouts shall be distributed each year for at least 75% of the intended audience.	Year 1-5, Months 6, 12	Schaumburg & Polk, Inc.
	2. Develop and implement a tracking system to estimate what percentage of the intended audience is reached for determining BMP effectiveness.	Year 1-5, Months 6, 12	Schaumburg & Polk, Inc.

Note: Year 1 = 2024, Year 2 = 2025, Year 3 = 2026, Year 4 = 2027, Year 5 = 2028

Month 1 = January… Month 12 = December

4.0 MCM-2 PUBLIC INVOLVEMENT/PARTICIPATION

The following section describes regulatory requirements, permit application requirements, current City programs, selected BMP's, measurable goals, implementation schedule, and responsible parties pertaining to MCM-2. Table 4-2, found at the end of this section, summarizes the measurable goals, implementation schedule, and responsible party for each BMP.

4.1 REGULATORY REQUIREMENTS

40 CFR 122.34 (b)(2) – *The permit must identify the minimum elements and require implementation of a public involvement/participation program that complies with State, Tribal, and local public notice requirements.*

4.2 PERMIT APPLICATION REQUIREMENTS

[From The General Permit to Discharge Under the Texas Pollutant Discharge Elimination System dated August 2024.]

All permittees, except prisons/correctional facilities, shall involve the public, and, at minimum, comply with any state and local public notice requirements in the planning and implementation activities related to developing and implementing the SWMP. The small MS4 operator must create opportunities, or support activities that are coordinated by citizen groups, for residents and others to become involved with the SWMP. The activities/BMPs must demonstrate an impact on stormwater runoff by improving water quality.

Over the permit term, small MS4 operators shall implement a minimum number of public involvement/participation activities and measurable goals from Table 5 as follows:

a. Level 1 small MS4: two BMPs;

b. Levels 2a and 2b small MS4: three BMPs; or

c. Levels 3 and 4 small MS4: four BMPs.

Table 4-1: Public Involvement/Participation BMPs

Activity/BMP	**Measurable Goals**
Stream/lake or watershed clean-up events; litter/trash clean-up events such as Texas Stream Team, Adopt-A-Highway, Adopt-A-Spot, Adopt-A-Street, Adopt-A-Stream, etc.	Host at a minimum two events annually. • To be considered an event, the land area cleaned must be a minimum of: o two acres, o 400 yards of steam/streambank/ riparian area, or o two miles of roadside • These may be combined (such as one acre of land and 200 yards of stream).
Habitat improvement; Tree planting; Invasive Vegetation removal; Stream restoration.	Host at a minimum two events annually. • To be considered an event, the project must be a minimum of 0.5 acres or 25 yards. • An event may take place in streams, parks, areas adjacent to public waterways, or other green space. • An event may be a combination of locations and areas.
Volunteer water quality monitoring.	Host a minimum one event annually. To be considered an event, the monitoring must be conducted at minimum once each year.
Stormwater related speaker series.	Host a minimum one event annually. To be considered an event, the monitoring must be conducted at minimum once each year.

MS4 area-wide stormwater survey for input on program implementation.	Provide a minimum of one public survey annually for input on the program implementation to be distributed to reach at least 75% of the intended audience.
Hold events to train residents, or work a project for homeowner associations (HOAs), or other public groups to cover stormwater topics such as: Building rain barrels; Fertilizer application training; Rain garden/bio retention creation or maintenance; How to recognize illicit discharge activities and communicate observations to appropriate MS4 staff.	Provide at minimum one project or training annually.
Educational display/booth at a school, public event, or similar event to provide information or displays that work to improve public understanding of issues related to water quality.	Provide one booth or display at minimum annually. The booth or display must be staffed during the time which the event is open to the public.
Public meeting for input on the program implementation such as a city council meeting, board meeting, or stakeholder meeting.	Host a minimum of one meeting annually for input on the program implementation to be advertised to reach at least 75% of the intended audience.

Small MS4 operators shall create or support the public involvement/participation BMP(s) in Part IV.D.2.(a). To be considered support given to the coordinating groups the small MS4 operator shall at minimum conduct the following or similar:

a. Plan, or assist with planning, the event or activity;

b. Contribute supplies, materials, tools, or equipment;

c. Provide assistance from MS4 staff during the activity;

d. Provide assistance with recruiting volunteers for events;

e. Make a space available for projects, meetings, or events;

f. Advertisement for the events;

g. Supply disposal services;

h. Arrange land or stream access;

i. Provide financial support; or

j. Provide donations of goods and services such as food.

Small MS4 operators may partner with other MS4 operators to maximize the program and cost effectiveness of the required public involvement/participation activities.

4.3 DISCUSSION OF CURRENT BMP PROGRAMS

4.3.1 STREAM, LAKE, OR WATERSHED CLEAN-UP EVENTS; LITTER/TRASH CLEAN-UP EVENTS SUCH AS TEXAS STREAM TEAM, ADOPT-A-HIGHWAY, ADOPT-A-STREET, ADOPT-A-STREAM, ETC.

Description: The City will host a minimum of one event annually, using volunteers to monitor water quality. To be considered an event, the land area cleaned must be a minimum of:

- two acres,
- 400 yards of steam/streambank/ riparian area, or
- two miles of roadside

These may be combined (such as one acre of land and 200 yards of stream).

Measurable Goals, Implementation Schedule, and Responsible Party: See Table 4-2.

Status: Events planned at ongoing intervals with Kemah volunteer organization.

4.3.2 PUBLIC MEETING FOR INPUT ON PROGRAM IMPLEMENTATION

Description: The City will host a public meeting to receive public comment/input on the program implementation, such as a city council meeting, board meeting, or stakeholder meeting. This will be a minimum of one meeting annually for input on the program implementation to be advertised to reach at least 75% of the intended audience. The City will use the announcements to track the percentage of the intended audience reached for invitation.

Measurable Goals, Implementation Schedule, and Responsible Party: See Table 4-2.

Status: Ongoing

Table 4-2 BMP's for Public Involvement/Participation (MCM-2)			
BMP	**Measurable Goals**	**Due Date**	**Responsible Party**
Stream/Lake or Watershed Clean-Up Events; Litter/Trash Clean-Up Events	1. Publicize event for volunteer monitoring of water quality in the area. Advertise using website and city council announcements to reach at least 75% of the intended audience	Years 1-5, Month 7	Schaumburg & Polk, Inc.
	2. Inspect water quality in the area using volunteer forces as much as possible. Record 100% of observations and track number of instances of low quality recorded. Record number of volunteers.	Years 1-5, Month 7	Schaumburg & Polk, Inc.
Public Meeting for Input on Program Implementation	1. Host a minimum of one meeting annually for input on the program implementation to be advertised to reach at least 75% of the intended audience.	Year 1-5, Month 12	Schaumburg & Polk, Inc.
	2. During the meeting, present the proposed SWMP, solicit feedback on the selected BMP's, and invite suggestions for additional BMP's. Record the date, agenda, and number of participants at the meeting.	Year 1-5, Month 12	Schaumburg & Polk, Inc.
	3. Record, evaluate and incorporate valid comments and suggestions into SWMP.	Year 1-5, Month 12	Schaumburg & Polk, Inc.

Note: Year 1 = 2024, Year 2 = 2025, Year 3 = 2026, Year 4 = 2027, Year 5 = 2028

Month 1 = January… Month 12 = December

5.0 MCM-3 ILLICIT DISCHARGE DETECTION AND ELIMINATION (IDDE)

The following section describes regulatory requirements, permit application requirements, current City programs, selected BMP's, measurable goals, implementation schedule, and responsible parties pertaining to MCM-3. Tables 5-2 and 5-3, found at the end of this section, summarize the measurable goals, implementation schedule, and responsible party for each BMP.

5.1 REGULATORY REQUIREMENTS

40 CFR 122.34 (b)(3) – *The permit must identify the minimum elements and require the development, implementation, and enforcement of a program to detect and eliminate illicit discharges (as defined at Sec. 122.26(b)(2)) into the small MS4.*

At a minimum, the permit must require the permittee to:

- *Develop, if not already completed, a storm sewer system map, showing the location of all outfalls and the names and locations of all waters of the United States that receive discharges from those outfalls;*
- *To the extent allowable under state, Tribal, or local law, effectively prohibit, through ordinance, or other regulatory mechanism, non-storm water discharges into the storm sewer system and implement appropriate enforcement procedures and actions;*
- *Develop and implement a plan to detect and address non-storm water discharges, including illegal dumping, to the system; and*
- *Inform public employees, businesses, and the general public of hazards associated with illegal discharges and improper disposal of waste.*

The permit must also require the permittee to address the following categories of non-storm water discharges or flows (i.e., illicit discharges) only if the permittee identifies them as a significant contributor of pollutants to the small MS4: Water line flushing, landscape irrigation, diverted stream flows, rising ground waters, uncontaminated ground water infiltration (as defined at 40 CFR 35.2005(b)(20)), uncontaminated pumped ground water, discharges from potable water sources, foundation drains, air conditioning condensation, irrigation water, springs, water from crawl space pumps, footing drains, lawn watering, individual residential car washing, flows from riparian habitats and wetlands, dechlorinated swimming pool discharges, and street wash water (discharges or flows from firefighting activities are excluded from the effective prohibition against non-storm

water and need only be addressed where they are identified as significant sources of pollutants to waters of the United States).

5.2 PERMIT APPLICATION REQUIREMENTS

[From The General Permit to Discharge Under the Texas Pollutant Discharge Elimination System dated August 2024.]

5.2.1 PROGRAM DEVELOPMENT

All permittees shall develop, implement, and enforce a program to investigate, detect, and eliminate illicit discharges into the small MS4. The program must include a plan to detect and address non-stormwater discharges, including illegal dumping to the small MS4.

The Illicit Discharge Detection and Elimination (IDDE) program must include the following:

1. *A current and accurate MS4 map (see Part IV.D.3.(c)(1));*
2. *Methods for informing and training MS4 field staff (see Part IV.D.3.(c)(2));*
3. *Methods for facilitating public reporting of illicit discharges and illegal dumping (see Part IV.D.3.(c)(3));*
4. *Procedures for responding to illicit discharge, illegal dumping, and spills (see Part IV.D.3.(c)(4));*
5. *Procedures for tracing the source of an illicit discharge and illegal dumping (see Part IV. D.3.(c)(5));*
6. *Procedures for removing the source of the illicit discharge and illegal dumping (see Part IV.D.3.(c)(5));*
7. *Conduct inspections in response to complaints including follow-up inspections, and procedures for inspections (see Part IV.D.3.(c)(6));*
8. *For Levels 2, 3 and 4, if applicable, procedures to prevent and correct any leaking on-site sewage disposal systems that discharge into the small MS4;*
9. *For Level 4, procedures for identifying priority areas within the small MS4 likely to have illicit discharges and illegal dumping, and a list of all such areas identified in the small MS4 (see Part IV.D.3.(e)(1));*

10. *For Level 4, dry weather field screening to detect illicit discharges and illegal dumping (see Part IV.D.3.(e)(2)); and*

11. *For Level 4, procedures to reduce the discharge of floatables in the small MS4 (see Part IV.D.3.(e)(3)).*

For non-traditional small MS4s, if illicit connections, illegal dumping, or illicit discharges are observed related to another operator's MS4, the permittee shall notify the other MS4 operator within 48 hours of discovery. If notification to the other MS4 operator is not practicable, then the permittee shall notify the appropriate TCEQ Regional Office of the possible illicit connection, illegal dumping, or illicit discharge.

If another MS4 operator notifies the permittee of an illegal connection, illegal dumping, or illicit discharge to the small MS4, then the permittee shall follow the requirements specified in Part IV.D.3.(c)(5).

5.2.2 ALLOWABLE NON-STORM WATER DISCHARGES

Non-stormwater discharges listed in Part II.D do not need to be considered by the permittee as an illicit discharge requiring elimination unless the permittee or the TCEQ identifies the discharge as a significant source of pollutants to the small MS4.

5.2.3 REQUIREMENTS FOR ALL PERMITTEES

All permittees shall meet all the following requirements, including Table 6.

1. *MS4 Mapping - All permittees shall maintain a current and accurate MS4 map, which must be located on site and available for review by TCEQ. The MS4 map must show at a minimum the following information:*

    a. *The location of all small MS4 outfalls that are operated by the permittee and that discharge into Waters of the U.S.;*

    b. *The location and name of all surface waters receiving discharges from the small MS4 outfalls; and*

    c. *Priority areas identified under Part IV.D.3.(e)(1), if applicable.*

2. *Education and Training - All permittees shall implement a method for informing or training all the permittee's field staff that may come into contact with or otherwise observe an illicit discharge, illegal dumping, or illicit connection to the small MS4 as*

part of their normal job responsibilities. Training program materials and attendance lists must be maintained onsite and made available for review by the TCEQ.

3. *Public Reporting of Illicit Discharges and Spills - All permittees shall publicize and facilitate public reporting of illicit discharges, illegal dumping, or water quality impacts associated with discharges into or from the small MS4. The permittee shall provide a central contact point to receive reports; for example, by including a telephone number for complaints and spill reporting.*

4. *All permittees shall develop and maintain onsite procedures for responding to illicit discharges, illegal dumping, and spills.*

5. *Source Investigation and Elimination*

    a. *Minimum Investigation Requirements – Upon becoming aware of an illicit discharge or illegal dumping, all permittees shall conduct an investigation to identify and locate the source of such illicit discharge or illegal dumping as soon as practicable.*

        i. *All permittees shall prioritize the investigation of discharges based on their relative risk of pollution. For example, sanitary sewage may be considered a high priority discharge.*

        ii. *All permittees shall report to the TCEQ immediately upon becoming aware of the occurrence of any illicit flows believed to be an immediate threat to human health or the environment.*

        iii. *All permittees shall track all investigations and document, at a minimum, the date(s) the illicit discharge or illegal dumping was observed; the results of the investigation; any follow-up of the investigation; and the date the investigation was closed.*

    b. *Identification and Investigation of the Source of the Illicit Discharge –All permittees shall investigate and document the source of illicit discharges and illegal dumping where the permittees have jurisdiction to complete such an investigation. If the source of illicit discharge or illegal dumping extends outside the permittee's boundary, all permittees shall notify the adjacent permitted MS4 operator or the appropriate TCEQ Regional Office.*

    c. *Corrective Action to Eliminate Illicit Discharge*

i. *If and when the source of the illicit discharge or illegal dumping has been determined, all permittees shall immediately notify the responsible party of the problem, and shall require the responsible party to perform all necessary corrective actions to eliminate the illicit discharge and illegal dumping.*

6. *<u>Inspections</u> - The permittee shall conduct inspections, in response to complaints, and shall conduct follow-up inspections to ensure that corrective measures have been implemented by the responsible party. The permittee shall develop written procedures describing the basis for conducting inspections in response to complaints and conducting follow-up inspections.*

Table 5-1: Required IDDE BMPs

Activity/BMP	**Measurable Goals**
Maintain a current and accurate MS4 map as described in Part IV.D.3.(c)(1).	Review and update, as necessary, at least one time annually to include features which have been added, removed, or changed.
Conduct training for all the permittee's field staff as described in Part IV.D.3.(c)(2). Training may be conducted in person or using self-paced training materials such as videos or reading materials.	Conduct a minimum of one training annually for 100% of MS4 field staff that may come into contact with or otherwise observe an illicit discharge, illegal dumping, or illicit connection to the small MS4 as part of their normal job responsibilities.
Maintain and publicize a public reporting method for the public to report illicit discharges, illegal dumping, or water quality impacts associated with discharges into or from the small MS4 such as a reporting hotline, online form, or other similar mechanism as described in Part IV.D.3.(c)(3).	Maintain a minimum of one public reporting mechanism 100% of the time during the permit term. Publicize the public reporting mechanism a minimum of two times annually in a method designed to reach at least 75% of the intended audience. In addition, if the MS4 operator has a public website, the public reporting mechanism must be publicized on the public website 100% of the

	time during the permit term.
Develop and maintain procedures for responding to illicit discharges, illegal dumping, and spills as described in Part IV.D.3.(c)(4).	Review and update the procedures at least one time annually to address changes and make improvements to the established procedures where applicable.
Source investigation and elimination of illicit discharges and illegal dumping as described in Part IV.D.3.(c)(5).	Respond to 100% of known illicit discharges and illegal dumping incidents each year to investigate sources (or some Level 2b MS4s must notify the appropriate agency with the authority to act). Each year, respond to 100% of high priority discharges each year, such as sanitary sewer discharges within 24 hours (or some Level 2b MS4s must notify the appropriate agency with the authority to act). For 100% of known illicit discharges or illegal dumping incidents where the small MS4 does not have jurisdiction, notify the adjacent MS4 operator or the applicable TCEQ regional office each year. Notify TCEQ immediately of 100% of illicit flows believed to be an immediate threat to human health or the environment throughout the permit term.
Corrective action to eliminate illicit discharges and illegal dumping as described in Part IV.D.3.(c)(5).	For 100% of illicit discharges or illegal dumping where a source has been determined, notify the responsible party of the problem within 24 hours. Require the responsible party to perform all necessary corrective actions to eliminate the illicit discharge.
Inspection Procedures as described in Part IV.D.3.(c)(6).	Review and update the procedures at least one time annually to address changes and make improvements to the established procedures

	where applicable.
Inspections in response to complaints as described in Part IV.D.3.(c)(6).	Conduct inspections in response to 100% of complaints each year according to the established procedures (or some Level 2b MS4s must notify the appropriate agency with the authority to act). Conduct follow up inspections in 100% of cases each year where necessary as described in the established procedures (except for some Level 2b MS4s without the appropriate authority to act).

5.3 DISCUSSION OF CURRENT BMP PROGRAMS

5.3.1 MS4 MAP

Description: The City will create a storm sewer map (See Figure 2-1 on Page 2-2) that illustrates the location of major outfalls, drainage area boundaries, and the names and locations of all waters of the United States that receive discharges from those outfalls. The map will be updated at least one time annually to include features which have been added, removed, or changed. Information sources, outfall verification method, and update procedures will be defined on the map. A hard copy of the map is kept at City Hall at all times. This map will be reviewed at least one time annually and updated any time additions, changes, or modifications to the storm sewer system and/or outfalls are made.

Measurable Goals, Implementation Schedule, and Responsible Party: See Table 5-2.

Status: Completed; system is updated as improvements/modifications are made.

5.3.2 FIELD STAFF TRAINING

Description: The City will conduct training for all the permittee's field staff, as described in Part IV.D.3.(c)(2). This training may be conducted in person or using self-paced training materials such as videos or reading materials. A minimum of one training session will be conducted annually for 100% of MS4 field staff that may come into contact with or otherwise observe an illicit discharge, illegal dumping, or illicit connection to the small MS4 as part of their normal job responsibilities.

Measurable Goals, Implementation Schedule, and Responsible Party: See Table 5-2.

Status: Ongoing

5.3.3 PUBLIC REPORTING METHOD

Description: The City will maintain and publicize a public reporting method for the public to report illicit discharges, illegal dumping, or water quality impacts associated with discharges into or from the small MS4 such as a reporting hotline, online form, or other similar mechanism as described in Part IV.D.3.(c)(3). A minimum of one public reporting mechanism will be maintained 100% of the time during the permit term. The public reporting mechanism will be publicized a minimum of two times annually in a method designed to reach at least 75% of the intended audience. In addition, public reporting mechanism will be publicized on the public website 100% of the time during the permit term.

The City will continue to operate a phone line for residents to call in questions and complaints. The City will review existing record-keeping and follow-up procedures and make modifications if necessary. The phone line will continue to field calls regarding environmental concerns, dumping activities, construction runoff, and hazard and nuisance conditions. City personnel will continue to investigate valid complaints. The hotline will be advertised to City residents and businesses through the City's website.

Measurable Goals, Implementation Schedule, and Responsible Party: See Table 5-2.

Status: Ongoing; hotline continually operated

5.3.4 RESPONSE PROCEDURES

Description: The City will develop and maintain procedures for responding to illicit discharges, illegal dumping, and spills as described in Part IV.D.3.(c)(4). The procedures will be reviewed and updated at least one time annually to address changes and make improvements to the established procedures where applicable.

Measurable Goals, Implementation Schedule, and Responsible Party: See Table 5-2.

Status: Ongoing

5.3.5 SOURCE INVESTIGATION AND ELIMINATION OF ILLICIT DISCHARGES AND ILLEGAL DUMPING

Description: The City will conduct source investigation and elimination of illicit discharges and illegal dumping as described in Part IV.D.3.(c)(5). The City will respond to 100% of known illicit discharges and illegal dumping incidents each year to investigate sources. Each year, the City will respond to 100% of high priority discharges each year, such as sanitary sewer discharges within 24 hours. For 100% of known illicit discharges or illegal dumping incidents where the small MS4 does not have jurisdiction, the adjacent MS4 operator or the applicable TCEQ regional office will be notified each year. TCEQ will be notified immediately of 100% of illicit flows believed to be an immediate threat to human health or the environment throughout the permit term.

Measurable Goals, Implementation Schedule, and Responsible Party: See Table 5-2.

Status: Ongoing

5.3.6 CORRECTIVE ACTION TO ELIMINATE ILLICIT DISCHARGES AND ILLEGAL DUMPING

Description: As described in Part IV.D.3.(c)(5), the City will notify the responsible party for 100% of illicit discharges or illegal dumping where a source has been determined. This party will be notified of the problem within 24 hours. The responsible party will be required to perform all necessary corrective actions to eliminate the illicit discharge.

Measurable Goals, Implementation Schedule, and Responsible Party: See Table 5-3.

Status: Ongoing

5.3.7 INSPECTION PROCEDURES

Description: As described in Part IV.D.3.(c)(6), the City will review and update the procedures at least one time annually to address changes and make improvements to the established procedures where applicable.

Measurable Goals, Implementation Schedule, and Responsible Party: See Table 5-3.

Status: Ongoing

5.3.8 INSPECTIONS IN RESPONSE TO COMPLAINTS

Description: The City will conduct inspections in response to complaints as described in Part IV.D.3.(c)(6 by conducting inspections in response to 100% of complaints each year according to the established procedures. The City will conduct follow up inspections in 100% of cases each year where necessary as described in the established procedures.

Measurable Goals, Implementation Schedule, and Responsible Party: See Table 5-3.

Status: Ongoing

5.4 LIST OF INCIDENTAL NON-STORM WATER DISCHARGES

The City has considered and determined the following occasional incidental non-storm water discharges to be insignificant contributors of pollutants to the MS4: water line flushing, landscape irrigation, diverted stream flows, rising ground waters, uncontaminated ground water infiltration (as defined at 40 CFR 35.2005(20)), uncontaminated pumped ground water, discharges from potable water sources, foundation drains, air conditioning condensation, irrigation water, springs, water from crawl space pumps, footing drains, lawn watering, individual residential car washing, charity car washing, flows from riparian habitats and wetlands, dechlorinated swimming pool discharges, and street wash water.

Table 5-2 BMP's for Illicit Discharge Detection and Elimination (MCM-3)			
BMP	**Measurable Goals**	**Due Date**	**Responsible Party**
Maintain and Current and Accurate MS4 Map	Review and update, as necessary, at least one time annually to include features which have been added, removed, or changed.	Years 1-5, Month 4	Schaumburg & Polk, Inc.
Conduct Training for All the Permittee's Field Staff	Conduct a minimum of one training annually for 100% of MS4 field staff that may come into contact with or otherwise observe an illicit discharge, illegal dumping, or illicit connection to the small MS4 as part of their normal job responsibilities.	Years 1-5, Month 11	Schaumburg & Polk, Inc.
Maintain and Publicize a Public Reporting Method for the Public to Report Illicit Discharges, Illegal Dumping, or Water Quality Impacts Associated with Discharges Into or From the Small MS4	1. Maintain a minimum of one public reporting mechanism 100% of the time during the permit term.	Years 1-5, Months 1 – 12	Schaumburg & Polk, Inc.
	2. Publicize the public reporting mechanism a minimum of two times annually in a method designed to reach at least 75% of the intended audience.	Years 1-5, Months 1, 6	Schaumburg & Polk, Inc.
	3. In addition, the public reporting mechanism must be publicized on the MS4 operator's public website 100% of the time during the permit term.	Years 1-5, Months 1 – 12	Schaumburg & Polk, Inc.
Develop and Maintain Procedures for Responding to Illicit Discharges, Illegal Dumping, and Spills	Review and update the procedures at least one time annually to address changes and make improvements to the established procedures where applicable.	Years 1-5, Month 2	Schaumburg & Polk, Inc.
Source Investigation and Elimination of Illicit Discharges and Illegal Dumping	1. Respond to 100% of known illicit discharges and illegal dumping incidents each year to investigate sources.	Years 1-5, Months 1 – 12	Schaumburg & Polk, Inc.
	2. Each year, respond to 100% of high priority discharges each year, such as sanitary sewer discharges within 24 hours.	Years 1-5, Months 1 – 12	Schaumburg & Polk, Inc.
	3. For 100% of known illicit discharges or illegal dumping incidents where the small MS4 does not have jurisdiction, notify the adjacent MS4 operator or the applicable TCEQ regional office each year.	Years 1-5, Months 1 – 12	Schaumburg & Polk, Inc.
	4. Notify TCEQ immediately of 100% of illicit flows believed to be an immediate threat to human health or the environment throughout the permit term.	Years 1-5, Months 1 – 12	Schaumburg & Polk, Inc.

Note: Year 1 = 2024, Year 2 = 2025, Year 3 = 2026, Year 4 = 2027, Year 5 = 2028

Month 1 = January… Month 12 = December

Table 5-3 BMP's for Illicit Discharge Detection and Elimination (MCM-3)			
BMP	**Measurable Goals**	**Due Date**	**Responsible Party**
Corrective Action to Eliminate Illicit Discharges and Illegal Dumping	1. For 100% of illicit discharges or illegal dumping where a source has been determined, notify the responsible party of the problem within 24 hours.	Years 1-5, Months 1 – 12	Schaumburg & Polk, Inc.
	2. Require the responsible party to perform all necessary corrective actions to eliminate the illicit discharge.	Years 1-5, Months 1 – 12	Schaumburg & Polk, Inc.
Inspection Procedures	Review and update the procedures at least one time annually to address changes and make improvements to the established procedures where applicable.	Years 1-5, Month 8	Schaumburg & Polk, Inc.
Inspections in Response to Complaints	1. Conduct inspections in response to 100% of complaints each year according to the established procedures	Years 1-5, Months 1 – 12	Schaumburg & Polk, Inc.
	2. Conduct follow up inspections in 100% of cases each year where necessary as described in the established procedures.	Years 1-5, Months 1 – 12	Schaumburg & Polk, Inc.

Note: Year 1 = 2024, Year 2 = 2025, Year 3 = 2026, Year 4 = 2027, Year 5 = 2028

Month 1 = January… Month 12 = December

6.0 MCM-4 CONSTRUCTION SITE STORMWATER RUNOFF CONTROL

The following section describes regulatory requirements, permit application requirements, current City programs, selected BMP's, measurable goals, implementation schedule, and responsible parties pertaining to MCM-4. Table 6-2, found at the end of this section, summarizes the measurable goals, implementation schedule, and responsible party for each BMP.

6.1 REGULATORY REQUIREMENTS

40 CFR 122.34 (b)(4) – *The permit must identify the minimum elements and require the development, implementation, and enforcement of a program to reduce pollutants in any storm water runoff to the small MS4 from construction activities that result in a land disturbance of greater than or equal to one acre. Reduction of storm water discharges from construction activity disturbing less than one acre must be included in your program if that construction activity is part of a larger common plan of development or sale that would disturb one acre or more. If the Director waives requirements for storm water discharges associated with small construction activity in accordance with §122.26(b)(15)(i), the permittee is not required to develop, implement, and/or enforce a program to reduce pollutant discharges from such sites.*

At a minimum, the permit must require the permittee to develop and implement:

- *An ordinance or other regulatory mechanism to require erosion and sediment controls, as well as sanctions to ensure compliance, to the extent allowable under State, Tribal, or local law;*
- *Requirements for construction site operators to implement appropriate erosion and sediment control best management practices;*
- *Requirements for construction site operators to control waste such as discarded building materials, concrete truck washout, chemicals, litter, and sanitary waste at the construction site that may cause adverse impacts to water quality;*
- *Procedures for site plan review that incorporate consideration of potential water quality impacts;*
- *Procedures for receipt and consideration of information submitted by the public; and*
- *Procedures for site inspection and enforcement of control measures.*

6.2 PERMIT APPLICATION REQUIREMENTS

[From The General Permit to Discharge Under the Texas Pollutant Discharge Elimination System dated August 2024.]

6.2.1 REQUIREMENTS AND CONTROL MEASURES

All permittees shall develop, implement, and enforce a program requiring operators of small and large construction activities to select, install, implement, and maintain stormwater control measures that prevent illicit discharges to the MEP. The program must include the development and implementation of an ordinance or other regulatory mechanism, as well as sanctions to ensure compliance to the extent allowable under state, federal, and local law, to require erosion and sediment control.

If TCEQ waives requirements for stormwater discharges associated with small construction from a specific site(s), the permittee is not required to enforce the program to reduce pollutant discharges from such site(s).

6.2.2 REQUIREMENTS FOR ALL PERMITTEES

All permittees shall meet the following requirements including Table 9.

1. *All permittees shall require that construction site operators implement appropriate erosion and sediment control BMPs. The permittee's construction program must ensure erosion and sediment controls, soil stabilization, and BMP requirements are effectively implemented for all small and large construction activities discharging to its small MS4 consistent with the TPDES CGP, TXR150000.*

2. *Prohibited Discharges – The following discharges are prohibited:*

    a. *Wastewater from washout of concrete and wastewater from water well drilling operations, unless managed by an appropriate control;*

    b. *Wastewater from washout and cleanout of stucco, paint, from release oils, and other construction materials;*

    c. *Fuels, oils, or other pollutants used in vehicle and equipment operation and maintenance;*

    d. *Soaps or solvents used in vehicle and equipment washing; and*

    e. *Discharges from dewatering activities, including discharges from dewatering of trenches and excavations, unless managed by appropriate BMPs.*

3. *Construction Plan Review Procedures – To the extent allowable by state, federal, and local law, all permittees shall maintain and implement site plan review procedures that describe which plans will be reviewed as well as when an operator may begin construction. For those permittees without legal authority to enforce site plan reviews, this requirement is limited to those sites operated by the permittee and its contractors and located within the permittee's regulated area. The site plan procedures must meet the following minimum requirements:*

    a. *The site plan review procedures must incorporate consideration of potential water quality impacts.*

    b. *The permittee may not approve any plans unless the plans contain appropriate site-specific construction site control measures that, at a minimum, meet the requirements described in the TPDES CGP, TXR150000. The permittee may require and accept a plan, such as a stormwater pollution prevention plan (SWP3), that has been developed pursuant to the TPDES CGP, TXR150000.*

4. *Construction Site Inspections and Enforcement – To the extent allowable by state, federal, and local law, all permittees shall implement procedures for inspecting large and small construction projects. Permittees without legal authority to inspect construction sites shall at a minimum conduct inspection of sites operated by the permittee or its contractors and that are located in the permittee's regulated area.*

    a. *The permittee shall conduct inspections based on the evaluation of factors that are a threat to water quality, such as: soil erosion potential; site slope; project size and type; sensitivity of receiving water bodies; proximity to receiving water bodies; non-stormwater discharges; and past record of non-compliance by the operators of the construction site.*

    b. *Inspections must occur during the active construction phase.*

        i. *All permittees shall develop and implement updated written procedures outlining the inspection and enforcement requirements. These procedures must be maintained on-site or in the SWMP and be made available to TCEQ.*

        ii. *Inspections of construction sites must, at a minimum:*

            1. *Determine whether the site has appropriate coverage under the TPDES CGP, TXR150000. If no coverage exists, notify the permittee of the need for permit coverage;*

2. *Conduct a site inspection to determine if control measures have been selected, installed, implemented, and maintained according to the small MS4's requirements;*

3. *Assess compliance with the permittee's ordinances and other regulations; and*

4. *Provide a written or electronic inspection report.*

c. *Based on site inspection findings, all permittees shall take all necessary follow-up actions (for example, follow-up-inspections or enforcement) to ensure compliance with permit requirements and the SWMP. These follow-up and enforcement actions must be tracked and documentation maintained for review by the TCEQ. For non-traditional small MS4s with no enforcement powers, the permittee shall notify the adjacent MS4 operator with enforcement authority or the appropriate TCEQ Regional Office.*

5. *Information Submitted By the Public - All permittees shall develop, implement, and maintain procedures for receipt and consideration of information submitted by the public.*

6. *MS4 Staff Training - All permittees shall ensure that all staff whose primary job duties are related to implementing the construction stormwater program (including permitting, plan review, construction site inspections, and enforcement) are informed or trained to conduct these activities. The training may be conducted by the permittee or by outside trainers.*

Table 6-1: Required Construction Site Stormwater Runoff Control BMPs

Activity/BMP	**Measurable Goals**
Develop and maintain an ordinance or other regulatory mechanism as described in Part IV.D.4.(a).	Review and update the ordinance or other regulatory mechanism at least one time during the permit term to address changes and make improvements to the ordinance where applicable.
Prohibit discharges as described in Part IV.D.4.(b)(2).	Develop and maintain an ordinance or other regulatory mechanism to prohibit these discharges. Review and update the ordinance or other regulatory mechanism at least one time during the permit term to address changes and make improvements to the ordinance where applicable.
Maintain and implement site plan review procedures that describe which plans will be reviewed as well as when an operator may begin construction as described in Part IV.D.4.(b)(3).	Review and update site plan review procedures at least one time annually to address changes and make improvements to the established procedures where applicable. Implement site plan review procedures for 100% of new construction site plans received each year.
Implement procedures for inspecting large and small construction projects as described in Part IV.D.4.(b)(4).	Review and update inspection procedures at least one time annually to address changes and make improvements to the established procedures where applicable.
Conduct construction site inspections as described in Part IV.D.4.(b)(4).	Conduct inspections at 80% of active construction sites annually according to the established procedures (or some Level 2b small MS4s must notify the appropriate agency with the authority to act). Each year, conduct follow up inspections in 100% of cases where necessary as described in the established procedures (except for some Level 2b small MS4s without the appropriate

	authority to act).
Develop, implement, and maintain procedures for receipt and consideration of information submitted by the public as described in Part IV.D.4.(b)(5).	Review and update procedures for the receipt and consideration of information submitted by the public at least one time annually to address changes and make improvements to the established procedures where applicable. Maintain one webpage, hotline, or similar method for receipt of information submitted by the public throughout the permit term.
Conduct training for all the MS4 staff whose primary job duties are related to implementing the construction stormwater program as described in Part IV.D.4.(b)(6). Training may be conducted in person or using self-paced training materials such as videos or reading materials.	Conduct a minimum of one training annually for 100% of MS4 staff whose primary job duties are related to implementing the construction stormwater program.

6.3 DISCUSSION OF CURRENT BMP PROGRAMS

6.3.1 DEVELOP AND MAINTAIN ORDINANCE/REGULATORY MECHANISM

Description: The City will develop and maintain an ordinance or other regulatory mechanism as described in Part IV.D.4.(a). The City will continue to enforce an existing waste control ordinance (Section 5-101). An inspector will continue to visit each construction site at least one time during construction period to ensure that operators properly dispose of generated wastes. Construction site operators will be notified of the ordinance prior to the start of construction activities at the time of permitting. The City will record the findings and enforcement actions for each inspection.

The City will review, and if necessary modify, existing ordinances requiring erosion, sediment, and on-site waste controls as well as sanctions to ensure compliance and effectiveness. Any amendments made to the ordinances will be documented and maintained. Residents and businesses will be notified of revisions made to ordinances via the City website list within one month of revision passage.

The ordinances will be reviewed and updated at least one time during the permit term to address changes and make improvements to the ordinance where applicable.

Measurable Goals, Implementation Schedule, and Responsible Party: See Table 6-2.

Status: Ongoing; ordinance is enforced on each construction activity. City will evaluate current ordinances for revision.

6.3.2 PROHIBIT DISCHARGES

Description: The City will develop and maintain an ordinance or other regulatory mechanism to prohibit these discharges as described in Part IV.D.4.(b)(2). The ordinance will be reviewed and updated at least one time during the permit term to address changes and make improvements to the ordinance where applicable.

Measurable Goals, Implementation Schedule, and Responsible Party: See Table 6-2.

Status: Ongoing; City will evaluate current ordinance for revision.

6.3.3 SITE PLAN REVIEW PROCEDURES

Description: The City will maintain and implement site plan review procedures that describe which plans will be reviewed as well as when an operator may begin construction as described in Part IV.D.4.(b)(3). Site plan review procedures will be reviewed and updated at least one time annually to address changes and make improvements to the established procedures where applicable. These procedures will be implemented for 100% of new construction site plans received each year.

Measurable Goals, Implementation Schedule, and Responsible Party: See Table 6-2.

Status: Ongoing; procedures are implemented for each proposed construction activity.

6.3.4 PROCEDURES FOR INSPECTING LARGE AND SMALL CONSTRUCTION PROJECTS

Description: The City will implement procedures for inspecting large and small construction projects as described in Part IV.D.4.(b)(4). Inspection procedures will be reviewed and updated at least one time annually to address changes and make improvements to the established procedures where applicable.

Measurable Goals, Implementation Schedule, and Responsible Party: See Table 6-2.

Status: Ongoing; inspections and enforcement are done for each construction activity

6.3.5 CONSTRUCTION SITE INSPECTION

Description: The City will conduct construction site inspections as described in Part IV.D.4.(b)(4). Inspections will be conducted at 80% of active construction sites annually according to the established procedures. Each year, follow up inspections will be conducted in 100% of cases where necessary as described in the established procedures.

Measurable Goals, Implementation Schedule, and Responsible Party: See Table 6-2.

Status: Ongoing; procedures are implemented for each proposed construction activity.

6.3.6 PROCEDURES FOR RECEIPT AND CONSIDERATION OF PUBLIC SUBMITTED INFORMATION

Description: The City will develop, implement, and maintain procedures for receipt and consideration of information submitted by the public as described in Part IV.D.4.(b)(5). The City will review and update procedures for the receipt and consideration of information submitted by the public at least one time annually to address changes and make improvements to the established procedures where applicable. A webpage, hotline, or similar method for receipt of information submitted by the public will be maintained throughout the permit term.

Measurable Goals, Implementation Schedule, and Responsible Party: See Table 6-2.

Status: Ongoing; procedures are implemented for each proposed construction activity.

6.3.7 MS4 STAFF TRAINING

Description: The City will conduct training for all the MS4 staff whose primary job duties are related to implementing the construction stormwater program as described in Part IV.D.4.(b)(6). Training may be conducted in person or using self-paced training materials such as videos or reading materials. The City will conduct a minimum of one training annually for 100% of MS4 staff whose primary job duties are related to implementing the construction stormwater program.

Measurable Goals, Implementation Schedule, and Responsible Party: See Table 6-2.

Status: Ongoing; inspections and enforcement are done for each construction activity.

Table 6-2 BMP's for Construction Site Runoff Control (MCM-4)			
BMP	**Measurable Goals**	**Date Due**	**Responsible Party**
Develop and Maintain an Ordinance or Other Regulatory Mechanism	Review and update the ordinance or other regulatory mechanism at least one time during the permit term to address changes and make improvements to the ordinance where applicable.	Years 1-5, Month 10	Schaumburg & Polk, Inc.
Prohibit Discharges	1. Develop and maintain an ordinance or other regulatory mechanism to prohibit these discharges.	Years 1-5, Months 1 – 12	Schaumburg & Polk, Inc.
	2. Review and update the ordinance or other regulatory mechanism at least one time during the permit term to address changes and make improvements to the ordinance where applicable.	Years 1-5, Month 10	Schaumburg & Polk, Inc.
Maintain and Implement Site Plan Review Procedures that Describe Which Plans Will Be Reviewed as Well as When an Operator May Begin Construction	1. Review and update site plan review procedures at least one time annually to address changes and make improvements to the established procedures where applicable.	Years 1-5, Month 2	Schaumburg & Polk, Inc.
	2. Implement site plan review procedures for 100% of new construction site plans received each year.	Years 1-5, Months 1 – 12	Schaumburg & Polk, Inc.
Implement Procedures for Inspecting Large and Small Construction Projects	Review and update inspection procedures at least one time annually to address changes and make improvements to the established procedures where applicable.	Years 1-5, Month 8	Schaumburg & Polk, Inc.
Conduct Construction Site Inspection	1. Conduct inspections at 80% of active construction sites annually according to the established procedures.	Years 1-5, Months 1 – 12	Schaumburg & Polk, Inc.
	2. Each year, conduct follow up inspections in 100% of cases where necessary as described in the established procedures.	Years 1-5, Months 1 – 12	Schaumburg & Polk, Inc.
Develop, Implement, and Maintain Procedures for Receipt and Consideration of Information Submitted by the Public	1. Review and update procedures for the receipt and consideration of information submitted by the public at least one time annually to address changes and make improvements to the established procedures where applicable.	Years 1-5, Month 4	Schaumburg & Polk, Inc.
	2. Maintain one webpage, hotline, or similar method for receipt of information submitted by the public throughout the permit term.	Years 1-5, Months 1 – 12	Schaumburg & Polk, Inc.
Conduct Training for all the MS4 Staff Whose Primary Job Duties are Related to Implementing the Construction Stormwater Program	Conduct a minimum of one training annually for 100% of MS4 staff whose primary job duties are related to implementing the construction stormwater program.	Years 1-5, Month 11	Schaumburg & Polk, Inc.

Note: Year 1 = 2024, Year 2 = 2025, Year 3 = 2026, Year 4 = 2027, Year 5 = 2028

Month 1 = January… Month 12 = December

7.0 MCM-5 POST CONSTRUCTION STORMWATER MANAGEMENT IN NEW DEVELOPMENT AND REDEVELOPMENT

The following section describes regulatory requirements, permit application requirements, current City programs, selected BMP's, measurable goals, implementation schedule, and responsible parties pertaining to MCM-5. Table 7-1, found at the end of this section, summarizes the measurable goals, implementation schedule, and responsible party for each BMP.

7.1 REGULATORY REQUIREMENTS

40 CFR 122.34 (b)(5) – *The permit must identify the minimum elements and require the development, implementation, and enforcement of a program to address storm water runoff from new development and redevelopment projects that disturb greater than or equal to one acre, including projects less than one acre that are part of a larger common plan of development or sale, that discharge into the small MS4. The permit must ensure that controls are in place that would prevent or minimize water quality impacts.*

At a minimum, the permit must require the permittee to:

- *Develop and implement strategies that include a combination of structural and/or non-structural best management practices (BMPs) appropriate for the community;*
- *Use an ordinance or other regulatory mechanism to address post-construction runoff from new development and redevelopment projects to the extent allowable under State, Tribal, or local law; and*
- *Ensure adequate long-term operation and maintenance of BMPs.*

7.2 PERMIT APPLICATION REQUIREMENTS

[From The General Permit to Discharge Under the Texas Pollutant Discharge Elimination System dated August 2024.]

7.2.1 POST-CONSTRUCTION STORMWATER MANAGEMENT PROGRAM

All permittees shall meet the requirements below including Table 11.

3. *All permittees shall develop, implement, and enforce a program, to the extent allowable under state, federal, and local law, to control stormwater discharges from new development and redeveloped sites that discharge into the small MS4 that disturb one*

acre or more, including projects that disturb less than one acre that are part of a larger common plan of development or sale. The program must be established for private and public development sites. The program may utilize an offsite mitigation and payment in lieu of components to address this requirement.

4. *All permittees shall use, to the extent allowable under state, federal, and local law and local development standards, an ordinance or other regulatory mechanism to address post-construction runoff from new development and redevelopment projects. The permittees shall establish, implement, and enforce a requirement that owners or operators of new development and redeveloped sites design, install, implement, and maintain a combination of structural and non-structural BMPs appropriate for the community and that protects water quality. If the construction of permanent structures is not feasible due to space limitations, health and safety concerns, cost effectiveness, or highway construction codes, the permittee may propose an alternative approach to TCEQ.*

7.2.2 REQUIREMENTS FOR ALL PERMITTEES

All permittees shall meet all the following requirements including Table 11.

1. *All permittees shall document and maintain records of enforcement actions and make them available for review by the TCEQ.*

2. *Long-Term Maintenance of Post-Construction Stormwater Control Measures - All permittees shall, to the extent allowable under state, federal, and local law, ensure the long-term operation and maintenance of structural stormwater control measures installed through one or both of the following approaches:*

    a. *Maintenance performed by the permittee. (See Part IV.D.6)*

    b. *Maintenance performed by the owner or operator of a new development or redeveloped site under a maintenance plan. The maintenance plan must be filed in the real property records of the county in which the property is located. The permittee shall require the owner or operator of any new development or redeveloped site to develop and implement a maintenance plan addressing maintenance requirement for any structural control measures installed on site. The permittee shall require operation and maintenance performed is documented and retained on site, such as at the offices of the owner or operator, and made available for review by the small MS4.*

Table 7-1: Required Construction Site Stormwater Runoff Control BMPs

Activity/BMP	**Measurable Goals**
Develop and maintain an ordinance or other regulatory mechanism as described in Part IV.D.5.(a)(2).	Review and update the ordinance or other regulatory mechanism at least one time during the permit term to address changes and make improvements to the ordinance where applicable.
Document and maintain records of enforcement actions and make them available for review by the TCEQ as described in Part IV.D.5.(b)(1).	Maintain records of 100% of enforcement actions taken each year. Make 100% of enforcement records available to TCEQ for review within 24 hours of request.
Ensure the long term operation and maintenance of structural stormwater control measures installed as described in Part IV.D.5.(b)(2).	Maintain 100% of stormwater control measures each year where the MS4 operator is responsible for maintenance. Each year, require 100% of the owners or operators of any new development or redeveloped sites to develop and implement a maintenance plan addressing maintenance requirement for any structural control measures installed on site. Require the site owner or operators to maintain documentation onsite of 100% of the maintenance performed and made available for review by the small MS4 operator or TCEQ within 24 hours of the request.

7.3 DISCUSSION OF CURRENT BMP PROGRAMS

7.3.1 DEVELOP AND MAINTAIN ORDINANCE

Description: The City will develop and maintain an ordinance or other regulatory mechanism as described in Part IV.D.5.(a)(2). The ordinance will be reviewed and updated at least one time during the permit term to address changes and make improvements to the ordinance where applicable.

Measurable Goals, Implementation Schedule, and Responsible Party: See Table 7-2.

Status: Ongoing; City is implementing existing ordinance and will evaluate current ordinance for revision.

7.3.2 ENFORCEMENT ACTION RECORDS

Description: The City will document and maintain records of enforcement actions and make them available for review by the TCEQ as described in Part IV.D.5.(b)(1). The City will maintain records of 100% of enforcement actions taken each year. 100% of enforcement records will be made available to TCEQ for review within 24 hours of request.

Measurable Goals, Implementation Schedule, and Responsible Party: See Table 7-2.

Status: Ongoing

7.3.3 STRUCTURAL STORMWATER CONTROL MEASURES

Description: The City will ensure the long term operation and maintenance of structural stormwater control measures installed as described in Part IV.D.5.(b)(2). The City will maintain 100% of stormwater control measures each year where the MS4 operator is responsible for maintenance. Each year, the City will require 100% of the owners or operators of any new development or redeveloped sites to develop and implement a maintenance plan addressing maintenance requirement for any structural control measures installed on site. This will also require the site owner or operators to maintain documentation onsite of 100% of the maintenance performed and made available for review by the small MS4 operator or TCEQ within 24 hours of the request.

Measurable Goals, Implementation Schedule, and Responsible Party: See Table 7-2.

Status: Ongoing

Table 7-2 BMP's for Post-Construction Runoff Control (MCM-5)			
BMP	**Measurable Goals**	**Date Due**	**Responsible Party**
Develop and maintain an ordinance or other regulatory mechanism	Review and update the ordinance or other regulatory mechanism at least one time during the permit term to address changes and make improvements to the ordinance where applicable.	Years 1-5, Month 3	Schaumburg & Polk, Inc.
Document and maintain records of enforcement actions and make them available for review by the TCEQ	1. Maintain records of 100% of enforcement actions taken each year.	Years 1-5, Months 1 – 12	Schaumburg & Polk, Inc.
	2. Make 100% of enforcement records available to TCEQ for review within 24 hours of request.	Years 1-5, Months 1 – 12	Schaumburg & Polk, Inc.
Ensure the long term operation and maintenance of structural stormwater control measures installed	1. Implement a maintenance plan and schedule addressing 100% of stormwater control measures each year where the MS4 operator is responsible for maintenance.	Years 1-5, Months 1 – 12	Schaumburg & Polk, Inc.
	2. Each year, require 100% of the owners or operators of any new development or redeveloped sites to develop and implement a maintenance plan addressing maintenance requirement for any structural control measures installed on site.	Years 1-5, Months 1 – 12	Schaumburg & Polk, Inc.
	3. Require the site owner or operators to maintain documentation onsite of 100% of the maintenance performed and made available for review by the small MS4 operator or TCEQ within 24 hours of the request.	Years 1-5, Months 1 – 12	Schaumburg & Polk, Inc.

Note: Year 1 = 2024, Year 2 = 2025, Year 3 = 2026, Year 4 = 2027, Year 5 = 2028

Month 1 = January… Month 12 = December

8.0 MCM-6 POLLUTION PREVENTION AND GOOD HOUSEKEEPING FOR MUNICIPAL OPERATIONS

The following section describes regulatory requirements, permit application requirements, current City programs, selected BMP's, measurable goals, implementation schedule, and responsible parties pertaining to MCM-5. Table 7-1, found at the end of this section, summarizes the measurable goals, implementation schedule, and responsible party for each BMP.

8.1 REGULATORY REQUIREMENTS

40 CFR 122.34 (b)(6) – *The permit must identify the minimum elements and require the development and implementation of an operation and maintenance program that includes a training component and has the ultimate goal of preventing or reducing pollutant runoff from municipal operations. Using training materials that are available from EPA, the State, Tribe, or other organizations, the program must include employee training to prevent and reduce storm water pollution from activities such as park and open space maintenance, fleet and building maintenance, new construction and land disturbances, and storm water system maintenance.*

8.2 PERMIT APPLICATION REQUIREMENTS

[From The General Permit to Discharge Under the Texas Pollutant Discharge Elimination System dated August 2024.]

8.2.1 PROGRAM DEVELOPMENT

All permittees shall develop and implement an operation and maintenance program (O&M), including an employee training component that has the ultimate goal of preventing or reducing pollutant runoff from municipal activities and municipally owned areas including but not limited to: park and open space maintenance; street, road, or highway maintenance; fleet and building maintenance; stormwater system maintenance; new construction and land disturbances; municipal parking lots; vehicle and equipment maintenance and storage yards; waste transfer stations; and salt/sand storage locations.

8.2.2 REQUIREMENTS FOR ALL PERMITTEES

All permittees shall meet the requirements described below including Table 13.

1. *Program Development - All permittees shall develop and implement an operation and maintenance program (O&M), including an employee training component that has the ultimate goal of preventing or reducing pollutant runoff from municipal activities and municipally owned areas including but not limited to: park and open space maintenance;*

street, road, or highway maintenance; fleet and building maintenance; stormwater system maintenance; new construction and land disturbances; municipal parking lots; vehicle and equipment maintenance and storage yards; waste transfer stations; and salt/sand storage locations.

2. *Requirements for All Permittees - All permittees shall meet the requirements described below including Table 13.*

    a. *Permittee-owned Facilities and Control Inventory – All permittees shall develop and maintain an inventory of facilities and stormwater controls that it owns and operates within the regulated area of the small MS4. The inventory must include all applicable permit numbers, registration numbers, and authorizations for each facility or controls. The inventory must be available for review by TCEQ and must include, but is not limited, to the following, as applicable:*

        i. *Composting facilities;*

        ii. *Equipment storage and maintenance facilities;*

        iii. *Fuel storage facilities;*

        iv. *Hazardous waste disposal facilities;*

        v. *Hazardous waste handling and transfer facilities;*

        vi. *Incinerators;*

        vii. *Landfills;*

        viii. *Materials storage yards;*

        ix. *Pesticide storage facilities;*

        x. *Buildings, including schools, libraries, police stations, fire stations, and office buildings;*

        xi. *Parking lots;*

        xii. *Golf courses;*

        xiii. *Swimming pools;*

xiv. *Public works yards;*

xv. *Recycling facilities;*

xvi. *Salt storage facilities;*

xvii. *Solid waste handling and transfer facilities;*

xviii. *Street repair and maintenance sites;*

xix. *Vehicle storage and maintenance yards; and*

xx. *Structural stormwater controls.*

b. *Training and Education – All permittees shall inform or train appropriate employees involved in implementing pollution prevention and good housekeeping practices. All permittees shall maintain a training attendance list for review by TCEQ when requested.*

c. *Disposal of Waste Material – Waste materials removed from the small MS4 must be disposed of in accordance with 30 TAC Chapters 330 or 335, as applicable.*

d. *Contractor Requirements and Oversight*

    i. *Any contractors hired by the permittee to perform maintenance activities on permittee-owned facilities must be contractually required to comply with all of the stormwater control measures, good housekeeping practices, and facility-specific stormwater management operating procedures described in Parts IV.D.6.(b)(2)-(6).*

    ii. *All permittees shall provide oversight of contractor activities to ensure that contractors are using appropriate control measures and SOPs. Oversight procedures must be maintained on-site and made available for inspection by TCEQ.*

e. *Municipal Operation and Maintenance Activities*

    i. *Assessment of permittee-owned operations – All permittees shall evaluate operation and maintenance (O&M) activities for their potential to discharge pollutants in stormwater, including but not limited to:*

1. *Road and parking lot maintenance, including such areas as pothole repair, pavement marking, sealing, and re-paving;*

2. *Bridge maintenance, including such areas as re-chipping, grinding, and saw cutting;*

3. *Cold weather operations, including plowing, sanding, and application of deicing and anti-icing compounds and maintenance of snow disposal areas; and*

4. *Right-of-way maintenance, including mowing, herbicide and pesticide application, and planting vegetation.*

ii. *All permittees shall identify pollutants of concern that could be discharged from the above O&M activities (for example, metals; chlorides; hydrocarbons such as benzene, toluene, ethyl benzene, and xylenes; sediment; and trash).*

iii. *All permittees shall develop and implement a set of pollution prevention measures that will reduce the discharge of pollutants in stormwater from the above activities. These pollution prevention measures must include at least two the following:*

1. *Replacing materials and chemicals with more environmentally friendly materials or methods;*

2. *Tracking application of deicing and anti-icing compounds;*

3. *Using suspended tarps, booms, or vacuums to capture paint, solvents, rust, paint chips and other pollutants generated by regular bridge maintenance; and*

4. *Placing barriers around or conducting runoff away from deicing chemical storage areas to prevent discharge into surface waters.*

iv. *Inspection of pollution prevention measures - All pollution prevention measures implemented at permittee-owned facilities must be visually inspected to ensure they are working properly. The permittee shall develop written procedures that describes frequency of inspections occurring at least one time annually and how they will be conducted. A*

log of inspections must be maintained and made available for review by the TCEQ upon request.

f. Structural Control Maintenance – If BMPs include structural controls, maintenance of the controls must be performed by the permittee and consistent with maintaining the effectiveness of the BMP. The permittee shall develop written procedures that define the frequency of inspections occurring at least one time annually and how they will be conducted.

Table 8-1: Required Pollution Prevention and Good Housekeeping for Municipal Operations BMPs

Activity/BMP	**Measurable Goals**
Permittee-owned Facilities and Control Inventory as described by Part IV.D.6.(b)(1).	Develop and maintain an annual inventory for 100% of the small MS4 owned and operated facilities and controls in the small MS4 area. Review and update the inventory at least one time annually to address changes or additions to the facilities and controls where applicable.
Training and Education as described in Part IV.D.6.(b)(2). Training may be conducted in person or using self-paced training materials such as videos or reading materials.	Conduct a minimum of one training annually for 100% of employees involved in implementing pollution prevention and good housekeeping practices. For small MS4s which use only contractors to implement pollution prevention and good housekeeping practices, ensure training of 100% of applicable contract staff is conducted at least one time annually using contract language or another similar method.
Disposal of Waste Material as described in Part IV.D.6.(b)(3).	Ensure that 100% of waste from the MS4 is disposed of in accordance with 30 TAC Chapters 330 or 335, as applicable each year.
Contractor Requirements and Oversight as described in Part IV.D.6.(b)(4).	Each year, ensure that 100% of contractors hired by the MS4 to perform maintenance activities on permittee-owned facilities is contractually

	required to comply with all of the stormwater control measures, good housekeeping practices, and facility-specific stormwater management operating procedures described in Parts IV D.6.(b)(2)-(6). Provide oversight of 100% of contractor activities to ensure that contractors are using appropriate control measures and SOPs each year. Oversight procedures must be maintained on-site 100% of the time and made available for review by TCEQ within 24 hours of request.
Assessment of permittee-owned operations as described in Part IV.D.6.(b)(5)a.	Evaluate 100% of O&M activities for their potential to discharge pollutants in stormwater annually including but not limited to: • Road and parking lot maintenance, including such areas as pothole repair, pavement marking, sealing, and re-paving; • Bridge maintenance, including such areas as re-chipping, grinding, and saw cutting; • Cold weather operations, including plowing, sanding, and application of deicing and anti-icing compounds and maintenance of snow disposal areas; and • Right-of-way maintenance, including mowing, herbicide and pesticide application, and planting vegetation.
Identify pollutants of concern as described in Part IV.D.6.(b)(5)b.	Identify pollutants of concern that could be discharged from all of the O&M activities described in Part IV.D.6.(b)(5)b and maintain a list of 100% of the pollutants identified.

	Including for example, metals; chlorides; hydrocarbons such as benzene, toluene, ethyl benzene, and xylenes; sediment; and trash. Review and update the pollutants of concern list at least one time annually to address changes or additions to the O&M activities where applicable.
Pollution Prevention Measures as described in Part IV.D.6.(b)(5)c.	Develop and implement a set of pollution prevention measures that will reduce the discharge of pollutants in stormwater from the permittee-owned operations. Implement at least two of the following pollution prevention measures: • Replace at least 50% of the MS4's materials and chemicals with more environmentally friendly materials or methods by the end of the permit term; • Track 100% of the application of deicing and anti-icing compounds in the MS4 area and record the amount of compound used for each application annually; • Use suspended tarps, booms, or vacuums to capture paint, solvents, rust, paint chips and other pollutants during 80% of regular bridge maintenance each year; and • Place barriers around or conduct runoff away from 100% of deicing chemical storage areas to prevent discharge into surface waters each year.
Inspection of Pollution Prevention Measures as described in Part IV.D.6.(b)(5)d.	At least one time annually, visually inspect 100% of pollution prevention measures implemented at permittee-owned facilities to ensure they are working properly.

	Develop and maintain written procedures that describe the frequency of inspections and how they will be conducted. Review and update the inspection procedures at least one time annually to address changes or additions to the pollution prevention measures. Maintain a log of 100% of the inspections conducted annually and make the log available for review by the TCEQ within 24 hours of a request.
Structural Control Maintenance as described by Part IV.D.6.(b)(6).	At least one time annually, perform maintenance of 100% of the structural controls which require maintenance. Maintenance must be consistent with maintaining the effectiveness of the BMP. The permittee shall develop and maintain written procedures that define the frequency of inspections and how they will be conducted. Review and update the maintenance procedures at least one time annually to address changes or additions to the pollution prevention measures.

8.3 DISCUSSION OF CURRENT AND NEW BMP PROGRAMS

8.3.1 PERMITTEE-OWNED FACILITIES AND CONTROL INVENTORY

Description: The City will develop and maintain an annual inventory for 100% of the small MS4 owned and operated facilities and controls in the small MS4 area. The inventory will be reviewed and updated at least one time annually to address changes or additions to the facilities and controls where applicable.

Measurable Goals, Implementation Schedule, and Responsible Party: See Table 8-2.

Status: Ongoing

8.3.2 TRAINING AND EDUCATION

Description: The City will conduct a minimum of one training annually for 100% of employees involved in implementing pollution prevention and good housekeeping practices. Training may be conducted in person or using self-paced training materials such as videos or reading materials. Training of 100% of applicable contract staff is conducted at least one time annually using contract language or another similar method.

Measurable Goals, Implementation Schedule, and Responsible Party: See Table 8-2.

Status: Ongoing; City will evaluate and update current manual.

8.3.3 DISPOSAL OF WASTE MATERIAL

Description: The City will ensure that 100% of waste from the MS4 is disposed of in accordance with 30 TAC Chapters 330 or 335, as applicable each year.

Measurable Goals, Implementation Schedule, and Responsible Party: See Table 8-2.

Status: Ongoing

8.3.4 CONTRACTOR REQUIREMENTS AND OVERSIGHT

Description: Each year, the City will ensure that 100% of contractors hired by the MS4 to perform maintenance activities on permittee-owned facilities is contractually required to comply with all of the stormwater control measures, good housekeeping practices, and facility-specific stormwater management operating procedures described in Parts IV D.6.(b)(2)-(6). Oversight of 100% of contractor activities will be provided to ensure that contractors are using appropriate control measures and SOPs each year. Oversight procedures must be maintained on-site 100% of the time and made available for review by TCEQ within 24 hours of request.

Measurable Goals, Implementation Schedule, and Responsible Party: See Table 8-2.

Status: Ongoing

8.3.5 ASSESSMENT OF PERMITTEE-OWNED OPERATIONS

Description: The City will evaluate 100% of O&M activities for their potential to discharge pollutants in stormwater annually including but not limited to:

- Road and parking lot maintenance, including such areas as pothole repair, pavement marking, sealing, and re-paving;
- Bridge maintenance, including such areas as re-chipping, grinding, and saw cutting;
- Cold weather operations, including plowing, sanding, and application of deicing and anti-icing compounds and maintenance of snow disposal areas; and
- Right-of-way maintenance, including mowing, herbicide and pesticide application, and planting vegetation.

Measurable Goals, Implementation Schedule, and Responsible Party: See Table 8-2.

Status: Ongoing

8.3.6 IDENTIFY POLLUTANTS OF CONCERN

Description: The City will identify pollutants of concern that could be discharged from all of the O&M activities described in Part IV.D.6.(b)(5)b and maintain a list of 100% of the pollutants identified. (For example, metals; chlorides; hydrocarbons such as benzene, toluene, ethyl benzene, and xylenes; sediment; and trash). The list of pollutants of concern will be reviewed and updated at least one time annually to address changes or additions to the O&M activities where applicable.

Measurable Goals, Implementation Schedule, and Responsible Party: See Table 8-2.

Status: Ongoing

8.3.7 POLLUTION PREVENTION MEASURES

Description: The City will develop and implement a set of pollution prevention measures that will reduce the discharge of pollutants in stormwater from the permittee-owned operations. At least two of the following pollution prevention measures will be implemented:

- Replace at least 50% of the MS4's materials and chemicals with more environmentally friendly materials or methods by the end of the permit term;
- Track 100% of the application of deicing and anti-icing compounds in the MS4 area and record the amount of compound used for each application annually;
- Use suspended tarps, booms, or vacuums to capture paint, solvents, rust, paint chips and other pollutants during 80% of regular bridge maintenance each year; and
- Place barriers around or conduct runoff away from 100% of deicing chemical storage areas to prevent discharge into surface waters each year.

Measurable Goals, Implementation Schedule, and Responsible Party: See Table 8-3.

Status: Ongoing

8.3.8 INSPECTION OF POLLUTION PREVENTION MEASURES

Description: At least one time annually, the City will visually inspect 100% of pollution prevention measures implemented at permittee-owned facilities to ensure they are working properly. Written procedures will be developed and maintained that describe the frequency of inspections and how they will be conducted. Review and update the inspection procedures at least one time annually to address changes or additions to the pollution prevention measures. A log of 100% of the inspections conducted annually will be maintained and made available for review by the TCEQ within 24 hours of a request.

Measurable Goals, Implementation Schedule, and Responsible Party: See Table 8-3.

Status: Ongoing

8.3.9 STRUCTURAL CONTROL MAINTENANCE

Description: At least one time annually, the City will perform maintenance of 100% of the structural controls which require maintenance. Maintenance must be consistent with maintaining the effectiveness of the BMP. The permittee shall develop and maintain written procedures that define the frequency of inspections and how they will be conducted. The maintenance procedures will be reviewed and updated at least one time annually to address changes or additions to the pollution prevention measures.

Measurable Goals, Implementation Schedule, and Responsible Party: See Table 8-3.

Status: Ongoing

8.4 DISPOSAL OF WASTE

As the City of Kemah begins implementation of the SWMP, the City will characterize all wastes removed from the MS4 or collected as a result of municipal operation and maintenance activities. Based on waste characterization, the City will determine how to properly dispose of the waste materials in order to comply with all applicable federal, state, and local regulations. The City will develop and document standard operating procedures for collecting, managing, and disposing of waste materials in order to improve the decrease of bacteria through illicit discharge and dumping in the area. The standard operating procedures will be incorporated into the City's O&M training program.

8.5 MUNICIPAL OPERATIONS SUBJECT TO O&M TRAINING PROVISIONS

City or contractor staff working at City Hall or the City's landscaping storage yard will receive training.

8.6 MUNICIPALLY OWNED OR OPERATED INDUSTRIAL ACTIVITIES SUBJECT TO TPDES STORM WATER REGULATIONS

The City does not own or operate any facilities subject to industrial storm water regulations.

Table 8-2 BMP's for Pollution Prevention and Good Housekeeping for Municipal Operations (MCM-6)			
BMP	**Activity**	**Date Due**	**Responsible Party**
Permittee-owned Facilities and Control Inventory	1. Develop and maintain an annual inventory for 100% of the small MS4 owned and operated facilities and controls in the small MS4 area.	Years 1-5, Months 1 – 12	Schaumburg & Polk, Inc.
	2. Review and update the inventory at least one time annually to address changes or additions to the facilities and controls where applicable.	Years 1-5, Month 11	Schaumburg & Polk, Inc.
Training and Education	1. Conduct a minimum of one training annually for 100% of employees involved in implementing pollution prevention and good housekeeping practices.	Years 1-5, Month 11	Schaumburg & Polk, Inc.
	2. Ensure training of 100% of applicable contract staff is conducted at least one time annually using contract language or another similar method.	Years 1-5, Month 11	Schaumburg & Polk, Inc.
Disposal of Waste Material	Ensure that 100% of waste from the MS4 is disposed of in accordance with 30 TAC Chapters 330 or 335, as applicable each year.	Years 1-5, Months 1 – 12	Schaumburg & Polk, Inc.
Contractor Requirements and Oversight	1. Each year, ensure that 100% of contractors hired by the MS4 to perform maintenance activities on permittee-owned facilities is contractually required to comply with all of the stormwater control measures, good housekeeping practices, and facility-specific stormwater management operating procedures described in Parts IV D.6.(b)(2)-(6).	Years 1-5, Months 1 – 12	Schaumburg & Polk, Inc.
	2. Provide oversight of 100% of contractor activities to ensure that contractors are using appropriate control measures and SOPs each year.	Years 1-5, Months 1 – 12	Schaumburg & Polk, Inc.
	3. Oversight procedures must be maintained on-site 100% of the time and made available for review by TCEQ within 24 hours of request.	Years 1-5, Months 1 – 12	Schaumburg & Polk, Inc.
Assessment of permittee-owned operations	Evaluate 100% of O&M activities for their potential to discharge pollutants in stormwater annually including but not limited to: • Road and parking lot maintenance, including such areas as pothole repair, pavement marking, sealing, and re-paving; • Bridge maintenance, including such areas as re-chipping, grinding, and saw cutting; • Cold weather operations, including plowing, sanding, and application of deicing and anti-icing compounds and maintenance of snow disposal areas; and • Right-of-way maintenance, including mowing, herbicide and pesticide application, and planting vegetation.	Years 1-5, Months 1 – 12	Schaumburg & Polk, Inc.
Identify pollutants of concern	1. Identify pollutants of concern that could be discharged from all of the O&M activities described in Part IV.D.6.(b)(5)b and maintain a list of 100% of the pollutants identified. Including for example, metals; chlorides; hydrocarbons such as benzene, toluene, ethyl benzene, and xylenes; sediment; and trash.	Years 1-5, Month 1	Schaumburg & Polk, Inc.
	2. Review and update the pollutants of concern list at least one time annually to address changes or additions to the O&M activities where applicable.	Years 1-5, Month 1	Schaumburg & Polk, Inc.

Note: Year 1 = 2024, Year 2 = 2025, Year 3 = 2026, Year 4 = 2027, Year 5 = 2028

Month 1 = January… Month 12 = December

Table 8-3 BMP's for Pollution Prevention and Good Housekeeping for Municipal Operations (MCM-6)			
BMP	**Activity**	**Date Due**	**Responsible Party**
Pollution Prevention Measures	Develop and implement a set of pollution prevention measures that will reduce the discharge of pollutants in stormwater from the permittee-owned operations. Implement at least two of the following pollution prevention measures: • Replace at least 50% of the MS4's materials and chemicals with more environmentally friendly materials or methods by the end of the permit term; • Track 100% of the application of deicing and anti-icing compounds in the MS4 area and record the amount of compound used for each application annually; • Use suspended tarps, booms, or vacuums to capture paint, solvents, rust, paint chips and other pollutants during 80% of regular bridge maintenance each year; and • Place barriers around or conduct runoff away from 100% of deicing chemical storage areas to prevent discharge into surface waters each year.	Years 1-5, Months 1 – 12	Schaumburg & Polk, Inc.
Inspection of Pollution Prevention Measures	1. At least one time annually, visually inspect 100% of pollution prevention measures implemented at permittee-owned facilities to ensure they are working properly.	Years 1-5, Month 11	Schaumburg & Polk, Inc.
	2. Develop and maintain written procedures that describe the frequency of inspections and how they will be conducted.	Years 1-5, Month 7	Schaumburg & Polk, Inc.
	3. Review and update the inspection procedures at least one time annually to address changes or additions to the pollution prevention measures.	Years 1-5, Month 9	Schaumburg & Polk, Inc.
	4. Maintain a log of 100% of the inspections conducted annually and make the log available for review by the TCEQ within 24 hours of a request.	Years 1-5, Month 11	Schaumburg & Polk, Inc.
Structural Control Maintenance	1. At least one time annually, perform maintenance of 100% of the structural controls which require maintenance. Maintenance must be consistent with maintaining the effectiveness of the BMP.	Years 1-5, Month 10	Schaumburg & Polk, Inc.
	2. The permittee shall develop and maintain written procedures that define the frequency of inspections and how they will be conducted.	Years 1-5, Month 3	Schaumburg & Polk, Inc.
	3. Review and update the maintenance procedures at least one time annually to address changes or additions to the pollution prevention measures.	Years 1-5, Month 5	Schaumburg & Polk, Inc.

Note: Year 1 = 2024, Year 2 = 2025, Year 3 = 2026, Year 4 = 2027, Year 5 = 2028

Month 1 = January… Month 12 = December

9.0 RECORD-KEEPING AND REPORTING

Record-keeping and reporting requirements are defined below.

9.1 REGULATORY REQUIREMENTS

40 CFR 122.34 (d)(1) – The permit must require the permittee to evaluate compliance with the terms and conditions of the permit, including the effectiveness of the components of its storm water management program, and the status of achieving the measurable requirements in the permit.

40 CFR 122.34 (d)(2) – The permit must require that the permittee keep records required by the NPDES permit for at least 3 years and submit such records to the NPDES permitting authority when specifically asked to do so. The permit must require the permittee to make records, including a written description of the storm water management program, available to the public at reasonable times during regular business hours (see §122.7 for confidentiality provision). (The permittee may assess a reasonable charge for copying. The permit may allow the permittee to require a member of the public to provide advance notice.)

40 CFR 122.34 (d)(3) – Unless the permittee is relying on another entity to satisfy NPDES permit obligations under §122.35(a), the permittee must submit annual reports to the [TCEQ] for the first permit term. For subsequent permit terms, [the MS4 operator] must submit reports in years two and four unless the [TCEQ] requires more frequent reports. As of December 21, 2020 all reports submitted in compliance with this section must be submitted electronically by the owner, operator, or the duly authorized representative of the small MS4 to the NPDES permitting authority or initial recipient, as defined in 40 CFR 127.2(b), in compliance with this section and 40 CFR part 3 (including, in all cases, subpart D to part 3), § 122.22, and 40 CFR part 127. Part 127 is not intended to undo existing requirements for electronic reporting. Prior to this date, and independent of part 127, the owner, operator, or the duly authorized representative of the small MS4 may be required to report electronically if specified by a particular permit or if required to do so by state law. The report must include:

(i) The status of compliance with permit terms and conditions

(ii) Results of information collected and analyzed, including monitoring data, if any, during the reporting period

(iii) A summary of the storm water activities the permittee proposes to undertake to comply with the permit during the next reporting cycle

(iv) Any changes made during the reporting period to the permittee's storm water management program

(v) *Notice that the permittee is relying on another governmental entity to satisfy some of the permit obligations (if applicable), consistent with §122.34(a)*

9.2 RECORD-KEEPING

The City will maintain the following records at a location accessible to the TCEQ for a period of at least three years, or for the term of the permit, whichever is longer:

1. TPDES Permit
2. Required Annual Reports as well as supporting documents and data used to generate the reports
3. Current Storm Water Management Program Document
4. Audit Logs and other SWMP supporting materials

The City will make the records available to the public during regular business hours if requested to do so in writing. The SWMP will be made available within two working days following the request from the public. Other records will be provided within 10 working days unless the request requires an unusual amount of time or effort to assemble, in which case Texas law regarding the Public Information Act will be followed. Reasonable charges, in accordance with Texas law, may be levied by the City for researching and preparing any requested materials.

9.3 REPORTING

The City will submit an annual report to TCEQ by March 31 (of the following year) for each year of the permit term. The annual report will contain the following:

1. The status of compliance with permit conditions, an assessment of the appropriateness of the identified BMP's, progress toward achieving the statutory goal of reducing the discharge of pollutants, the measurable goals for each of the minimum control measures, and an evaluation of the success of the implementation of the goals
2. Status of any additional control measures implemented by the City (if applicable).
3. Any minimum control measure activities initiated prior to permit issuance (up to three years) as part of the first year's annual report.

4. A summary of the results of information collected and analyzed, if any, during the reporting period, including monitoring data used to assess the success of the program at reducing the discharge of pollutants.

5. A summary of the storm water activities the City plans to undertake during the next reporting cycle (including implementation schedule).

6. Proposed changes to the storm water management program, including changes to any BMP's or any identified measurable goals that apply to the program elements.

7. Notice that the City is relying on another government entity to satisfy some of the Permit obligations (not currently applicable).

8. A signed certification page.

10.0 REFERENCES

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Appendix A

Good Housekeeping Procedures

(Materials to be added as developed)

What to do When a Spill Occurs

Identify spilled product. If you are NOT familiar with the liquid and its chemical properties, vacate the area and contact proper authorities.

1. Risk Assessment

Evaluate the type of material spilled and identify the source.

2. Protective Clothing

Wear the appropriate protective gear for the situation. If the source or the material are not identifiable assume the worst.

3. Containment

Contain the liquid and seal drains

4. Stop the Source

Close valves, rotate punctured drums and plug leaks where it is possible and safe to do so.

5. Begin Clean Up

Use XtremeSorb sorbents to absorb spilled liquids.

6. Contact Authorities

Report the spill to the proper legal authorities in your community. Be sure to fill out all necessary reports in accordance with local laws.

7. Disposal of Used Material

Absorbent materials take on the characteristics of whatever they absorb. Be sure to dispose of used absorbents and spilled liquids in accordance with local laws

8. Decontaminate

Clean all tools and reusable materials properly before reuse.

9. Restock Materials

Replace absorbent materials and safety equipment used in any clean up operation.

10. Review Contingency Plans and Procedures!

PLEASE NOTE: AN XtremeSorb SPILL KIT IS A STOP-GAP MEASURE FOR MINOR SPILL CLEAN-UP. IF A SERIOUS SPILL OCCURS, CONTACT LOCAL AUTHORITIES FOR DIRECTION AND ASSISTANCE FOR THE PROBLEM.

DUE TO THE POSSIBLE TOXIC AND HAZARDOUS FLUIDS ABSORBED, SETON DOES NOT RECOMMEND DISPOSAL PROCEDURES.

SETON

Preventing Storm Water Pollution: *What We Can Do*

~Employee Training Series~

Materials Storage and Spill Cleanup

PREPARED IN COOPERATION WITH THE Texas Commission on Environmental Quality AND U.S. ENVIRONMENTAL PROTECTION AGENCY
The preparation of this report was financed through grants from the U.S Environmental Protection Agency through the Texas Commission on Environmental Quality.

1

Materials Storage and Spill Cleanup

- Employees can help reduce waste and water pollution by making sure materials aren't spilled or washed into the storm drain system.
  - Store and Handle Materials Safely
  - Clean Up Spills Properly

2

Store and Handle Materials Safely

3

Store and Handle Materials Safely

- Read and follow label or MSDS instructions and local procedures for all materials that you use.
- Store materials in original containers if possible. If not, clearly label replacement containers.

4

Store and Handle Materials Safely

- Make sure containers are closed or sealed except when they are being filled or emptied.
- Keep material or waste containers in good condition and replace any containers that leak.
- Regularly inspect containers for corrosion or signs of leaks.

5

Store and Handle Materials Safely

- Store materials and containers as follows:
  - Best: Indoors in sealed containers.
  - Good: Outdoors in sealed containers, within in a covered, paved area.
  - Acceptable: Outdoors in sealed containers, on an uncovered, paved area.

6

Store and Handle Materials Safely

- Spill trapping devices are recommended:
  - Indoors: store barrels on a spill containment base.
  - Outdoors: storage areas should be bordered by a curb or berm to contain spills.

7

Store and Handle Materials Safely

- Store materials away from high traffic areas to prevent accidents that might cause spills or cause spilled material to be spread by traffic.
- Report large spills or spills of hazardous materials your supervisor or environmental department personnel.

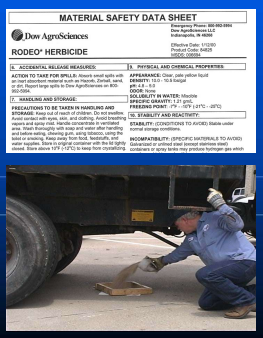
8

Clean Up Spills Properly

9

Clean Up Spills Properly

- Follow cleanup instructions specified on the MSDS and local procedures for the spilled material.
- Contain the spill:
  - Use a drip pan or absorbent material to collect dripping fluids.
  - If a liquid spill might enter a storm drain, use a drain mat to cover the drain.


MATERIAL SAFETY DATA SHEET

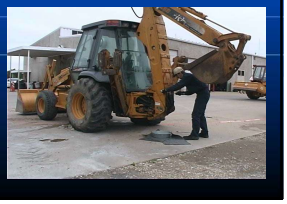
Dow AgroSciences

RODEO® HERBICIDE

10

Clean Up Spills Properly

- Locate the source of the spill and take steps to stop further spillage.
- Clean up spills immediately to minimize safety hazards and deter spreading.



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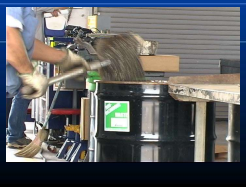
Clean Up Spills Properly

Liquid spills:

- Use absorbent materials or mop up small liquid spills. Do not hose the spill to a storm drain.
- Remove the absorbent materials promptly and follow procedures for proper disposal.



12

Clean Up Spills Properly

Dry material spills:

- Cover a powder spill with plastic sheeting to keep it from blowing until the spill can be cleaned up.
- Do not hose the spill to a storm drain.
- If usable, place spilled material in original or properly marked container.
- Follow procedures for disposal of spilled material that cannot be used.

13

Clean Up Spills Properly

- Report large spills or spills of hazardous materials to your supervisor or environmental department personnel.
- *[Insert locality-specific contact information or other instructions here.]*

14

Preventing Storm Water Pollution: *What We Can Do*

Protecting water quality requires that all employees do their part to prevent storm water pollution.

15

Preventing Storm Water Pollution: *What We Can Do*

~Employee Training Series~

Fleet Maintenance

PREPARED IN COOPERATION WITH THE Texas Commission on Environmental Quality AND
U.S. ENVIRONMENTAL PROTECTION AGENCY
The preparation of this report was financed through grants from the
U.S Environmental Protection Agency through the Texas Commission on Environmental Quality.

1

Fleet Maintenance

- Employees who service and repair our vehicles and equipment can help reduce water pollution by following precautions in their daily activities.
  - General Guidelines
  - Leaks and Spills
  - Disposal Methods
  - Parts Cleaning
  - Shop and Pavement Cleaning
  - Fueling
  - Washing

2

General Guidelines

- Conduct all vehicle and equipment maintenance at designated locations, preferably inside the shop or outdoors on a paved, covered surface.
- Park damaged, leaking, or dirty vehicles under cover, if possible, to prevent exposure to rainfall.

3

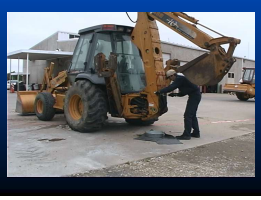
General Guidelines

- Keep maintenance areas clean by promptly disposing of trash, debris, old parts, and absorbents used on spills.
- Promptly dispose of fluids that have been collected in drip pans or other open containers.

4

Leaks and Spills

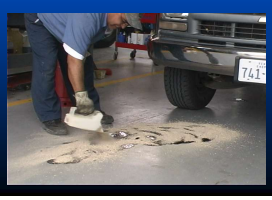
- Regularly inspect for leaks or stains around vehicles and equipment. Use a drip pan or absorbent material to collect dripping fluids.
- Locate the source of leakage and stop further spillage by fixing the leak or draining the fluid.



5

Leaks and Spills

- Clean up spills immediately to minimize safety hazards and deter spreading.
- Store cracked batteries in a leak proof container.
- Refer to the Materials Storage and Spill Cleanup module for more information.



Storm Water Pollution Prevention:
What We Can Do

~Employee Training Series~

Materials Storage and Spill Cleanup

6

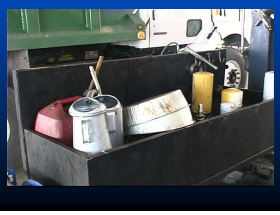
Disposal Methods

- Collect all used anti-freeze, motor oil, transmission fluid, and hydraulic fluid and store them in separate containers by type.
- Make sure storage containers are properly labeled.
- Never mix different types of fluids.

7

Disposal Methods

- Recycle used fluids, oil, transmission, and hydraulic filters, and batteries.
- Never dispose of used fluids, filters, or batteries in the trash.



8

Parts Cleaning

- Clean parts indoors and properly dispose of fluids, grease, dirt, and other debris cleaned from parts.
- Allow parts to fully drain before removing from cleaning sink to reduce dripping of cleaning fluid to the floor.

- Keep lids closed on parts cleaning sinks when not in use.

9

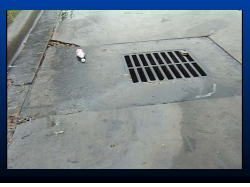
Shop and Pavement Cleaning

- Use dry methods (sweeping, wiping, absorbents) to clean work areas as much as possible.
- Dispose of mop water properly, usually by pouring down a sanitary sewer drain.

10

Shop and Pavement Cleaning

- Don't hose down outside work areas.
- In addition to regular, periodic cleaning, clean outside work areas when rain is forecast.



11

Fueling

- Don't top off fuel tanks to prevent spills due to overfilling.
- Be aware of the emergency pump shut-off button location.
- Keep absorbent materials on site for use in prompt cleanup of spills.

12

Fueling

- Periodically clean fueling areas using approved methods to remove accumulated fuel and grease.

- Transport equipment to a designated fueling area rather than using mobile fueling.
- If mobile fueling is used, keep a spill kit on the fuel truck.

13

Washing

- Wash equipment and vehicles ONLY in designated facilities where the wash water drains to the sanitary sewer system or is collected and recycled.

14

Preventing Storm Water Pollution: *What We Can Do*

Protecting water quality requires that all employees do their part to prevent storm water pollution.

OUR WATER
Take it personally!

North Central Texas Council of Governments

TCEQ

15

Preventing Storm Water Pollution: *What We Can Do*

~Employee Training Series~

Land Disturbances

PREPARED IN COOPERATION WITH THE Texas Commission on Environmental Quality AND U.S. ENVIRONMENTAL PROTECTION AGENCY
The preparation of this report was financed through grants from the U.S Environmental Protection Agency through the Texas Commission on Environmental Quality.

1

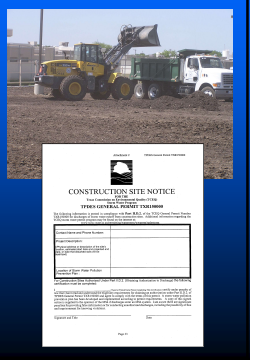
Land Disturbances

- Employees can help reduce water pollution by making sure dirt and debris aren't washed into the storm drain system.
  - Utility repairs
    - »water and sanitary sewer lines
    - »storm drain system
  - Street repairs
  - Sidewalk construction and repairs
  - Landscaping (parks, buildings, medians)
  - Power pole installation and replacement

2

Land Disturbances

- Note: Projects that disturb one acre or more must comply with the state's storm water permit for construction activities.
- If a permit is required, your supervisor or environmental coordinator will provide specific instructions.



CONSTRUCTION SITE NOTICE

TPDES GENERAL PERMIT TXR150000

3

Land Disturbances

- All projects must be managed to prevent or reduce soil or other pollutants from being washed into storm drains, creeks, or lakes.
- In addition to soil, potential pollutants on construction sites include trash, debris, oil, grease, lime, concrete truck wash water, etc.

4

Definitions

- Erosion - the removal or wearing away of soil due to the action of water (or wind).
- Sediment - soil particles that settle out of flowing water.

5

General Principles

- Preventing erosion is more effective than trying to remove sediment from runoff.
- Minimize the amount of disturbed area.
- Divert runoff or flowing water away from disturbed areas.

6

General Principles

- Locate dirt stockpiles out of the street and away from runoff or flowing water to prevent sediment from washing into storm drains.
- Cover stockpiles or provide a barrier such as an organic filter berm or silt fence around the pile.


7

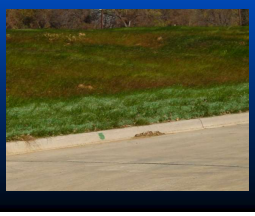
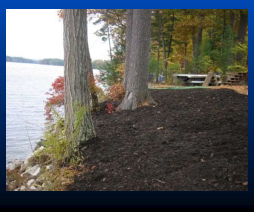
Best Management Practices

- Best Management Practices (BMPs) are tools used to reduce or prevent water pollution.
  - Erosion Control BMPs are used to protect disturbed soils from being washed off by rainfall and/or runoff.
  - Sediment Control BMPs are used to trap sediment carried by runoff and keep it on the construction site.
  - Waste Management BMPs are good housekeeping practices to control trash, chemicals, and debris.

8

Best Management Practices

- Erosion Control BMPs:
  - Vegetation - grasses or other plants that provide "permanent" erosion protection.
  - Mulching - a layer of straw or wood mulch.

9

Best Management Practices

- Erosion Control BMPs (continued):
  - Erosion control blankets - mesh matting made of straw, wood fiber, or plastic.
  - Plastic sheeting - may be used for short-term protection of disturbed areas or dirt stockpiles.

10

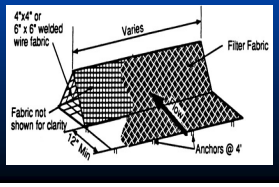
Best Management Practices

- Sediment Control BMPs:
  - Organic filter berm - a 1 to 3 foot high berm of mulch and compost placed around a disturbed area.
  - Silt fence - filter fabric trenched into the soil and attached to supporting posts.


11

Best Management Practices

- Sediment Control BMPs (continued):
  - Triangular sediment dike - filter fabric placed over welded wire shaped into a triangle.
  - Inlet protection - filter fabric or stone placed around or in front of a storm drain inlet.



12

Best Management Practices

- Waste Management BMPs:
  - Debris and trash control - use covered trash cans, bins, and/or roll-off boxes for disposing trash and debris.
  - Chemical management - follow proper material storage and spill cleanup procedures for chemicals used on construction sites.

13

Best Management Practices

- Waste Management BMPs (continued):
  - Concrete washout - use designated facilities to capture wash water from concrete truck cleaning.

14

Preventing Storm Water Pollution: *What We Can Do*

Protecting water quality requires that all employees do their part to prevent storm water pollution.

OUR WATER Take it personally!

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15

Preventing Storm Water Pollution: *What We Can Do*

~Employee Training Series~

Parks and Grounds Maintenance

PREPARED IN COOPERATION WITH THE Texas Commission on Environmental Quality AND U.S. ENVIRONMENTAL PROTECTION AGENCY
The preparation of this report was financed through grants from the U.S Environmental Protection Agency through the Texas Commission on Environmental Quality.

1

Parks and Grounds Maintenance

- Employees who maintain our parks and landscaped areas can help reduce water pollution by following precautions in their daily activities.
  - Plant Selection
  - Watering
  - Debris Management
  - Soil Management
  - Pesticide and Herbicide Practices

2

Plant Selection

- Utilize native or adapted perennial vegetation to reduce water, fertilizer, and pesticide needs.
- Use Texas SmartScape™ as a plant selection and plant care tool.

3

Watering

- Avoid over-watering to prevent excess runoff.
- Avoid runoff by adjusting watering time and direction and volume of spray heads.
- Check soil moisture and water only when the top 4” to 5” of soil is dry.

4

Watering

- Monitor rainfall and turn off sprinklers during rainy weather.
- Install rain and freeze sensors on automated sprinkler systems where possible.

5

Debris Management

- Mow grass as high as possible and leave clippings on the lawn.
- Compost leaves for use as a soil amendment or shred and add to flower beds as mulch.

6

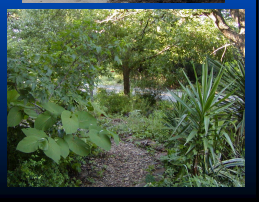
Debris Management

- Sweep paved surfaces or blow clippings and trimmings onto grass rather than hosing down.
- Never dispose of grass clippings, leaves, or other debris in the storm drain.
- Remove accumulated litter and debris from storm drain inlets.

7

Soil Management

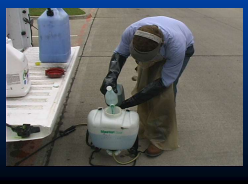
- Aerate and add compost to the soil to reduce fertilizer needs, improve drainage, and promote root growth.
- Have soil tested well before the application season to determine fertilizer needs.
- Limit soil erosion by planting vegetation on bare areas and using mulch or matting for landscaped areas.



8

Pesticide and Herbicide Practices

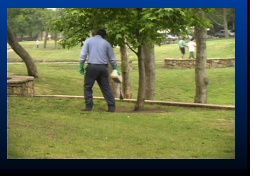
- Follow safety, storage and disposal procedures for pesticides and herbicides.
- Follow label directions precisely when mixing or applying pesticides or herbicides.
- Mix pesticides and herbicides where spills will not soak into the ground or runoff into the storm drainage system.



9

Pesticide and Herbicide Practices

- Use landscaping pesticides and herbicides only as needed.
- Use non-toxic substitutes for chemicals when possible.
- Carefully select the most appropriate product for the problem to be treated.
- Apply pesticides and herbicides to the problem area only, versus application over a wider area.



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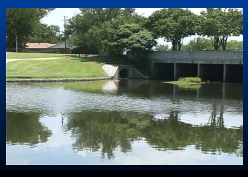
Pesticide and Herbicide Practices

- Avoid stray product from being deposited on streets or other paved surfaces where it may be washed into the storm drain system.
- Don't apply chemicals near sensitive areas including streams, lakes, wetlands, or drainageways.



11

Pesticide and Herbicide Practices

- Don't apply during windy conditions or when rain is predicted within 24 hours.
- Report any suspected problems regarding pesticide or herbicide applications.

12


Preventing Storm Water Pollution:
What We Can Do
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Preventing Storm Water Pollution: *What We Can Do*

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Solid Waste Operations

PREPARED IN COOPERATION WITH THE Texas Commission on Environmental Quality AND U.S. ENVIRONMENTAL PROTECTION AGENCY
The preparation of this report was financed through grants from the U.S Environmental Protection Agency through the Texas Commission on Environmental Quality.

1

Solid Waste Operations

- By taking precautions in their daily activities, Solid Waste employees can help reduce water pollution.
  - Trash Collection Activities
  - Transfer Station/Drop Off Operations
  - Mulching Operations
  - Landfill Operations
  - Composting Operations

2

Trash Collection Activities

- Try to identify and do not pick up hazardous wastes (flammables, toxics, explosives, etc.).

Examples include:
- used batteries
- solvents, fuels
- pesticides, herbicides
- fireworks, ammunition
- pool chemicals
- fluorescent bulbs

3

Trash Collection Activities

- Try to identify and do not pick up liquid wastes.

Examples include:
- used motor oil
- paint
- antifreeze
- cleaning liquids
- cooking oil

- Notify residents of household hazardous waste collection / disposal opportunities.

4

Trash Collection Activities

- Pick up spilled trash from around cans or bags.
- Notify residents of persistent problems with scattered trash.
- Watch the area around the hopper to avoid leaving litter behind.
- Pick up any material that falls from the truck during compaction.

5

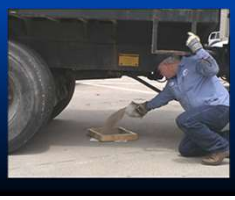
Trash Collection Activities

- Include spill kits on trash collection trucks and service vehicles.
- Kits could include:
  - –broom
  - –shovel
  - –absorbents
  - –pop-up pools.

6

Trash Collection Activities

- Check vehicle frequently for leaking fluids and notify supervisor of significant leaks.
- Contain spills using absorbents and take steps to stop the leak if possible.
- Immediately clean up spills to minimize safety hazards and deter spreading.



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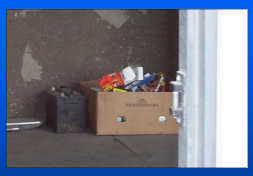
Trash Collection Activities

- Make certain that hopper drain plugs are always sealed during collection.
- Wash collection trucks only in facilities where the wash water drains to the sanitary sewer system or is collected and recycled.

8

Transfer Stations & Drop Off Centers

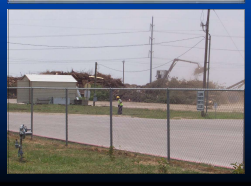
- Look for hazardous or liquid wastes. Remove any of these materials and store in designated locations for proper disposal.
- Pick up all windblown litter and rubbish.



9

Transfer Stations & Drop Off Centers

- Dry sweep litter and rubbish periodically, especially before expected rain or windy conditions.
- Use litter screens to catch windblown trash.
  - chain link fence
  - welded wire mesh fence
  - orange construction fencing



10

Transfer Stations & Drop Off Centers

- Locate source of spills and prevent further spillage. Immediately clean spills using absorbents.
- Remove the absorbent materials promptly and dispose in accordance with procedures.

11

Transfer Stations & Drop Off Centers

- Do not overfill collection receptacles.
- Conduct facility wash-down activities as directed by the supervisor.
- Do not hose down work areas that drain into storm sewers or drainage ways.
- Retain spills and prevent them from entering the environment.

12

Transfer Stations & Drop Off Centers

- Make sure lids on bins and receptacle are closed, especially during rain events.
- Notify haulers and citizens on requirements to cover loads during transport.

13

Pollution Prevention at Mulching Operations

- Remove trash and foreign materials from brush prior to grinding.
- Place trash and debris in covered containers.
- Use litter screens (fencing) to capture windblown trash.
- Mulch berms can be used to filter runoff from work area.

14

Landfills and Composting Operations

- These operations will have specific SWPPP requirements governed by either a Multi-Sector General Permit or the facility's individual registration or permit.
- Follow all Best Management Practices, record keeping, training, and reporting requirements detailed in the facility permit.

15

Preventing Storm Water Pollution: *What We Can Do*

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Preventing Storm Water Pollution: *What We Can Do*

~Employee Training Series~

Streets and Drainage Maintenance

PREPARED IN COOPERATION WITH THE Texas Commission on Environmental Quality AND U.S. ENVIRONMENTAL PROTECTION AGENCY
The preparation of this report was financed through grants from the U.S Environmental Protection Agency through the Texas Commission on Environmental Quality.

1

Streets and Drainage Maintenance

- Employees who maintain and repair our streets and drainage infrastructure can help reduce water pollution by following precautions in their daily activities.
  - Pavement Repair
  - Paint Striping
  - Storm Drain Inlet Cleaning
  - Ditch Maintenance
  - Report Pollution and Illegal Dumping

2

Pavement Repair

- Vacuum slurry and cuttings during sawcutting operations. Don't allow the slurry to enter the storm drain or to remain on pavement to dry out.
- Properly dispose of slurry in accordance with established procedures.

3

Pavement Repair

- Require concrete trucks to wash out in a designated location where wash water will not drain to a storm drain, drainage ditch, or creek.
- Locate stockpiles of asphalt patching material on a concrete or other paved surface. Cover to prevent contact with rain.

4

Pavement Repair

- Mix only the amount of patching material necessary to complete the repair.
- Sweep up and properly dispose of all patching material that is not compacted or is left over from the repair.

5

Pavement Repair

- Use less harmful products rather than diesel for asphalt patching and cleanup activities.
- Clean trucks, equipment, and tools in designated equipment wash facilities where wash water will not drain to a storm drain, ditch, or creek.

6

Pavement Repair

- If no wash facility is available, clean equipment over a layer of absorbent material spread on a paved surface and/or heavy plastic sheeting.
- Promptly sweep up absorbent and dispose in accordance with established procedures.


7

Paint Striping

- Don't apply paint when rain is likely or during high winds.
- Waste handling for water-based (latex) paint:
  - Pour small quantities of unused paint in open barrels and allow to dry. Dispose of dried paint in trash.
  - Contain wash water used for equipment cleaning and dispose in sanitary sewer.

8

Paint Striping

- Waste handling for oil-based paint:
  - Unused oil-based paint must be disposed in accordance with established procedures.
  - Dispose of solvents used for equipment cleaning in accordance with established procedures.

9

Storm Drain Inlet Cleaning

- Dispose of trash and debris removed from inlets in a sanitary landfill.
- Report suspected dumping or pollution problems to supervisory personnel.
- Apply markers with NO DUMPING message to inlets where there is evidence of dumping.


10

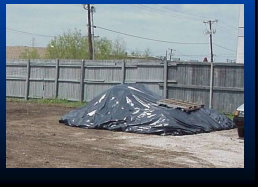
Ditch Maintenance

- Sample and analyze material that has been removed from ditches if it appears to be contaminated with oil or other pollutants.
- Contaminated sediments must be disposed in accordance with established procedures.


11

Ditch Maintenance

- Uncontaminated soil may be used onsite (shaped into ditch) or stockpiled and used as fill or other land application.
- Cover soil stockpiles to prevent erosion and/or install silt fence to capture sediment.

12

Ditch Maintenance

- Apply grass seed to exposed soils. A compost/mulch mixture applied with seed speeds vegetation growth and prevents erosion.
- If the channel experiences high velocities, turf reinforcement mats and/or check dams should be used to protect the channel until vegetation is established.

13

Report Pollution and Dumping

- Look for signs of pollution at the jobsite and during travel:
  - Oil sheen on water surface
  - Excess trash and debris
  - Odor
  - Colored or cloudy water
  - Dead or dying fish

- Report suspected pollution problems to supervisory personnel or to the local TCEQ office.

14

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Appendix B

Audit Logs for O&M Activities

Appendix C

Illicit Discharge Detection and Elimination Ordinance and Procedures

ORDINANCE NO. 1071

AN ORDINANCE OF THE CITY OF KEMAH, TEXAS, TO PROHIBIT ILLICIT DISCHARGES OF NON-STORM WATER DISCHARGES INTO THE CITY'S STORM WATER SYSTEM AND TO IMPLEMENT APPROPRIATE ENFORCEMENT PROCEDURES AND ACTIONS. PROVIDING A PENALTY IN AN AMOUNT NOT TO EXCEED $2,000.00 FOR EACH AND EVERY DAY A VIOLATION HEREOF OCCURS; PROVIDING AN APPEAL CLAUSE; AN INJUNCTIVE RELIEF CLAUSE; A SEVERABILITY CLAUSE; AND THE EFFECTIVE DATE THEREOF.

WHEREAS, the City Council of the City of KEMAH, TEXAS, as an operator of a Small Municipal Separate Storm Sewer System (MS4), is required to reduce the discharge of pollutants to the water of the State and the United Sates to the "maximum extent practicable" to protect water quality; and

WHEREAS, the City Council of the City of KEMAH, TEXAS, in order to provide for the health, safety, and welfare of its citizens, finds that it is necessary to implement procedures to monitor and regulate the discharge of non-storm water pollutants into the City's storm water drainage system in order to comply with Federal and State law, as well as, the Phase II requirements of the City's TCEQ MS4 permit; and

NOW THEREFORE, BE IT ORDAINED BY THE CITY COUNCIL OF THE CITY OF KEMAH, TEXAS:

SECTION 1.

Intent of provisions.

The purpose and objectives of this Ordinance are as follows:

1. To prevent the illicit discharge of contaminated storm water runoff from industrial, commercial, residential, and construction sites into the municipal separate storm water system (MS4) within the City of Kemah.
2. To maintain and improve the quality of the surface water and groundwater within the City of Kemah, the County of Galveston, and the State of Texas.
3. To promote public awareness of the hazards involved in the improper discharge of hazardous substances, petroleum products, household hazardous waste, industrial waste, sediment from construction sites, pesticides, herbicides, fertilizers, and other contaminates into the storm drainage system and natural waters of the City.
4. To encourage the recycling of used motor oil and safe disposal of other hazardous consumer products.
5. To facilitate compliance with State and Federal standards and permits by owners and operators of industrial and construction sites within the City.
6. To establish legal authority to carry out all inspection, surveillance and monitoring procedures necessary to ensure compliance with this Article.

SECTION 2.

Applicability.

This Article shall apply to all water entering the storm drainage system generated on any developed or undeveloped lands unless explicitly exempted by an authorized enforcement agency.

SECTION 3.

Administration.

The City Administrator, except as otherwise provided herein, shall administer, implement, and enforce the provisions of this Ordinance. The City Administrator may delegate this responsibility to either the City Engineer or the Storm Water Manager, whichever is appropriate, based on current City staffing levels.

SECTION 4.

Definitions.

The following words, terms, and phrases shall have the meanings ascribed to them in this section, unless the context of their usage clearly indicates another meaning:

1. ***Authorized Enforcement Agency*** shall mean employees or other personnel designated by the City Administrator for the City of Kemah to enforce this ordinance.
2. ***Best Management Practices (BMP)*** shall mean schedules of activities prohibitions of practices, general house keeping practices, pollution prevention and educational practices, maintenance procedures, and other management practices to prevent or reduce the discharge of pollutants directly or indirectly to storm water receiving waters, or storm water conveyance systems. BMPs also include treatment practices, operating procedures, and practices to control site runoff, spillage or leaks, sludge or waste disposal, or drainage from raw materials storage.
3. ***City Administrator*** shall mean the person hired by the City of Kemah to oversee and manage the day-to day operations of the City.
4. ***City*** shall mean the City of Kemah.
5. ***City Engineer*** is the person appointed to the position of City Engineer by the City Administrator for the City of Kemah.
6. ***Commercial*** pertains to any business, trade, industry, or other activity engaged in for profit activities.
7. ***Construction Activity*** shall mean activities subject to TPDES Construction Permits. These include construction projects resulting in land disturbance of one (1) acre or more. Such activities include but not limited to clearing and grubbing, grading, excavating, filling, and demolition.

8. ***Discharge*** is any addition or introduction of any pollutant, storm water, or any other substance whatsoever into the municipal separate storm sewer system (MS4) or into waters of the United States.
9. ***Discharger*** is any person who causes, allows, permits, or is otherwise responsible for a discharge, including, without limitation, any operator of a construction site or industrial facility.
10. ***Facility*** is any building, structure, installation, process, or activity from which there is or may be a discharge of a pollutant.
11. ***Garbage*** shall mean putrescible animal and vegetable waste materials from the handling, preparation, cooking, or consumption of food, including waste materials from markets, storage facilities, and the handling and sale of produce and other food products.
12. ***Hazardous Household Waste (HHW)*** is any material generated in a household (including single and multiple residences, hotels, and motels, camp grounds, picnic ground, and day use recreational areas) by a consumer which, except for the exclusion provided in 40 CFR 261.4(b)(1), would be classified as a hazardous waste 40 CFR Part 261.
13. ***Hazardous Materials*** are 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.
14. ***Illicit*** **Discharge** is any direct or indirect non-storm water discharge to the storm water system, except as exempted in Section 5 herein.
15. ***Illicit Connection*** shall mean any drain or conveyance connecting an illicit discharge directly to the storm sewer system, whether on the surface or subsurface, which allows and illicit discharge to enter the storm water system, including, but not limited to, any conveyances that allow any non-storm water discharge including sewage, process wastewater, and wash water to enter the storm drain system and any connections to the storm drainage 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 system which has not been documented in plans, maps, or equivalent records and approved by an authorized enforcement agency.
16. ***Industrial Waste*** is any waterborne liquid or solid substance that results from any process of industry, manufacturing, mining, production, trade, or business.
17. ***Municipal Separate Storm Water System (MS4)*** is the system of conveyances, including roads with drainage systems, municipal streets, catch basins, curbs, gutters, ditches, man-made channels, or storm drains) owned and operated by the City and designed or used for collecting or conveying storm water, and which is not used for collecting or conveying sewage.
18. ***National pollutant Discharge Elimination System (NPDES) Storm Water Discharge Permit*** shall mean a permit issued by either the EPA or by the State (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.

19. ***Notice of Intent (NOI)*** is a document that is required by either the Industrial General permit or the Construction General Permit.
20. ***Non-Storm Water Discharge*** is any discharge to the storm water drain system that is not composed entirely of storm water runoff.
21. ***Person*** shall mean any individual, association, organization, partnership, firm, corporation, or other entity recognized by law and acting as either the owner or the owner's agent.
22. ***Pollutant*** shall mean anything that causes or contributes to pollution. Pollutants may include, but are not limited to the following: paints, varnishes, and solvents; oil and other automotive or marine vessel fluids; non-hazardous liquid and solid wastes and yard wastes; refuse, rubbish, garbage, litter, or other discarded or abandoned objects; articles and accumulations, so that same may cause or contribute to pollution; floatables; pesticides, herbicides, and fertilizers; hazardous substances and wastes; sewage, fecal coli, form and pathogens; dissolved and particulate metals; animal wastes; wastes and residues that result from constructing a building or structure; and noxious or offensive matter of any kind.
23. ***Premises*** shall mean any building, lot, parcel of land, or portion of land whether improved or unimproved, including adjacent sidewalks and parking strips.
24. ***Release*** shall mean any spilling, leakage, pumping, pouring, emitting, emptying, discharging, injecting, escaping, leaching, dumping, or disposing into the municipal separate storm water system (MS4) or the waters of the United States.
25. ***Storm Water*** is any surface flow, runoff, and drainage consisting entirely of water from any form of natural precipitation, and resulting from such precipitation.
26. ***Storm Water Manager*** is the person appointed to implement and manage the City's Storm Water Management Program by the City Administrator for the City of Kemah.
27. ***Storm Water Pollution Prevention Plan (SWPPP)*** shall mean a document that describes the Best Management Practices and activities to be implemented by a person or entity to identify sources of pollution or contamination at a site and the actions to eliminate or reduce pollutant discharges to storm water, storm water conveyances system, and/or receiving waters to the maximum extent practicable.
28. ***Texas Pollutant Discharge Elimination System (TPDES).***
29. ***Uncontaminated*** shall mean not containing a harmful quantity of any substance.
30. ***Wastewater*** shall mean any water or other liquid, other than uncontaminated storm water, discharge from a facility.
31. ***Yard Waste*** is any leaves, grass clippings, yard and garden debris, and brush that results from landscaping maintenance and land-clearing operations.

SECTION 5.

Discharge prohibitions.

A. Prohibition of Illicit Discharges: It shall be unlawful for any person to discharge or cause to be discharged into the municipal storm drainage system or watercourses any materials, including, but not limited to pollutants or waters containing pollutants that cause or contribute to a violation of applicable water quality standards, other than storm water.

B. Exceptions: The commencement, conduct or continuance of any illicit discharge to the storm water drainage system is prohibited, except as described as follows;

(1) The following discharges are exempt from discharge prohibitions established by this Article:

a. flushing of water lines or other potable water sources;
b. landscape irrigation or lawn watering;
c. diverted stream flows;
d. rising ground water;
e. uncontaminated pumped ground water;
f. foundation or footing drains (not including active groundwater dewatering systems);
g. crawl space pumps;
h. air conditioning condensation;
i. springs;
j. non-commercial washing of vehicles;
k. natural riparian habitat or wetland flows;
l. swimming pools, if dechlorinated – typically less than one parts per million (PPM) chlorine);
m. firefighting activities;
n. any other water source not containing pollutants.

(2) Discharges specified in writing by the Authorized Enforcement Agency as being necessary to protect public health and safety.

(3) Dye testing, as long as a verbal notification is provided to the Authorized Enforcement Agency prior to the time of the test.

(4) Any Non-Storm Water discharge permitted under an NPDES or TPDES permit, waiver, or waste discharge order issued to the discharger and administered under the authority of the United States Environmental protection Agency (EPA) or the Texas Commission on Environmental Quality (TCWQ), provided that the discharger is in full compliance with all the requirements of the permit, waiver, or order and other applicable laws and regulations, and provided further that written approval has been granted for any discharge to the storm drainage system.

C. Specific Prohibitions and Requirements:

(1) It shall be unlawful to construct, use maintain or continue the existence of illicit connections to the City's storm drainage system.

(2) This prohibition expressly includes, without limitation, illicit connections made in the past, regardless of whether the connection was permissible under the laws or practices applicable or prevailing at the time of connection.

(3) A person is considered to be in violation of this Article if the person connects a line conveying sewage to the MS4, or allows such a connection to continue.

(4) No person shall dump, spill, leak, pump, pour, emit, empty, discharge, leach, dispose, or otherwise introduce or cause, allow, or permit to be introduced any of the following substances into the MS4:

a. Any used motor oil, antifreeze, or any other motor vehicle or marine vehicle fluid;

b. Any industrial waste;

c. Any hazardous waste, including hazardous household waste;

d. Any domestic sewage or septic tank waste, grease trap waste, sludge or grit trap waste;

e. Any garbage, rubbish, or yard waste;

f. Any dumpster or trailer overflow:

All individuals, businesses and /or firms renting dumpsters in the City of Kemah shall be responsible for the following:
(i) Keeping dumpster(s) covered at all times.
(ii) Maintaining their dumpster(s) and the area around their dumpsters(s) in a clean and sanitary condition.
(iii) Providing an adequately sized dumpster with necessary pickups in order to prevent the overflow of refuse.

All individuals, businesses, and/or firms utilizing trailers to store or transport household refuse and/or construction debris, shall keep trailers covered with a secured tarp at all times in order to prevent the release of windblown refuse or debris.

Any individual, business and/or firm failing to maintain a dumpster or trailer in accordance with these regulations shall be subject to a fine of up to two hundred fifty dollars ($250).

g. Any waste water from a commercial carwash facility; from any vehicle washing, cleaning, or maintenance at any new or used automobile or other vehicle dealership, rental agency, body shop, repair shop, or maintenance facility; or from any washing, cleaning, or maintenance of any business or

commercial or public service vehicle, including a truck, bus, or heavy equipment;

h. Any wastewater from a commercial mobile power washer or from the washing or cleaning of a building exterior that contains any soap, detergent, degreaser, solvent, or any other harmful cleaning substance;

i. Any wastewater from commercial floor, rug, or carpet cleaning;

j. Any wastewater from the wash down or other cleaning of pavement that contains any harmful quantity of soap, detergent, solvent, degreaser, emulsifier, dispersant, or any other harmful cleaning substances; or any wastewater from the wash down or other cleaning of any pavement where any spill, leak, or other release of oil, motor fuel, or other petroleum or hazardous substance has occurred, unless all harmful quantities of such released material have been previously removed;

k. Any effluent from cooling tower, condenser, compressor, emissions scrubber, emissions filter, or the blow down from a boiler;

l. Any ready-mixed concrete, mortar, ceramic, or asphalt base material or hydro-mulch material, or from cleaning of vehicles or equipment containing, or used in transporting or applying, such material;

m. Any filter backwash from a swimming pool, fountain, or spa;

n. Any water from a water curtain in a spray room used for painting vehicles, boats, or equipment;

o. Any contaminated runoff from a vehicle wrecking yard;

p. Any substance or material that will damage, block, or clog the MS4;

q. Any release from a petroleum storage tank (PST), or any leach ate or runoff from soil contaminated by leaking PST, or any discharge of pumped, confined, or treated wastewater from the remediation of any such PST release, unless the discharge satisfies all the following criteria: (i) Compliance with all State and Federal standards and requirements; (ii) no discharge containing a harmful quantity of any pollutant; (iii) No discharge containing more than 50 parts per billion of benzene; 500 parts per billion combined total quantities of benzene, toluene, methylbenzene, and xylem (BTEX); or 15/mg/l of total petroleum hydrocarbons (TPH).

(5) No person shall introduce or cause to be introduced into the MS4 any harmful quantity of sediment, silt, earth, soil, sludge, or other material associated with clearing, grading, excavation, or other construction activities, or associated with land filling or other placement or disposal of soil, rock, or other earth materials, in excess of what could be retained on

site or captured by employing sediment and erosion control measures to the maximum extent practicable.

(6) No person shall connect a line conveying sanitary sewage, domestic or industrial, to the MS4, or allow such a connection to continue.

(7) No person shall cause or allow any pavement wash water from a service station to be discharged into the MS4 unless such wash water has passed through a properly functioning and maintained, grease, oil, and sand interceptor before discharge into the MS4.

(8) Regulation of Pesticides, Herbicides, and Fertilizers:

a. Any sale, distribution, application, labeling, manufacture, transportation, storage, or disposal of a pesticide, herbicide, or fertilizer must comply fully with all State and Federal statutes and regulations including, without limitation, the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) and all Federal regulations promulgated pursuant to FIFRA; chapters 63, 75, and 76 of the Texas Agriculture Code and all State regulations promulgated pursuant thereto; and any other State or Federal requirement;

b. Any license, permit, registration, certification, or evidence of financial responsibility required by State or Federal law for sale, distribution, application, manufacture, transportation, storage, or disposal of a pesticide, herbicide, or fertilizer must be presented to the City Administrator, City Engineer, Storm Water Manager, or any City law enforcement officer for examination upon request.

c. No person shall use or cause to be used any pesticide or herbicide contrary to any directions for use on any labeling required by State or Federal statute or regulation.

d. No person shall use or cause to be used any pesticide or herbicide, or fertilizer in any manner that the person knows, or reasonably should know, is likely to cause, or does cause, a harmful quantity of the pesticide, herbicide, or fertilizer to enter the MS4 or wasters of the United States.

e. No person shall dispose of, discard, store, or transport a pesticide, herbicide, or fertilizer, or a pesticide, herbicide, or fertilizer container, in such a manner that the person knows, or reasonably should know, is likely to cause, or does cause, a harmful quantity of the pesticide, herbicide, or fertilizer to enter the MS4 or waters of the United States.

(9) Used Oil Regulation:

a. No person shall discharge motor vehicle oil into the MS4 or a sewer, drainage system, septic tank, surface waster, groundwater, or water course.

b. No person shall knowingly mix or commingle used oil with solid waste that is to be disposed of in a landfill or knowingly directly dispose of used oil on land or in a landfill.
c. No person shall apply used oil to a road or land for dust suppression, weed abatement, or other similar use that introduces used oil; into the environment.

SECTION 6.

Suspension of MS4 access.

A. Suspension due to illegal discharges in emergency situations – The City Administrator, City Engineer, or Storm Water Manager, without prior notice, can suspend MS4 discharge access to a person when such suspension is necessary to stop an actual or threatened discharge which presents or may present imminent and substantial danger to the environment, the health or welfare of persons, the MS4, or waters of the United States. If the violator fails to comply with a suspension order issued in an emergency, the Authorized Enforcement Agency may take such steps as deemed necessary to prevent or minimize damage to the MS4 or waters of the United States, or to minimize danger to persons.
B. Suspension due to the diction of illegal discharge – Any person discharging into the MS4 in violation of this Article may have their MS4 access terminated if such termination would abate or reduce an illegal discharge. The Authorized Enforcement Agency will notify a violator of the proposed termination of its MS4 access. The violator may petition the Authorized Enforcement Agency for a reconsideration and hearing.
C. Reinstatement without permission – A person commits an offense if the person reinstates MS4 access to premises terminated pursuant to this Section, without the prior approval of the Authorized Enforcement Agency.

SECTION 7.

Industrial or construction activity discharges.

Any person subject to an industrial or construction activity NPDES or TPDES storm water discharge permit shall comply with all provisions of such permit. Proof of compliance with said permit may be required in a form acceptable to the City Administrator prior to allowing discharges to the MS4.

SECTION 8.

Submission of Notice of Intent (NOI) to the City.

A. The operator of a facility, including construction sites, that is required to have a NPDES or TPDES permit to discharge storm water associated with industrial activity shall submit a copy of the Notice of Intent (NOI) to the City Administrator at the same time the operator submits the original NOI to the EPA or the TCEQ, as applicable. The copy of the NOI may be delivered to the City Administrator either in person or by mail.

B. A person commits an offense if the person operating a facility that is discharging storm water associated with an industrial activity without having submitted a copy of the NOI to do so to the City Administrator.

SECTION 9.

Monitoring of discharges.

A. Applicability – This Section applies to all facilities that have storm water discharges associated with industrial and construction activities.

B. Access to facilities:

(1) The City Administrator, City Engineer, and/or Storm Water Manager shall be permitted to enter and inspect facilities subject to regulation under this Article as often as necessary to determine compliance with this Article. If a discharger has security measures in force which require proper identification and clearance before entry into its premises, the discharger shall make the necessary arrangements to allow access to representatives of the Authorized Enforcement Agency.

(2) Facility operators shall allow the representatives of the Authorized Enforcement Agency ready access to all parts of the premises for the purpose of the inspection, sampling, examination and copying of records that must be kept under the conditions of a NPDES or TPDES permit to discharge storm water, and to the performance of any additional duties as defined by the State and Federal law.

(3) The Authorized Enforcement Agency shall have the right to set up on any permitted facility such devices as are necessary in their opinion to conduct monitoring and/or sampling of the facility's storm water discharge.

(4) The Authorized Enforcement Agency has the right to require the discharger to install monitoring equipment as necessary. The facility's sampling and monitoring equipment shall be maintained at all times in a safe and proper operating condition by the discharger at its own expense. All devices used to measure storm water flow and quality shall be calibrated to ensure their accuracy.

(5) Any temporary or permanent obstruction to safe and easy access to the facility to be inspected and/or sampled shall be promptly removed by the operator at the written or oral request of the City Administrator and shall not be replaced. The costs of clearing such access shall be borne by the operator.

(6) Unreasonable delays in allowing the Authorized enforcement Agency access to a permitted facility is a violation of a storm water discharge permit and of this Article. A person who is the operator of a facility with a NPDES or TPDES permit to discharge storm water associated with industrial activity commits an offense if the person denies the Authorized Enforcement Agency reasonable access to the permitted facility for the purpose of conducting any activity authorized or required by this Article.

(7) If the Authorized enforcement Agency has been refused access to any part of the premises from which storm water is discharged, and this Agency is able to demonstrate probable cause to believe that there may be a violation of this Article, or that there is a need to inspect and/or sample as part of a routine inspection and sampling program designed to verify compliance with this Article or any order issued hereunder, or to protect the overall public health, safety, and welfare of the community, then the Authorized Enforcement Agency may seek issuance of a search warrant from any court of competent jurisdiction.

SECTION 10.

Requirement for owners or operators to use of Best Management Practices (BMPs).

The City of Kemah will adopt policies identifying Best Management Practices (BMPs) for any activity, operation, or facility which may cause or contribute to pollution or contamination of municipal separate storm sewer system (MS4), or waters of the United States. The owner or operator of a commercial or industrial establishment shall provide, at their own expense, reasonable protection from accidental discharge of prohibited materials or other wastes into the MS4 or watercourses through the use of these structural and non-structural BMPs. Furthermore, any person responsible for a property or premise, which is, or may be, the source of an illegal discharge, may be required to implement, at said person's expense, additional structural and non-structural BMPS to prevent the further discharge of pollutants to the MS4. Compliance with all terms and conditions of a valid NPDES or TPDES permit authorizing the discharge of storm water associated with industrial activity, to the extent practicable, shall be deemed in compliance with the provisions of this Section. These BMPs shall be part of a storm water pollution prevention plan (SWPPP) as necessary for compliance with requirements of the NPDES and/or TPDES permit.

SECTION 11.

Watercourse protection.

Every person who owns property, or is responsible for maintaining an easement through which a watercourse passes, or the lessee of such property, shall keep and maintain that part of the watercourse within the property free of trash, debris, excessive vegetation, and other obstacles that would pollute, contaminate, or significantly retard the flow of water through the watercourse, so that such structures will not become a hazard to the use, function, or physical integrity of the watercourse.

SECTION 12.

Notification of spills.

Notwithstanding other requirements of law, as soon as any person responsible for a facility or operation, or responsible for an emergency response for a facility or operation has information of any known or suspected release of materials which are resulting, or may result in illegal discharges or pollutants discharging into storm water or the storm drainage system, or waters of the United States, said person shall take all necessary steps to ensure the discovery, containment, and cleanup of such release. In the event of such a release of hazardous materials, said person shall immediately notify emergency response agencies of the occurrence via emergency dispatch services. In the event of a release of non-hazardous materials, said person shall notify the Authorized Enforcement Agency no later than the next business day. Notifications in person or by phone shall be confirmed by written notice addressed and mails to the City Administrator within three (3) business days of the phone notification. If the discharge of prohibited materials emanates from a commercial or industrial establishment, the owner or operator of such establishment shall also retain an on-site written record of the discharge and the actions taken to prevent its reoccurrence. Such records shall be retained for at least three (3) years.

SECTION 13.

Enforcement.

A. Notice of Violation – Whenever the City Administrator finds that a person has violated a prohibition or failed to meet a requirement of this Article, the Authorized Enforcement Agency may order compliance by written notification of the violation to the responsible person. Such notice may require, without limitation:

(1) The performance of monitoring, analysis, and reporting;
(2) The elimination of illicit connections or discharges;
(3) That violating discharges, practices, or operations shall cease and desist;

(4) The abatement or remediation of storm water pollution or contamination hazards and the restoration of any affected property;
(5) Payment of a fine to cover administrative and remediation costs;
(6) The implementation of source control or treatment BMPs.

B. If abatement of a violation and/or restoration of affected property is required, the notice shall set forth a deadline within which such remediation must be completed. Said notice shall further advise that, should the violator fail to remediate or restore within the specified deadline, the work will be done by a designated governmental agency or a contractor and the expense thereof shall be charged to the violator.

SECTION 14.

Appeal of notice of violation.

Any person receiving a Notice of Violation may appeal the determination of the Authorized Enforcement Agency to the City Administrator. The notice of appeal must be received five (5) business days from the date of the Notice of Violation. A hearing on the appeal before the city Administrator shall take place within fifteen (15) business days from the date of receipt of the notice of appeal. The decision of the City Administrator shall be final.

SECTION 15.

Enforcement measures after appeal.

If any violation of which a person received notice as required by Section 12 hereof has not been corrected pursuant to the requirements set forth in the Notice of Violation, or, in the event of an appeal, within ten (10) business days of the decision of the City Administrator, then representatives of the Authorized Enforcement Agency shall enter upon the subject private property and take any and all measures necessary to abate the violation and/or restore the property. It shall be unlawful for any person, owner, agent, or person in possession of any premises to refuse to allow the Authorized Enforcement Agency or its designated contractor to enter upon the premises for the purposes set forth above.

SECTION 16.

Cost of abatement of the violation.

In the event of action by the Authorized Enforcement Agency, as described in Section 15 above, the owner of the property will be notified of the cost of the abatement, including administrative costs, within thirty (30) calendar days after the abatement of the violation. The property owner may file a written protest objecting to the amount of the assessment within ten (10) business days. If the amount due is not paid within a

timely manner as determined by the decision of the City Administrator, or by the expiration of the time in which to file an appeal, the charges shall become a special assessment against the property and shall constitute a lien on the property for the amount of the assessment. Any person violating any of the provisions of this Article shall become liable to the City by reason of such violation.

SECTION 17.

Injunctive relief.

It shall be unlawful for any person to violate any provision or fail to comply with any of the requirements of this Article. If a person has violated or continues to violate the provisions hereof, the Authorized Enforcement Agency may petition for a preliminary or permanent injunction restraining the person from activities that would create further violations or compelling the person to perform abatement or remediation of the violation.

SECTION 18.

Violations deemed a public nuisance.

In addition to the enforcement processes and penalties provided herein, any condition caused or permitted to exist in violation of any of the provisions of this Article is deemed to be a threat to public health, safety and welfare, and is declared to be a public nuisance. Consequently, any such public nuisance may be summarily abated or restored at the violator's expense and/or a civil action to abate, enjoin, or otherwise compel the cessation of such nuisance may be taken.

SECTION 19.

Criminal penalties.

Any person who intentionally, knowingly, recklessly, or with criminal negligence violates any of the provisions of this Ordinance shall be deemed guilty of a Class C misdemeanor and, upon conviction, shall be fined, except as otherwise provided herein, a sum not to exceed Two Thousand Dollars ($2,000.00) for each offense, and a separate offence shall be deemed committed upon each day during or on which a violation occurs or continues.

SECTION 21.

Severability.

That if any provision, section, subsection, sentence, clause, or phrase of this Ordinance is for any reason held to be invalid or unconstitutional by a court of competent jurisdiction,

such invalidity or unconstitutionality shall not affect, impair, or invalidate this Ordinance as a whole or any part or provision hereof other than the part declared to be invalid or unconstitutional; and the City Council of Kemah, Texas declares that it would have passed each and every part of the same notwithstanding the omission of any such part thus declared to be invalid or unconstitutional, whether there be one or more parts.

SECTION 22.

This Ordinance shall become effective after its approval and adoption and the penalty shall be enforceable following publication of the notice of penalty as required by law.

PASSED, APPROVED AND ADOPTED this 2nd day of August, 2012.

CITY OF KEMAH, TEXAS

ROBERT M. CUMMINS, MAYOR

ATTEST:

CITY SECRETARY

A Guidance Manual for Identifying and Eliminating Illicit Connections to Municipal Separate Storm Sewer Systems (MS4)

Prepared by:
Galveston County Health District
Pollution Control Division

In Cooperation with:
Houston-Galveston Area Council,
Galveston Bay Estuary Program,
and
Texas Commission on Environmental Quality
(formerly: Texas Natural Resource Conservation Commission)

August 2002

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Appendices

Introduction

This guidance manual for identifying and eliminating illicit connections to municipal separate storm sewer systems (MS4) was developed for two reasons. First, as a tool to assist all MS4 operators with Phase I and Phase II storm water program compliance, and second, to address the goals and needs of *The Galveston Bay Plan: The Comprehensive Conservation and Management Plan for Galveston Bay (The Plan)*. This manual outlines MS4 mapping options, dry weather survey procedures, sampling methods and illicit connection investigative techniques. This guidance manual also provides alternative ideas for municipalities to choose what is best suited for them based upon budget, personnel, and time constraints.

Background: In 1972, the Federal Water Pollution Control Act was passed with the intent to eliminate the discharge of pollutants into navigable waters, to protect and propagate shellfish and wildlife, to provide for recreation in or on the waters of the nation, and to prohibit the discharge of toxic pollutants in concentrations which would impair the multiple uses of all waters. Over the next thirty years, various legislation was enacted that addressed aspects of both point source and non-point source (NPS) pollution. By 1994, the "National Water Quality Inventory" indicated that storm water discharges from sources such as separate storm sewers, construction sites, waste disposal sites, and resource extraction activities were major causes of water quality impairment. One estuarine survey highlighted in the inventory found nearly fifty percent (50%) of the identified cases of water quality impairment were attributed to storm water runoff or NPS pollution.

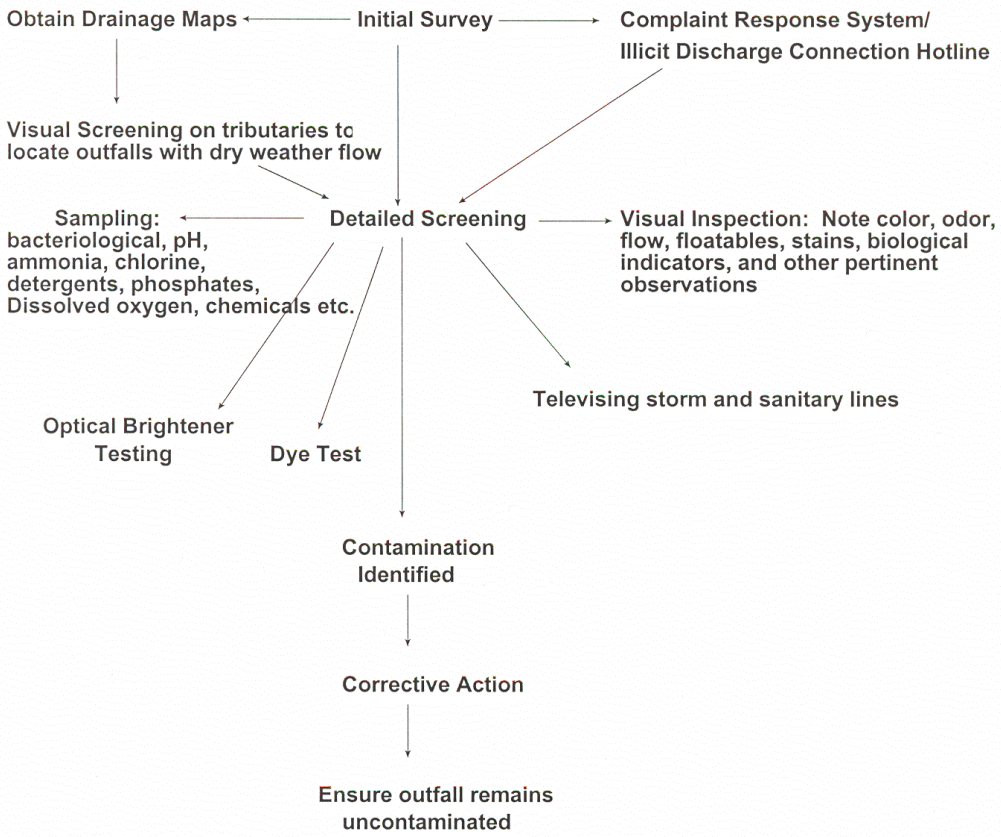
The National Pollutant Discharge Elimination System (NPDES) Phase I Storm Water regulations were developed in response to the 1987 Amendments to the Clean Water Act (CWA). Under Phase I, the Environmental Protection Agency (EPA) mandated medium and large municipal separate storm sewer systems (MS4) located in incorporated communities or counties with populations of 100,000 or more to permit their storm water discharges. Plus, NPDES Phase I permits became required for eleven categories of industrial activities, including any construction activity disturbing five or more acres of land. The regulations included the incentive to adopt "no exposure" practices in commercial and industrial operations and were intended to produce significant reductions in pollutant discharges and improvement in surface water quality. Ultimately, federally mandated Phase II Storm Water Regulations were passed to address the small MS4s (serving less than 100,000 persons).

Effective February 2000, small MS4 operators in urbanized areas and construction sites that disturb one to five acres became regulated. EPA believes that the implementation of the six minimum control measures identified for small MS4s should significantly reduce pollutants in urban storm water compared to existing levels. One of the six measures is the detection and elimination of illicit discharges to the MS4s. Illicit discharges include wastes and wastewater from non-storm water sources. Illicit discharges enter the MS4 through either direct connections such as piping mistakenly or deliberately connected to the storm drains or indirect connections such as infiltration into the MS4 from cracked sanitary sewer pipes.

In 1994, the Galveston Bay National Estuary Program also completed the development of *The Galveston Bay Plan: The Comprehensive Conservation and Management Plan for Galveston Bay (The Plan)*. Galveston Bay provides huge economic benefits to the region and the state. *The Plan* identified the threats to the bay resulting from pollution, development and overuse, then outlined a management strategy to maintain or improve the natural resources of the bay. The bay's second most serious problem was identified as being NPS pollution resulting from storm water runoff. There are sixteen initiatives in *The Plan* to reduce or eliminate NPS pollution. The first initiative is to help local municipalities implement storm water pollution prevention programs.

The Plan also has six initiatives related to point source pollution. In the past, discharges of pollutants from municipal and industrial wastewater treatment plants have upset the healthy balance of marine life in portions of the Galveston Bay estuary system. However, since the 1970's, the closely regulated permitting process has successfully reduced the pollutant loadings from large municipal and industrial discharges. The primary concerns today relate to wet weather by-passes and overflows, compliance issues with small wastewater treatment plants and illicit storm sewer connections. Initiative PS-5 of *The Plan* requires the implementation of a dry-weather illegal connections program. The objective is to actively search for illicit connections to the MS4s and eliminate them.

Figure 1: Identifying and Eliminating Illicit Connections Flow Chart



I. Mapping

Mapping is the first critical step in the detection and elimination of illicit connections between the sanitary and storm sewer systems. Accurate maps will enhance record keeping, facilitate investigations, and improve efficiency of field personnel. Detailed maps plus thorough field investigation notes will be invaluable for identifying the sources of the dry weather flows detected throughout any MS4. If maps are not created, the investigator will spend valuable time trying to locate the points of entry which facilitate tracking during the initial and detailed surveys.

Use a walking stick for balance and to warn off snakes.
Wear steel-toed/ steel shank work boots for foot protection.
Wear snake guards if walking through tall grass & brush.
Carry a cell phone if alone.
Use two-way radios if partnered.

Two options for Mapping: Owners or operators of the MS4 basically have two options when creating their maps. Either Geographic Informational System (GIS) or AutoCAD (computer assisted drawing) maps can be designed/updated **or** paper maps using U.S. Quadrangles, aerial photos, and/or street maps must be fabricated/created by hand. Combining GIS with AutoCAD provides the greatest flexibility and advantage to the MS4 operator/owner. Electronic mapping is the most desirable because it will meet today's information needs plus prepare the cities/utility districts for federal assets inventory responsibilities in the future.

- Electronic base maps may be acquired from several sources. Cities in Galveston County may acquire base maps with street names, property lines, ownership information, property values, etc. from the Galveston Central Appraisal District. Other cities may choose to get TIGER files from the Census Bureau or digitized base maps may be available from their own county appraisal districts or Houston-Galveston Area Council.

  Electronic maps which have sanitary sewer lines (including pipe size and flow direction), manholes and lift stations overlaid with storm sewer lines, manholes, inlets and outfalls are the investigator's most useful tool. Electronic maps can be constructed using different methods. Collecting global positioning satellite (GPS) coordinates on all manholes, outfalls, etc. provide the Geographic Information System (GIS) specialist with the data to "layer" information onto the base map. Conversely, geo-referenced satellite imagery allows all the information to be digitized directly without field GPS coordinates.

- Hand drawn paper maps. U.S. Quadrangles (Quads) have very good scale, topographic lines, and details regarding land uses. However, Quads are not updated on a regular basis. Aerial photos or satellite images, which are taken every few years in some locations, will help update specific Quads for your area but enlarged area street/highway maps may be the best maps to build upon. Since many are given away free of charge, they can be copied and enlarged to draw lines detailing drainage ditches. Arrows can also be used to indicate where and on which side of the ditch a storm water outfall is located.

Color coding maps. Color is the easiest way to designate problems and review accumulated data at-a-glance. Color is good for designating which outfalls have dry weather flow and which do not. Color can be used to separate "flows" into categories based upon volume (gallons per minute). Color can also be used to record information about problem areas upstream of an outfall with a dry weather flow. Use what works best for you.

II. Initial Dry Weather Flow Survey

After maps are completed, dry weather flows must be located. Investigators should walk, drive or float each waterway to identify outfalls having flow. Surveys should not be conducted within 12 hours of a rainfall event or until run-off has ceased. GCHD found 72 hours to be necessary after a significant rainfall. Conduct the survey as follows:

- Label map outfalls with appropriate color to indicate flow/non-flow.
- Document physical characteristics of all dry weather flows using the Illicit Discharge/ Connection Field Investigation Sheet found in Appendix C.
- Conduct field analyses on each flow and document. See Section III-A.
- Collect lab samples at this time as needed. See Sections III-B, III-C and IV-B.

On rare occasions an illicit connection may be identified during the initial survey but usually multiple detailed investigations are necessary. Physical characteristics, field analyses and laboratory tests are collectively known as "Tracers" and are described in detail in the following section.

III. Tracers

A tracer is a distinct characteristic, parameter or combination of such used to test for the presence of a pollutant(s). An ideal tracer should have the following traits:

- promotes time efficiency for field investigator(s),
- inexpensive,
- easy to perform in the field (requires minimum training to receive good results),
- provides results in the field (exception: laboratory samples),
- measures appropriate detection limits,
- produces a measurable concentration for comparison against a non-polluted standard,
- stable characteristics with no significant concentration change over time due to physical, chemical or biological processes,
- non-toxic to the environment (having no waste to return to lab for proper disposal), and/or
- appropriate to the situation (residential vs. industrial).

A. Physical Tracers

The presence of color, odor, turbidity, water temperature, estimated flow rates, biological activity, floatables, oil sheens and other observations can be very useful in identifying an illicit connection. Occasionally, these indicators can be used alone but are best used in conjunction with other field and/or lab tests to correctly identify a pollution source.

1. Color

The color of water is influenced by the presence or absence of substances such as metallic salts, organic matter, dissolved or suspended materials. Water appearance or color may also be an important indicator of water quality problems. The following are common colors and their possible causes (Kolbe):

Color	Possible Sources
Tan to brown	Runoff from rainfall event, construction, or soil erosion
Blue green/ brown green	Plankton bloom, sewage, fertilizer runoff, vehicular wash water or "tracing dye"
Milky white	Paint, lime, milk, or grease
Milky or dirty dishwater gray	Gray water or wastewater, musty odor present
Black	Septic wastewater, sulfuric acid spill or a turnover of oxygen depleted water. Hydrogen sulfide odor usually present.
Dark red, purple, blue, black	Industry - fabric dye, paper ink
Orange-red	Leachate from iron deposits; Tracing dye; Deposits on stream beds often associated with oil well operations such as brine water discharges; oily sheen or petroleum odor may be present.
Bright yellow green	Anti-freeze, tracing dye or algal bloom

Figure 2. Source of brown flow was sediment.

Figure 3. Source of blue-green flow was sewage.

Figure 4. Source of white flow was grease from a fast food restaurant.

Figure 5. Source of blue water was a car wash facility.

Technique #1 - the investigator makes a subjective visual description.

Technique #2 - The New Zealand National Institute of Water and Atmospheric Research developed a technique using a viewing box in conjunction with the Munsell Color Coding System. Comparison cards are used to match the color of the water. A viewing box and set of cards cost approximately $800.

Pros: Easy to track colored water upstream through underground drainage system.
Cons: Not every illicit discharge will have a color to trace.

2. Odor

Odor has very subjective characteristics and differs from one individual to another. Plus an investigator's ability to detect odors may change during the time of exposure. Because of this phenomenon, odors should be noted when first approaching an outfall or storm drain opening.

The following are some common odors and their probable causes:

Odor	Possible Sources
Musty	Raw or partially treated sewage, livestock waste, algae
Rotten egg/ Hydrogen Sulfide	Raw sewage, sulfuric acid, anaerobic water
Sewage/fecal	Raw sewage
Chlorine	Broken drinking water line, sprinkler runoff, swimming pool backwash water, wastewater treatment plant discharge, industrial discharges
Sharp, pungent odor	Chemicals or pesticides
Gasoline, spent petroleum	Industrial discharge, illegal dumping of wastes or waste water.

Pros: An odor can be very helpful in identifying the source of the flow or narrowing the area of focus.

Cons: Not every illicit flow will have an odor.
Investigators can become de-sensitized to a particular odor within minutes of exposure.

3. Turbidity

Turbidity in water is caused by suspended clay particles, silt, finely divided organic and inorganic matter, plankton and microscopic organisms. Movement of the water keeps these materials in suspension and prevents sunlight from filtering through the water. The heavier the turbidity, the more opaque the water appears. Highly turbid water can clog fish gills, reduce photosynthesis, and obscure in-stream habitat. Where a highly turbid flow exists there may be an illicit discharge occurring.

Technique #1 - collect a quantity of water in a white bucket and estimate the turbidity based upon how cloudy the water appears. Assign a ranking such as high, medium, or low turbidity.

Technique #2 - use a turbidity meter. Commercial meters measure the amount of light allowed to pass through a glass tube filled with a solution. However, turbidity meters are not 100% accurate and not every meter is accurate for all conditions. Some meters work best in low turbidity while others are more accurate in medium or heavy turbidity. Others require several correction factors to improve their accuracy.

Pros: The "type" of turbidity may help identify the source of the flow.

Cons: Turbidity alone will not identify whether multiple sources are present.
No single meter is good for all conditions.

4. Water Temperature

The temperature of the dry weather flow can sometimes be useful in identifying flows contaminated by sanitary wastewater. Household and commercial sewage tends to have a consistently warm temperature year round. Therefore, during colder months, any sewage escaping from the sanitary sewer into the storm sewer system may leave a temperature trail.

Allow 1 minute for thermometer or probe to stabilize.

Thermometer, water sample, and sampling container should NOT be in direct sunlight or exposed to a strong breeze.

Technique #1 - collect a quantity of sample in a bucket then submerge the tip of a thermometer in the water. Take the reading while bulb is submerged.

Technique #2 - use a multi-probe meter with a temperature probe, submerge the probe directly in the stream or submerge the probe into a bucket of sample water. Take reading while probe is submerged.

Pros: Inexpensive and time efficient.
Cons: Only helpful in cold weather otherwise, temperature difference is not significant enough to track.

5. Flow

Determining flow will help set investigation priorities. High flow but minimal contamination may take precedent over a lower flow with higher pollutant level. Two simple and inexpensive techniques that can be used to monitor flow.

Technique #1 - use a bucket and a stopwatch. This method must have a drop space large enough to accommodate a measuring container (bucket) under the lower edge of the outfall. Either the container is held under the outfall for one minute and the volume of the flow is measured **or** the time for "how fast the container fills" is recorded. Either way, the gallons per minute can easily be calculated. This procedure should be conducted at least 3 times and an average taken. The latter option is best suited for very small flows.

Case Study #1: Setting investigation priorities based upon flow.

Two outfalls have *E.coli* results of >24,000 mpn/100ml, but one outfall has a flow of 1 gpm and the second outfall has a 3 gpm flow, the outfall with the higher flow rate and higher impact would take priority for investigation. The actual bacteria loading, from a source point to the receiving stream, can be calculated using the bacteria and flow data. The number of bacteria in a 100 ml sample along with the flow in gallons per minute is entered into the following formula:

Bacteria (x) gpm (x) 54800* = bacteria/day.

Technique #2 - use a tracing dye or floatable item such as a cheese ball, match, or cork, a tape measure, a stop watch, and two people. First, measure the distance from the outfall to the first upstream storm water manhole. Second, one person drops the floatable object into the upstream manhole and starts the stop watch. Third, as the object flows out the pipe, the time is documented. Repeat this procedure two more times and take an average of the results. Next, calculate the volume of the channel segment to finish determining flow.

Distance ÷ Time = Velocity

Velocity x Volume = Flow

Pros: Inexpensive method and time efficient
Outfall investigations can be prioritized

Cons: The flow, using the above methods, is an estimate and not exact
The end of the pipe can be submerged making the bucket method non-functional.
The floatable may be hindered or trapped due to uneven substrate or excessive debris within the underground pipe.

Case Study #2: Using flow as an indicator of contamination.

During an intensive survey, a storm water outfall that is usually dry was found to have a heavy flow of 5 gpm. The water was clear with few or no solids. There was no strong odor associated with the flow. But suds were present in the receiving stream. Since there had been no significant rainfall for more than seven (7) days, further investigation was warranted. A sanitary sewer overflow (SSO) was located upstream. The manhole lid was straining the solids and the wastewater was flowing directly into a nearby storm drain inlet.

6. Other Relevant Observations

"Other" observations about the outfall, the area surrounding the outfall, or activities occurring in the vicinity will sometimes give clues to the source of a flow or the cause of the pollution. Noting these observations and using them to complete the investigation "puzzle" will provide a complete picture.

Figure 6. Trash and debris washed out of the storm drain.

Figure 7. Heavy algal flow.

Figure 8. Oil dumped at a storm drain outfall.

Figure 9. Paint stained concrete.

- Debris includes trash, leaves, and grass clippings
- Floatables are from a sanitary waste, commercial or an industrial source
- Vegetation such as algae or "sewer lilies" is present only around and in close proximity of the storm water outfall.
- Lack of any vegetation or stunted plant life may indicate a problem.
- Stains or deposits - dark stains, crystalline, oil, or amorphous powder
- Sewage fungus, *Sphaerotilus natans*, is a soft, gray, filamentous bacteria. When present in large quantities, the bacteria will form a sheet or layer which can be seen with the naked eye. It is found primarily in areas polluted by wastewater or activated sludge and is associated with low dissolved oxygen conditions. The growth of *S. natans* is stimulated by nitrogen and phosphorus
- Surface scum, film, or foam and an associated color may indicate possible sources of contamination.

Figure 10. Rainbow sheen on water caused by oil.

Figure 11. White foam from soap.

Figure 12. Surface scum from sewage.

Surface Scum	Possible Sources
Tan foam	Harmless, cause is high flow or wave action
White foam	Found around wastewater outfalls, thin, mostly due to soaps
Yellow, brown, black film	Tree pollens
Rainbow film	Oil or other fuel type

Activities in the watershed may also indicate causes or sources of contamination:

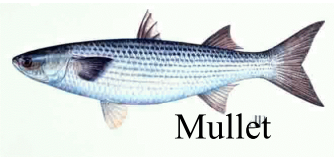
Lawn mowing - illegal dumping of organic waste, ie. grass clippings.

Construction activities - source of sediment, heavy turbidity, petroleum products associated with large equipment.

Livestock such as horses, cows, etc. - contribute contamination in the form of bacteria, nutrients and organic matter.

B. Biological Tracers

Biological tracers include all things living or that grow. Certain organisms are known to indicate polluted or lesser quality waters. Examples are listed below:


Mullet

Mullet are an example of an opportunistic fish species that tend to congregate around "easy" nutrients such as sewage solids flowing from a storm water outfall.

Red-eared sliders are turtles which like "easy" nutrients and their presence may indicate a possible storm water outfall problem.


Red-eared slider

Sewage fungus, *Sphaerotilus natans* Lush green vegetation around an outfall especially when other vegetation is less green or less dense may indicate a nutrient source.

1. Bacteria

Pathogenic organisms are prevalent in fecal contaminated water and pose a great risk to human health. Due to their variety and the complexity involved in identifying individual types of bacteria, indicator organisms are used to assess the potential for presence of pathogens due to fecal contamination (Samadpour). A group of bacteria called fecal coliforms can be detected using a relatively simple laboratory method but they are not specific to warm-

E.coli for fresh water

enterococci for tidal or salt water

fecal coliform for all water

blooded animals and the test may produce false positives. The species, *Escherichia coli (E. coli)*, is part of the fecal coliform group and is specific to humans and other warm-blooded animals. EPA recommends it as the best freshwater indicator organism when evaluating health risk for recreational waters. If the water body in question is salt water or tidally influenced waters, enterococci bacteria should be used as the indicator organism due to its ability to survive in high salinity conditions.

Bacterial sampling depends on available funding. Even though relatively inexpensive, collecting ten to twelve samples in one day could cost $ 100 or more. The bacteriological sampling technique is as follows:

1. Whenever possible, bacteria samples should be collected directly into a sterile, 100 ml bottle. If a sampling device such as a bucket must be used, the bucket must be rinsed several times with the water to be sampled. The bacteria sample shall be collected before any meters are placed in the sampled water.
2. The sample bottle shall be properly labeled with the site ID, date, and analysis desired and placed in ice immediately.
3. Deliver to laboratory for testing. Costs are fairly inexpensive (range $ 8 - $ 12 each) and results are usually available within 24 hours.

If bacterial testing was done, the results can be used in conjunction with flow data to determine the bacterial loading to the receiving waters (See case study #3).

Pros:	Good indicator of pollution sources
	Inexpensive
	Easy sampling technique
	Get results quickly
Cons:	Use sterile conditions to avoid contamination
	Samples must be returned to laboratory within six (6) hours of collection for results to be valid

Case Study #3: Calculating the Human Equivalence (HE) of a contaminated flow.

If the fecal sample result equals 24,000 mpn/100 ml and the flow from an outfall is measured to be 3 gpm, then the Bacterial Loading will equal 3,945,600,000 fecal coliform. If one adult human is equivalent to 2 billion fecal coliform per day, then 3,945,600,000 ÷ 2,000,000,000 will equal 1.97 adults. This result may indicate that the source is from a very small flow such as a single house or the leak into the storm system if very small.

Bacteria results X flow (gpm) X 54800 = Bacterial Loading (bacteria/day)

Bacterial Loading ÷ 2,000,000,000 = Human Equivalent (HE)

C. Chemical Tracers

Measuring the chemical characteristics or make-up of a dry weather flow will help the investigator track the source of the flow and identify the cause of the contamination or vice versa. Chemical tests are needed to supplement the physical parameters noted and confirm contamination. Chemical tracers can either be tested for in the field, if the right equipment is available, or samples may be taken to a laboratory for analyses. The chemical tests - DO, pH, chlorine, ammonia, phosphate, dye testing, and optical brighteners - are described below. Each section includes approximate costs, equipment needs, sampling tips, and the pros and cons of each test. A case study is also included to illustrate how each chemical test was helpful in locating an illicit connection for GCHD.

Salinity, specific conductance, total suspended solids, biological oxygen demand, and fluoride also may be useful indicators on occasion but they have not been discussed in this manual. Plus, other tests available to the investigator (organics, metals, etc.) are not discussed in this manual. Cost per test or requirements such as ultra clean sampling techniques make some tests prohibitive for small entities.

1. Dissolved Oxygen

Dissolved oxygen (DO) is essential for the continued survival of most aquatic organisms. The *Guidance for Assessing Texas Surface and Finished Drinking Water Quality Data, 2002* designates aquatic life uses for all water bodies as exceptional, high, intermediate, limited, or no significant aquatic life use. In freshwater, the *absolute minimum criteria* are 4.0, 3.0, 3.0, 2.0, 1.5 milligram per liter (mg/L) respectively. Several factors affect the ability of water to absorb and hold dissolved oxygen. As water temperatures increase, DO generally decreases. Also, an algal bloom will increase the DO during the day while the same bloom will consume or "use" the oxygen at night sometimes causing total depletion. Lastly, bacteria metabolize available DO during the decomposition of organic matter.

Methods for measuring Dissolved Oxygen: There are three methods for measuring DO. The choice of procedure depends on the interferences present, the accuracy desired, and, in some cases, convenience or expedience.

- The Winkler Method is a titration procedure based on the oxidizing property of DO. It involves performing a 5-10 minute analytical test on a quantity of sample water in the field. A field kit can be assembled using equipment from an existing lab or a Digital Titrator/ Modified Winkler kit may be purchased for approximately $200.
- Two (2) colorimetric tests are available from Hach Corporation for screening

To collect water samples for DO measurements:

Do NOT agitate/aerate water to be measured.

Submerse probe completely in bucket of sample water and stir slowly (about 1 revolution/second for at least 90 seconds (SWQM)) or until the display stabilizes.

purposes. First, a colored disc comparitor is used to match the color of the solution generated by adding chemical reagents. Second, a hand-held colorimeter is used to measure the color intensity after being mixed with the appropriate reagents. Both are read directly from the devices. The methodology for each kit is explained in the instruction manual.

- DO meters use membrane covered electrodes to measure the rate of diffusion of molecular oxygen across a membrane. A DO meter can be purchased as a stand alone meter or as a multi-probe instrument having multiple functions such as temperature, pH, conductivity, and/or salinity. Meter prices range from $800 to ~$5,000 depending on the capabilities of the meter.

Pros	Simple, easy to learn procedures. Colorimetric kits: relatively inexpensive. Meters: produce fastest results.
Cons	Low DO is not positive indication of pollution. Low DO may be due to warm water temperatures. Bucket or telescoping pole required to collect sufficient sample volume. Sampling technique will potentially add DO to water. DO meters: require significant initial investment but have low long term costs. Meter: requires regular calibration and maintenance.

2. pH

Potential hydrogen (pH) measures the hydrogen ion activity in solution. Waters with a pH less than 7 are considered to be acidic while water with a pH greater than 7 are alkaline or basic. A pH between 6.5 and 8.2 is considered ideal for a healthy environment. Conversely, levels below 5.0 and above 10.5 can cause unhealthy stream conditions for aquatic life. Normal storm water, and even sanitary wastewater, has a pH around 7 or neutral. Since pH is logarithmic, a pH of 4.0 is ten times more acidic than a pH of 5.0. Measuring pH can identify whether the flow is industrial, commercial or domestic in nature.

Not only does pH affect aquatic life, but pH may also influence the toxicity of other chemicals. Ammonia becomes more poisonous in high pH (basic) solutions and heavy metals can leach out of stream sediment in acidic solutions (NVRC). Industries that release low pH (acidic) dry weather discharges include (but are not limited to) textile mills, pharmaceutical manufacturers, metal finishers/ fabricators, as well as companies producing resins, fertilizers and pesticides. In contrast, industries releasing high

To collect water samples for pH measurements:

Avoid collecting sediment with water to be measured.

Stir probe slowly (about 1 revolution/second for at least 90 seconds (SWQM)) or until the display stabilizes.

Rinse probe with de-ionized water between readings and before storage.

Even if a meter and probe are used,

pH (alkaline) wastes are commonly soap manufacturers, textile mills, metal plating industries, steel mills, and producers of rubber or plastic.

Methods for measuring pH: There are three (3) methods for measuring pH.

- pH paper is available in several different ranges. Besides the full range (0-14), they can be purchased for the high, mid, or low ranges.
- Test strips provide semi-quantitative results. One supplier advertised 50 test strips for less than $10.
- Colorimetric methods such as a color cube kits, color disc kits or a pocket colorimeter use a reagent to produce a color which is then matched to the comparitor or measured for light transmission. Colorimeters are more accurate than the color discs which are more accurate then the color cube kits. The methodology for each kit is explained in the instruction manual. Kits range from $15 - $55.
- A pH meter with electrode produces the fastest and most accurate results. However, probes are susceptible to fouling by oil and greases. Meter prices range from $450 to $1000.

Pros	Method is excellent detector of chemical releases
	pH paper: very inexpensive, quick and easy to use
	pH colorimetric tests: relatively inexpensive, accurate results
	pH meter: moderate in price, best results in fastest time
Cons	Method is insufficient indicator of sanitary sewer discharges
	pH paper: must be kept dry and stored in cool, dark place
	pH paper: is not very accurate for small changes
	pH meters: require routine calibrations and maintenance of probe

Case Study #4: Using pH as an indicator of contamination

While performing routine mapping and sampling, a milky white discharge was found flowing from a storm water outfall. A crystalized film had formed on the water surface and a white deposit was settling out on the bottom of the "pool." A pH of 12 was measured at the outfall but decreased to 9.5 about 10 yards downstream. Upstream of the outfall, a large amount of lime had been spread over a construction site to condition the soil. Because there were no silt fences at the site, rainfall and/or other water runoff was causing the lime slurry to flow into a drainage ditch and thence to the storm drain outfall. Lime is very alkaline in nature and therefore accounts for the high pH measurements.

Case Study #5: Investigation of contamination using pH levels.

An unusually high flow with a pH of 11.07 was found discharging from a storm water outfall. Investigative tracking of the pH revealed the source to be a car dealership. Paint and vehicular wash water was being discharged to a floor drain which had been plumbed to the ditch instead of the sanitary sewer. A Harris County Pollution Control Department investigator was called in to assist with getting the facility to correct the illegal plumbing.

Before

After

3. Chlorine

While beneficial for public health reasons (killing pathogenic organisms), chlorine is also harmful to the environment. Its lethal affect depends on concentration and time of exposure. Final wastewater treatment plant effluent and potable water are usually the only waters disinfected with chlorine. However, chlorine is also used in the production of plastics, cleaning products and insecticides. Therefore, detecting a chlorine residual in a dry weather flow and then tracking it upstream through an underground drainage system will usually result in locating the source of a contaminated discharge or cross-connection. In times of water shortages, it also helps to identify sprinkler systems with excess run-off or breaks in a drinking water line.

Chlorine also interferes with lab tests such as BOD, cyanide and pesticide/herbicide testing. Therefore, samples known to have a Cl_2 residual must be dechlorinated (treated with sodium thiosulfate to remove the Cl_2 ions) when the samples are collected or before analysis begins (SWQM, TNRCC).

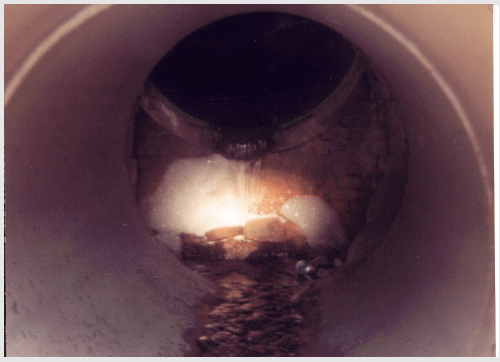
Methods for testing chlorine residual: Water samples are tested for free and/or total Cl_2 residual depending on the method used. Overall, the process of preparing the sample and reading the results takes a maximum of 5 minutes. Free Cl_2 residual are read immediately whereas, total Cl_2 residual tests usually require the sample to stand for a period of time before reading the results. For exact specifications refer to your kit's instruction manual.

- Chlorine test strips can be used to detect higher concentrations of chlorine (0.5, 1.0, 2.0, etc.) as would be found in a discharge from a swimming pool filtration system. Test strips provide semi-quantitative results. The individually wrapped strips cost around 50¢ each.
- colorimetric test kits such as a color cube kit, color disc kit or a pocket colorimeter use a reagent to produce a color which is then matched to a comparitor or measured for light transmission. Colorimeters are more accurate than the color discs which are more accurate then the color cube kits. The methodology for each kit is explained in the instruction manual. Kits range from $55 - $325.

Pros	All methods are quick and easy to perform
	Able to identify water line breaks
	Can detect illegal pool, spa discharges, and vehicular wash water
Cons	Test strips do not detect low concentrations
	Cost per test strip is moderately high
	Very few outfalls have a significant enough amount of chlorine to be able to track upstream
	Meters require regular calibration and maintenance

Case Study #6: Using chlorine as an indicator to locate an illicit discharge.

Using a high-beam cordless spotlight, billowing suds were discovered accumulating within a large concrete storm drain which discharged directly into a creek. The chlorine residual was >3 mg/l. Tracking upstream, the flow became cloudy with a whitish hue and had a pungent odor. The flow originated at a nearby fast-food restaurant that had a large grease spill in the dumpster area. The grease had been sprinkled with hTh chlorine and was being power washed. All wastewater was flowing into an open pipe in the driveway. The open pipe drained directly into the storm drain. Management was notified of the violation and actions were taken to correct the matter immediately.



4. Ammonia

Ammonia (NH_3) is produced by the decomposition of plant and animal protein. Ammonia is also a main ingredient in fertilizers. Its presence in surface waters usually indicates domestic or agricultural pollution. At certain levels, ammonia is toxic to fish and creates an oxygen demand in the receiving water. It is also an excellent indication of contamination by sanitary wastewater.

Methods for measuring ammonia: There are several methods available to test for the presence of ammonia. Some of the methods are less accurate but can still be used as a screening tool. The methods are listed below.

- Ammonia nitrogen test strips are available to measure ammonia in increments of 0, 0.25, 0.5, 1.0, 3.0, & 6.0 parts per million (ppm) or mg/L. Test strips provide semi-quantitative results. Each test strip costs ~ 60¢ and they are available in packages of twenty-five (25).
- Colorimetric test kits such as a color cube kit, color disc kit or a pocket colorimeter use a reagent to produce a color which is then matched to a comparitor or measured for light transmission. Colorimeters are more accurate than the color discs which are more accurate then the color cube kits. Most kits are available in ranges - high, medium, and low concentrations. The smallest increment available in any kit is 0.1 mg/L. While not acceptable for determining surface water quality, it can be used to screen for pollution sources. The methodology for each kit is explained in the instruction manual. Kits range from $30 - $325.
- Portable ISE meters with ammonia sensing electrodes are available for field use. The cost of a meter with the required electrode will range from $1,000 - to $1,500. The methodology for the meter is explained in the owner's instruction manual. There are accuracy issues with the electrodes, see **Cons** below.
- Analytical tests can be conducted in a laboratory. Water samples are collected and returned to the lab for analysis. Costs per test range from $20 - $30. This test is the most accurate available but turn-around time for results is a major hindrance.

Pros	Test strips and kits easy to use in the field. Test strips and kits provide results in the field which can facilitate immediate tracking. Good indicator of sanitary sewage.
Cons	Time consuming: depending on which kit is used - can take up to 15-20 minutes per sample analysis. Most of the time values are too small to track. Additional steps must be taken to negate the interferences: saltwater may interfere with test methods reducing accuracy up to 30%; chlorine must be removed from sample prior to testing; iron, sulfides, and extreme hardness in the water will also cause interferences. Regular calibration and maintenance required on all meters.

Case Study #7: Elevated ammonia levels from sanitary sewage

For more than twenty years, residents had complained about persistent sanitary sewer problems. During an intensive sampling event, investigators noted a foul odor associated with the drainage ditch and storm water outfall. Biological indicators, such as red-eared slider turtles, plus ammonia levels measuring up to 7.32mg/L and high levels of *E. coli* bacteria confirmed the presence of an illicit connection. After several investigation attempts, it was discovered that two residential service lines had been hooked up to the storm sewer instead of the sanitary sewer. Wastewater was draining straight into the drainage ditch behind the owners' property. The proper authorities were contacted and the problem was corrected.

5. Phosphates

Phosphorus occurs in natural water and wastewaters almost solely as phosphate. A certain amount of phosphate is essential fro most plants and animals, but too much phosphate in water can contribute to eutrophication. Phosphates may enter water from agricultural run-off an biological and industrial wastes. They may be added to water in municipal and industrial water treatment processes to control corrosion. Phosphates (PO_4) were most commonly found in soap and detergent discharges from household and industrial laundering activities and are common ingredients in fertilizers.

Methods for measuring phosphates: There are several methods available to test for the presence of phosphates. Some of the methods are less accurate but can still be used as a screening tool. The methods are listed below.

- Orthophosphate test strips are available to measure phosphorus in increments of 0, 5.0, 100, 200, & 500 parts per million (ppm) or mg/L. Test strips provide semi-quantitative results. Each test strip costs ~ 30¢ and they are available in packages of fifty (50).
- Colorimetric test kits such as a color cube kit, color disc kit or a pocket colorimeter use a reagent to produce a color which is then matched to a comparitor or measured for light transmission. Colorimeters are more accurate than the color discs which are more accurate then the color cube kits. Most kits are available in ranges - high, medium, and low concentrations. The smallest increment available in any kit is 0.02 mg/L. While these kits are not acceptable for determining surface water quality, they can be used to screen for pollution sources. The methodology for each kit is explained in the instruction manual. Kits range from $20 - $325.
- Analytical tests can be conducted in a laboratory. Water samples are collected and returned to the lab for analysis. Costs per test range from $18 - $30. This test is the most accurate available but turn-around time for results is a major hindrance.

Pros	Test strips and kits: easy to use in the field. Test strips and kits: provide results in the field which can facilitate immediate tracking.
Cons	Test strips: accurate for gross contamination only. Test kits: depending on which kit is used - can take up to 15-20 minutes per sample analysis. Most of the time values are too small to track. Some amount of PO_4 can be found at almost every outfall because it is naturally occurring, fertilizer run-off from lawns is common and residential car washing generally produces a run-off.

Case Study #8: Using phosphates to identify an illicit discharge

A outfall was investigated due to elevated bacteria levels detected in a continuous dry weather flow estimated at >5 gpm. The flow was followed to the first manhole upstream where an incoming lateral line that was discharging sudsy water. A PO_4 level of 3.10 mg/L was measured. The lateral line was coming from a car dealership where two problems were identified. First, the shop floor was cleaned by hosing the wastewater outside to a storm drain located in the driveway and, second, vehicles were being washed next to the garage instead of on the car wash pad. All wastewater was flowing directly into the storm grate.

D. Confirmation Techniques

1. Dye Testing

Dye testing uses a brightly colored, fluorescent substance to detect leaks in the sewage system, locate illegal sewer connections, trace cross connections, monitor flow studies, analyze septic systems and track groundwater movement. Tracing dye is available in many forms - liquid, tablet, powder, wax, and strips.

Liquid dye is very concentrated and disperses quickly. It is easy to use and works well in all volumes of flow. Dye strips are similar to the liquid but are less messy. Powder can be very messy and must dissolve in liquid to reach its full potential. Tablets are compressed powder and

are particularly useful for releasing dye over time. Tablets are less messy than the powder form. All forms of the dye stain hands and clothes so caution should be taken when handling the containers. Latex gloves provide a good barrier and adequate hand protection.

Tracing dye is available in different colors such as blue, red, violet, and yellow-green. Several colors should be kept on hand so multiple lines can be tested at the same time. When dye testing, use the color which creates the greatest contrast with the receiving water. Yellow-green dye is the preferred dye because of its great contrast in color but it disappears quickly in sunlight. Red, however, is most helpful when there is a lot of algae present. Red also withstands sunlight and lingers in the environment longer.

Equipment needed for dye testing:

- fluorescent dyes,
- rubber or latex gloves,
- manhole hook or pick ax,
- camera (for documentation),
- high power flashlight,
- two-way radios (if two investigators).

Methods for conducting dye testing: Depending on the scenario, there are different techniques for dye testing. It is always helpful to have two people testing but one person can complete the job. Ideally, one person drops the dye and the second person looks for evidence of dye downstream.

- If a residential property is suspect, dye can be placed in the house clean-out and washed downline using a nearby hose (seek permission from the property owner first). If dye surfaces in the storm drain system, then the problem most likely exists in the service line for this private property. The property owner should be informed of the situation and served a notice to make necessary repairs.

- When a commercial property needs to be tested, dye should be flushed down a restroom toilet or washed down the janitor's sink (speak to manager or owners first). Flush quickly and repeatedly to prevent staining. If dye surfaces in the storm system, it is most likely the commercial business responsibility to fix the problem. Inform the manager or owner and serve a notice to make repairs.

- To dye test a sanitary sewer line, choose a sanitary manhole upstream of the storm water outfall **or** upstream of where the sanitary line crosses the storm line **or** upstream of the area of concern. Choose the upstream sanitary manhole that has no odor, color, or any other relevant observations that may signify a pollution source. If dye surfaces in the storm drain system, the problem and responsibility most likely lies with the city or utility district.

- If dye **does not** surface in the storm drain after a period of time **or** if the investigator cannot wait for the dye to surface, secure charcoal packets any place where dye is expected to surface. Leave the packets in place for a week or two then retrieve and analyze. Complete instructions for processing the charcoal packets are provided in Appendix D. The charcoal packets are necessary because dye can take anywhere from a few minutes to days to surface in the storm drainage system. Even though another site visit must be made, the packets save time. Personnel do not have to wait at the site and multiple check-backs and/or risk of missing the dye is avoided.

Heavy flows from rain, a garden hose, or flushing a toilet several times, can speed up the dye testing process.

A partially blocked sanitary sewer line can slow down the dye process or give false results.

A fully charged or blocked sanitary sewer line may be the only time a cross-connection occurs and is detectable.

Case Study #9: Dye testing to confirm sewer leak at private home

Elevated bacteria levels at a storm water outfall led to an upstream investigation and additional sampling. Results narrowed the area of concern and the city storm sewer lines were televised. No problems were located so residential homes were dye tested via clean outs. Dye from one home surfaced in the storm sewer. The residential service line was televised and two breaks were identified. The line was repaired at the owners expense.

Case Study #10: Dye testing a sump pump to confirm an illicit connection

During routine ambient monitoring, a white, 2 inch PVC pipe was found gushing water directly into a creek for about 30 seconds and then the discharge stopped. The pipe was located next to a car repair shop. An investigation revealed a sump pump located in the underground area of the shop. Knowing these units function intermittently, the sump was dye tested. After filling with enough water, the pump turned on and dye discharged out of the PVC pipe at the creek. City representatives were informed of the illicit connection and asked to oversee needed repairs.

Pros	Dye is water soluble, biodegradable, fairly stable, has a low toxicity and has been used for over 100 years Highly detectable and only a small amount is needed Relatively inexpensive Can narrow down the pollution source area to a street block or even a specific house or building
Cons	Can be very time consuming. May require several check backs if charcoal packets are not used.

2. Optical Brightener

Optical brighteners (OB), or fabric whitening agents, are good tracers because they indicate a presence of laundry effluent which is specific to humans. OB's can be used to identify storm drain cross connections, sewage system exfiltration, and faulty septic systems, plus differentiate between human and animal waste.

Equipment needed for OB detection: Below is a brief list of the primary needs. A complete equipment list can be found in Appendix E. Start up costs for all materials can range anywhere from $100 to $500, the most expensive item being the UV light.

- Individually wrapped, untreated cotton pads,
- Vinyl-coated "cages" to hold the pads,
- A 4-6 watt fluorescent ultraviolet light box.

Method for deploying optical brightener traps: Optical brightener placement is best suited for pipes, storm drains and small streams (out of direct sunlight).

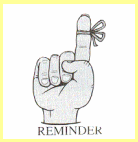
Figure 13: Optical Brightener Device

- Insert untreated cotton pad into the vinyl-coated cage and secure the cage shut using a zip tie or rubber band. (See picture at right.)
- Secure the cage in the pipe, storm sewer, or stream using high test monofilament line tied to a rock, a manhole lid (with holes), aluminum (tent) spikes, or a nearby branch.
- Complete *Field Investigation Sheet* (Appendix C) and collect bacterial samples (if needed) on the day of deployment.
- On the *OB Data Sheet* (See Appendix F), list the site ID, date of deployment, and various locations of cage(s). Expose the cage device for approximately 7 days. Leave out longer if heavy rainfall has occurred. (This time frame allows for at least one laundry event to take place.) If dry weather flow contains heavy sediment or debris, shorten the deployment time period.
- Temporarily install a rain gauge at the site if possible.

- During retrieval, rinse the gauze pads in the receiving water to remove excess sediment.
- Squeeze excess water from the pad and place pad in clean zip lock baggie.
- Label a piece of dark manila folder with the site ID or location, date of placement, amount of rainfall and the date of retrieval and staple to the gauze pad. Place pad with label in a clean baggie and transport in a dark container to minimize exposure to the sun.
- Complete data sheets with the date of retrieval, number of days the pad was exposed to a flow and total rainfall (See Appendix F).
- Return to office or lab and dry pads by hanging them on a clean monofilament line in a dark area.
- After the pads have dried, place the gauze pad (with attached label) under a UV light to check for fluorescence. A UV light box is the simplest method for examining the pads, otherwise use a UV light strip in a darkened room.
- Compare a "control" pad (clean) to the dried pads and rate each as Positive, Negative, or Inconclusive. A pad having a definite glow or fluorescence is positive for exposure to grey water. A pad that looks similar to the control is negative for laundry wastewater. Any pads with an inconclusive or questionable result should have the location retested. Consider lengthening the new pad's exposure time.
- At least 10% of the dried pads should be re-read by a second trained personnel for Quality Control (See Appendix G). GCHD recommends 100% QC check for confirmation.

Figure 14: OB device deployed in storm drain.

Do NOT touch gauze pad to clothing or hands that may have laundry detergent residual.



Check cages after heavy rainfall to ensure devices are still secure.

Do NOT use white paper labels. They may contain optical brighteners and will contaminate the sample.

A negative pad may occur at a flow with high bacterial contamination. The source may be from a non-detergent using facility or be agricultural in nature. If only the outfall was tested and the pad was positive, the site should be re-tested along with several upstream sites to narrow down the area of the source. Bacteria sampling at each upstream site is also beneficial. OB success rate may be improved if:

- they are deployed in a constant, dry weather flow rate
- the sampling device (cage) is completely submerged so the entire gauze pad is exposed

- the device is hidden from public view (as much as possible) to avoid tampering
- use an ultra-clean methodology to minimize false positives

Factors decreasing OB success rates include:
- heavy rainfall
- sediment and debris clogging or burying the gauze

Pros	Inexpensive supplies
	Animal / human waste differentiation
	Does not require a laboratory to attain results,
	One field personnel can complete all steps
Cons	Can be time consuming
	Results are not obtained for at least one week
	Heavy rains require longer deployment periods.

Case Study # 11: Storm drain tracking using OB devices.

Due to elevated bacteria levels (*E. coli* >24,000 mpn/100 ml) and a thick, white colored flow from a storm water outfall, an investigation of a residential area was under taken. The color was tracked and found in five (5) upstream storm water manholes. Between the 5th and 6th manhole, painters were seen actively painting a home but the painters insisted that their paint brushes and equipment were washed inside the home and not outside. Initially, a break in the service line of this house was suspected but dye testing was negative. Dye surface in the sanitary line only. Next, optical brightener devices were placed at the outfall and in four (4) upstream storm water manholes. The devices were left for eight (8) days, retrieved, dried, and analyzed. At the time of retrieval, the manholes were no longer white and the painting had ceased. The outfall and 1st upstream manhole were positive for optical brighteners while the other manholes were negative. Additional *E. coli* and ammonia sampling mirrored the OB results. *E. coli* was >24,000 mpn/100 ml at the outfall and the 1st manhole and dropped to 200 mpn/100 ml or below for the remaining upstream manholes. Ammonia was high at the outfall and first manhole, dropping considerably at the second. Using the *E. coli*, ammonia and OB results, the area of concern was localized to about 14 homes. The city televised the storm lines and found no problems so each home was scheduled for dye testing. Ironically, the first house tested revealed a problem and has been referred to the city for repairs. See Appendix H for map of sample sites and data.

3. Televising

Cities with budgets capable of supporting a crew for televising have an advantage over those that do not. After the area of a possible pollution source is narrowed down, the surrounding sanitary and/or storm sewer lines can be televised to locate the exact position of the break, infiltration, or cross connection. This method is also much safer then having field personnel do confined space entries to look for pollution sources.

Pros	Best way to pinpoint exact location of breaks, infiltration, and cross connections.
	Video tapes can be viewed after crew has left the field
Cons	Very expensive to maintain equipment
	Crews (multiple employees) must be trained to operate equipment
	Require line cleaning before televising
	Cameras are limited on the size of pipes they can view
	Cameras cannot take pictures if pipes are full of liquid

E. Future Tracers

As this project was being implemented and the manual drafted, ongoing research identified several new and innovative technologies that were being developed to help determine pollution types and their sources. These tracers were not utilized for various reasons but brief discussions have been included for future reference. These new technologies include testing for DNA, caffeine, pharmaceuticals, viruses, and using infrared heat detection. This research should be reviewed periodically to determine whether a technique is applicable to a given situation, if it becomes cost effective, and whether necessary laboratory support is available.

1. DNA

Microbial Source Tracking (MST) uses DNA testing, or "fingerprinting" of *E. coli*, to differentiate between human and non human waste. *E. coli* bacteria is found in all warm-blooded animals but each DNA sequence within every *E. coli* strain is different probably due to differing intestinal environments. This contrast is what will help determine if polluted waterways are actually contaminated with human sewage or animal waste runoff.

The first step in DNA testing requires the building of a library of fingerprints, or isolates, taken from humans, wildlife and domestic animals. For example, waste samples must be obtained from cows, horses, deer, waterfowl, dogs, cats or any other known potential pollution source and analyzed. A few hundred isolates are needed per source to build a large enough library and the larger the library, the easier it is to match isolates. Dr. Samadpour's laboratory, who developed the MST method, has subtyped more than 65,000 *E. coli* strains. Unfortunately, libraries from other geographical areas should not be relied upon due to possible genetic variances. After the reference library is built, bacteria samples from unknown origins can then be compared to the library for

identification. Antibiotic resistance analysis (ARA) is also recommended to be used in conjunction with the DNA ribotying to make the results more reliable. ARA uses *E. coli* samples to determine antibiotic resistance. Humans having a higher resistance.

Currently, the number of laboratories set up to analyze these types of samples are limited and the cost per test is significant. If starting from scratch, laboratory costs, including building the library and running DNA and ARA tests, are expensive. For example, the City of Albuquerque compiled a library of eight (8) different animals, including humans, and sampled 16 sites two (2) times each. Their costs were approximately $100,000 and their results were not absolute. (Over the next two years, the State of New Mexico will be conducting a study on eight (8) different sites testing for ARA and ribotyping). Additionally, highly trained personnel are required to performed the tests due to the risk of error.

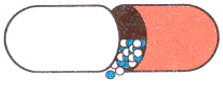
2. Caffeine

Caffeine was investigated as a tracer for leaking sanitary sewer lines because it passes through the digestive system virtually unchanged and is persistent in the environment. Caffeine is generally found in human sewage only but may be detected in certain plants such as watermelon. Presently, sample analysis is running about $100.00 per test which makes it financially infeasible for smaller cities and utility districts. Bench top methods may be run in-house but have a large margin of error.

A study conducted in Puget Sound found caffeine present in more than 160 of the 216 samples collected. Contaminated samples were even found at depths of 640 feet. Scientists believe this wide spread contamination is due to Seattle motorists and coffee cart operators dumping cold coffee along streets and into storm drains. The city has since withdrawn plans to use caffeine as an indicator but there is every indication that caffeine testing may be beneficial for other cities.

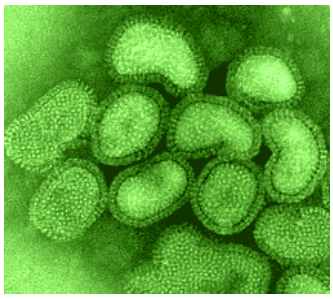
3. Pharmaceuticals/Drugs

Pharmaceuticals are being investigated due to increased awareness of their presence in major waterways. The FDA has begun asking pharmaceutical manufacturers what ecological effects may be caused by their products. The U.S. Geological Survey (USGS) reported finding "95 pharmaceutical hormones and other organic chemicals in U.S. waters." Most importantly, endocrine disrupters which change, imitate or block hormonal functions have been found in these waterways. During a 5-year study in London, England, the environmental agency investigated a decline in human male fertility. In conjunction with findings, male fish in nearby rivers were found to be changing sex due to ethanol estradiol (a synthetic estrogen in urine of women using birth control pills) found in the waters. The decline in male fertility was suggested to be caused by men ingesting ethanol estradiol via drinking water. The chemical is thought to remain active for a month and surface water is the main source of drinking water in the study area. Therefore, it is very possible that the chemical causing male fish to change sex could also be linked to male infertility.



4. Viruses

Researchers have discovered human adenoviruses contaminating surface water along the California coastline. The methodology used to identify the viruses in coastal waters was originally used to trace pathogens in sewage. The presence of these viruses in such waterways supports the idea that the source of contamination is from human waste discharging into waterways. Unfortunately, it is not known whether the viruses are virulent. Interestingly enough, there are no significant correlations between the presence of viruses and bacterial indicator levels (total coliforms, fecal coliforms and Enterococci). This news has serious implications so California has been asked to re-examine their water quality standards for recreational areas. The standards do not address the viral quality of those same waters. This concern brings rise to the question, "Should every state be re-examining their own water quality standards in regards to viral quality?"



5. Infrared heat detection systems (IHDS)

Arkansas Department of Health employee, John Church, devised a technique for locating leaking septic systems while watching the television show COPS. Infrared heat detection systems (IHDS) detect changes or variations in temperature. Based on the theory that human waste is going to be significantly warmer than the ambient ground, the detection system can easily give a visual picture of a leaking septic system. In turn, this system can be used for bodies of water, such as lakes, to locate areas that are slightly warmer possibly due to wastewater inflow. This detection system tends to work best in colder seasons when the warm septic effluent or wastewater can be detected easier. The effectiveness of this system has not been tested in southern states with warmer climates. Nor has a hand held system been tested during ground surveillance. Church also used a state police helicopter with a Forward Looking Infrared (FLIR) imaging system, global positioning system (GPS), video equipment, and maps. Using the IHDS in aerial reconnaissance seemed to be cost effective if usage of the helicopter was donated.

IV. Sampling

As previously stated, sampling is conducted at the time that a dry weather flow is found or when priorities indicate an area needs to be resampled. Sampling and detailed investigations are best conducted in the morning when there are greater sanitary sewer flows from residential areas, during or after high use periods such as tourist season or holidays, or while tides are ebbing or at their lowest, if applicable. Determine the approximate number of samples to collect on a particular day by considering:

Physical proximity of dry weather flows to office or laboratory. How much time will be spent driving to and from the field sampling area?

Accessibility to the dry weather flows. Must the investigator walk from outfall to outfall or can he/she drive? Can the opening of the outfall be easily reached for sampling or does an upstream manhole have to be sampled?

Many analytical tests have maximum holding times before they must be delivered to the lab and analyzed.
Some laboratories limit the time when samples can be received for same day analysis and/or require pre-notification of plans to sample.
What has the weather been like? (See Section III. Initial Dry Weather Flow Survey.) All outfall sampling should occur only during periods of dry weather.

- Take and consume plenty of drinking water.
- Use sun screen repeatedly.
- Use insect repellent as needed.
- Use safety lights on vehicles, safety cones, and safety vests when working along a roadway.

A. Preparing to Sample

Once a sampling event is planned and scheduled, notify the laboratory as needed.
Gather the appropriate type and number of bottles for the intended tests including extra bottles required for lab duplicates, etc. See Appendix I.
Check bottles for cracks or splits, verify the "sterilized" tab is in-tact.
Follow established standard operating procedures (SOP) for sample preservatives.
Acid preservation is placed in the sampling containers at the lab before departure or in the field using an acid kit.
Pre-label bottles, if possible, using a water proof pen or marker. Include sample site i.d., date, preservation information, and analysis requested. Time of sampling and collector's name will be added in the field.
Assemble coolers with ice for sample preservation and transportation. The ice chests must be able to keep the samples at 4 °C or less for delivery to the lab.
Gather field meters and pre-calibrate according to approved methods. Document calibration and maintenance activities in permanent calibration logs developed for each meter used.

- Pre-rinse the bucket 3 times using the dry weather flow before collecting water to fill sample containers.
- The turkey baster or pump & tubing should be sanitized between outfalls using a dilute chlorine solution. Rinse with dry weather flow before sampling.

B. Collecting Samples

Travel to an outfall with a dry weather flow. If receiving water and dry weather flow are mixed and backing up into the drainage pipe, sample at the first upstream storm drain manhole where mixing does not occur.
Complete field sampling sheet or make observations before sampling. See Appendix J.
Collect dry weather flow directly into the sample containers or use a bucket or telescoping

sampling pole to collect the water sample. If the flow is too small and/or if the flow does not "fall" into the container or bucket, use a turkey baster, small hand pump or another such device to collect the water.

Preserve samples if still needed.

Immerse filled sample containers in ice for transportation to lab. Deliver samples to lab within required time limit.

Check in samples at lab, complete chain-of-custody papers,

Enter field data into the proper database for later use.

Figure 15. Collecting a sample using telescoping sampling pole.

C. Using the Sample Results

After lab results are obtained:

Label each outfall flow as pathogenic, toxic, nuisance, and/or aquatic life threatening for record keeping purposes. See Appendix K for "Summary of Illicit Connection Investigation."

Determine priorities for conducting detailed investigations of the underground storm drain system upstream of the outfalls experiencing a contaminated dry weather flow.

- pathogenic and/or toxic problems should be addressed first due to human health risks.
- use the pre-determined screening levels for each parameter plus flow data to identify which discharges pose the greatest threat.

• Enter confined spaces with required training and appropriate equipment only.

• Use proper tool for removing and replacing manhole lids.

Use a combination of physical, biological and chemical tracers to conduct each detailed investigation. Multiple tracers will give a more detailed picture of what is occurring underground. Table 1 in Appendix L indicates the most common pollution sources associated with each tracer. Refer to Section III for specific "how to" instructions for each tracer.

Make an enlarged map of the underground "watershed" for each storm water outfall to be investigated.

Assemble equipment used to perform detailed investigations. Refer to the Investigation Check List in Appendix M.

Begin the investigation by comparing current outfall and discharge conditions with previous information. If the same, choose the "best fit" tracer(s) and begin tracking upstream. Move systematically from manhole to manhole or sample each storm water manhole immediately upstream and downstream of where a sanitary sewer line crosses the storm sewer system. If the flow in the manhole is obviously contaminated, skip to the next upstream location to save time.

Make notations on the underground "watershed" map indicating flows and directions or the lack of flow. Other observations are noted on additional Illicit Discharge Connection Field Investigations Sheets (See Appendix C)
Make observations about above ground conditions such as large trees, broken or shifted concrete or asphalt. Tree roots and shifted pipes are common causes of illicit connections.
Compile all information from "Illicit Discharge Connection Field Investigations Sheets" onto a "Tracer Summary Sheet" found in Appendix N. Use this summary sheet to determine the area of concern.
After localizing the area of concern, initiate dye testing or request the sewer line be televised to confirm the exact location of the illicit connection.
Notify the responsible party to make the necessary repairs.
Once a repair is made or a pollution source is eliminated, resample any continuing flow from the outfall to verify there are no additional problems impacting the same storm sewer line.
Repeat investigation efforts if samples are unacceptable.

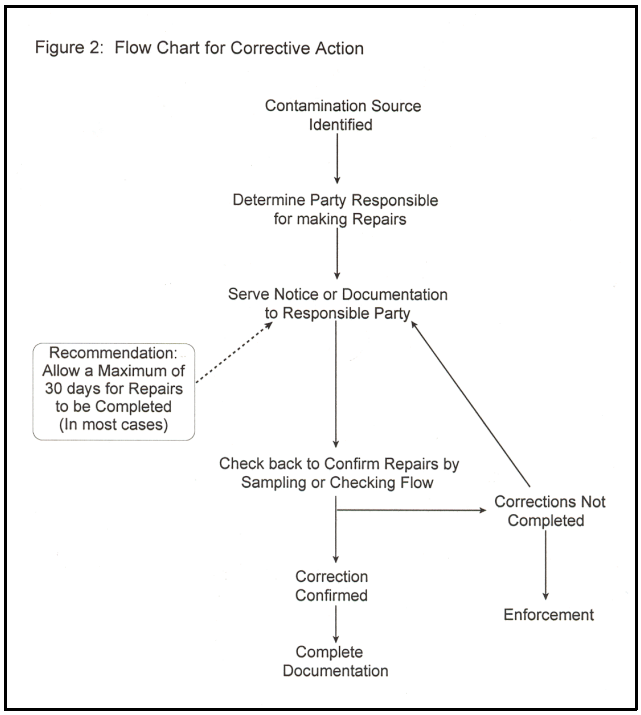
Case Study #12: Using multiple tracers in a detailed investigation.

While investigating one particular outfall, a total of thirteen (13) tracers plus other observations were used. They included six (6) physical tracers (color, odor, turbidity, water temperature, flow, and other observation), one biological tracer (*E.coli*), four (4) chemical tracers (pH, chlorine, ammonia, & phosphates) and three (3) confirmation techniques (dye testing, optical brighteners, and televising). Of the thirteen tracer used, only five (5) were helpful in identifying the area of concern in this situation. Dye testing the houses one-at-a-time identified the problem.

V. Documentation and Reporting

Documenting all steps of an investigation is absolutely essential regardless of whether an investigator reports to a supervisor only, implements enforcement action or writes annual reports for a regulatory authority. Good record keeping will enhance the success and timely corrections of most identified illicit connections. Numerous sheets of paper will be generated during the mapping, surveying and detailed investigation activities. All of this information should be organized, evaluated, and summarized with the idea that legal enforcement action is a possibility.

The process for eliminating identified illicit connections is shown in the flow chart on page 32. After confirming the existence and location of the illicit connection, some type of notice must be issued to the responsible party. The notice may be in the form of a work order to a city/district department or a notice of violation (NOV) delivered to a private citizen. Whatever the case, someone or some entity is responsible for making necessary repairs. The notice must include a time frame in which the repairs need to be made. Next, the investigator should conduct a check



back inspection at the end of the time allowed. Should repairs not be complete and/or the contaminated flow continues, several questions must be answered to determine which strategy to use next. Investigators may find that there is a second illicit connection in the same MS4 or they may choose to issue a second NOV for extenuating circumstances or they may decide that enforcement is the next step towards resolving the problem. If the problem is resolved, all documentation should be completed for reporting purposes.

If enforcement is the option chosen, the investigator has several options. First, city ordinances may be written to mandate repairs and enforcement procedures. Second, cities/districts may have the option of turning the case over to a county agency with enforcement capabilities; or third, the case may be referred to the state environmental agency for enforcement. Every program should create a standard operating procedure (SOP) so all cases are handled consistently and efficiently.

Every illicit connection to the MS4 is an "unauthorized discharge" to the waters of the state and is a violation of the Texas Water Code §26.121. If the discharge is intentional for the purpose of avoiding pretreatment or disposal costs, immediate enforcement with repairs and mitigation may be the appropriate process. Unintentional discharges such as a cracked pipe caused by shifting soils is still an unauthorized discharge but is usually handled quite differently. Regardless, when wastewater from the sanitary sewer escapes into the MS4 it is considered to be a by-pass of the treatment works and it is a reportable incident. The owner/operator of the sanitary sewer collection system has the responsibility of reporting the discharge as such.

An illicit connections investigator will generate at least three types of reports from the data collected. First, if the municipality or utility district is responsible for making repairs, then work orders for the same should be written and given to the appropriate personnel. Second, periodic summary reports need to be sent to immediate supervisors for management purposes. Third, annual reports on eliminating illicit connections must be compiled for the state regulatory agency, the Texas Commission on Environmental Quality (TCEQ) formerly known as the Texas Natural Resource Conservation Commission (TNRCC).

At this time, each entity determines what their reports will look like and what they will include, however, a sample supervisor's report has been developed and provided in Appendix K.

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Glossary

Adenovirus (Human)

A DNA virus that affects the respiratory system (fever, sore throat, runny nose), gastrointestinal tract, or the eye (conjunctivitis). The virus may be latent then become re-activated at a later time. The virus can be passed through contaminated water.

Anaerobic decomposition

Biological metabolism or decomposition in the absence of oxygen.

Conductivity

The measure of a liquid's ability to carry an electrical charge. Expressed in micromhos per centimeter (µmhos/cm) at 25 °C. It is dependent on the presence of ions, the total concentration of the ions, their mobility and valence as well as the temperature of the solution.

Deposits or stains

Any type of coating or discoloration that remains at an outfall as a result of dry weather discharges.

Direct Connection

Physical connections of sanitary, commercial, or industrial piping which carry untreated wastewater to a storm sewer system. A direct connection is usually unauthorized and may be accidental or intentional.

Discharge

The volume of water that passes a given point within a given period of time.

Dissolved Oxygen

The oxygen freely available in water. Dissolved oxygen is vital to a fish and other aquatic life and for the prevention of odors. Traditionally, the level of dissolved oxygen has been accepted as the single most important indicator of a water body's ability to support desirable aquatic life.

Dry Weather Discharge

The flow of a liquid from a storm water outfall during dry weather.

Effluent

Treated wastewater that flows out of a treatment plant or industrial outfall (point source), prior to entering a water body

Eutrophication

The accelerated growth of aquatic plant life in a body of water due to excessive dissolved nutrients. Ultimately it results in lowered or depleted dissolved oxygen levels.

Floatables

Floating materials (plastic containers, condoms, sanitary napkins, tissues, corks, paper containers, wood, leaves, detritus, grease balls, oil films, slimes, scum, etc.) that are either part of the inappropriate waste streams discharged to a storm water system or are collected by flows which enter a storm water drainage system.

Illicit Connection

Any discharge to a MS4 that is not composed entirely of storm water and is not authorized by an NPDES permit. (One exception is fire fighting activities).

Indicator Organism

An organism, species, or community that indicates the presence of a certain environmental condition or conditions.

Infiltration

The process whereby water or waste water enters an underground storm drainage system through such means as defective pipes, pipe joints, connections, manhole walls, etc.

Inflow

The process whereby water enters a sanitary wastewater collection system from surface locations (including but limited to depressed, perforated manhole covers, yard drains, area inlets, or roof leader)

Lateral

A drain or sewer that has no other drains or sewers discharging into it, except for service connections or house laterals.

MS4

Municipal Separate Storm Sewer System. A conveyance or system of conveyances which includes roadway and drainage systems, municipal streets, catch basins, curbs, gutters, ditches, man-made channels, or storm drains. See 40 CFR 122.26(b)(8) Classification: Large MS4 have a population > 250,000, a medium MS4 has a population of 100,000 to 250,000, and a small MS4 is any other system not regulated under Phase I.

NPDES

National Pollutant Discharge Elimination System. A permitting program that regulates polluted storm water runoff from MS4's, construction sites, and industrial activities.

Nuisance and aquatic life threatening pollutant

A constituent which will cause in impairment in surface waters such as low dissolved oxygen levels, excessive algal growth, floatables, color change, odor, and/or turbidity. The origins of this pollutant is from sanitary wastewater, laundry wastewater, construction sites, automobile wash waters, or lawn runoff.

Nutrient

Any substance used by living things to promote growth. The term is generally applied to nitrogen and phosphorus in water and wastewater, but is also applied to other essential and trace elements.

Outfall

The point at which a storm water drainage system discharges from a pipe, ditch, or other conveyance to a receiving water. There is sometimes a concrete structure or retaining wall at this location to protect the end of the discharge pipe and prevent erosion of the receiving water bank.

Pathogenic or toxic pollutant

A constituent that by itself or in combination with others may cause illness through contact, ingestion, and/or inhalation. Sources include sanitary, commercial, or industrial wastewater plus improper disposal of household hazardous materials, fertilizers and pesticides, and other sources of the like.

pH

The measurement of hydrogen-ion activity of water caused by the breakdown of water molecules and presence of dissolved acids and bases. Simply: the measure of a solution's acidity or alkalinity.

Phosphorus

Essential nutrient to the growth of organisms and can be the nutrient that limits the primary productivity of water. In excessive amounts, from wastewater, agricultural drainage and certain industrial wastes, it also contributes to the eutrophication of lakes and other water bodies. The nutrient screening level for total phosphorus is 0.2 mg/l. Anything over this is considered high for a body of water.

Photosynthesis

The process used by green plants to use light energy to convert carbon dioxide and water to simple sugar and oxygen.

Point Source

A single, identifiable location or source from which pollution may be discharged to surface waters (example: a pipe or a ship).

Pollutant

Any material, substance, organism, or condition which can alter the physical, thermal, chemical or biological quality of water and render it harmful, detrimental or injurious to humans, animal life, vegetation or property, or to the public's health, safety or welfare, or impairs the usefulness or public enjoyment of the water for any lawful or reasonable purpose.

Potable Water

Water which has been treated or is naturally safe for drinking. It contains no toxic constituent which would make it harmful for human consumption.

Raw sewage

Untreated wastewater from all sources not permitted to discharge to an MS4.

Receiving Water

A river, stream, lake, estuary, or other body of water, natural or manmade, into which storm water or treated wastewater may be discharged.

Run-off

That part of precipitation or irrigation water which runs off the land into surface waters or waters of the state.

Sanitary sewer

A series of underground pipes which carry sanitary waste or process wastewater to a treatment plant.

Septic odor

Rotten egg smell produced by decomposing organic matter and the lack of oxygen.

Sewage

Sanitary wastewater or wastewater generated by commercial or industrial operations but does not include storm water.

Sewer

A pipe, conduit or drain, generally closed, but not normally flowing full, for carrying sanitary, industrial and commercial wastewater or storm water flows.

Storm drain

A pipe, ditch, or natural or manmade channel that is designed to carry storm water, surface runoff, street wash water, and other drainage from a specific area/source to receiving waters.

Storm Water

Water resulting from precipitation which either infiltrates into the ground, impounds/puddles, and/or runs freely from the surface, or is captured by storm drainage, a combined sewer, and, to a limited degree, by sanitary sewer facilities.

Surface Waters or **Waters of the State**

Groundwater (percolating or otherwise), lakes, bays, ponds, impounding reservoirs, springs, rivers, streams, creeks, estuaries, marshes, inlets, canals, the Gulf of Mexico inside the territorial limits of the state, and all other bodies of surface water, natural or artificial, inland or coastal, fresh or salt, navigable or

non-navigable, and including the beds and banks of all watercourses and bodies of surface water, that are wholly or partially inside or bordering the state or inside the jurisdiction of the state.

Tracer

A distinct component, or combination of components, of a polluting source which is identified in order to confirm the entry of a pollutant to a storm drainage system.

Turbidity

The lack of clarity in the water usually caused by suspended particulate and colloidal matter such as clay, silt, finely divided organic and inorganic matter, and plankton and other microscopic organisms. It is measured by interference to light penetration.

Urbanized Area (UA)

A land area containing one or more central places. The residential population is at least 50,000 with at least 1,000 people per square mile.

Watershed

A confluence of streams or rivers that drain a geographical area to a specified point.

Illicit Discharge/Connection Field Investigation Sheet

Field Site Description

Outfall ID: Tributary/Drainage Ditch:

Location:

Land Use: Residential Commercial Industrial Agricultural

Discharge Observations

Flow: Yes/No (If yes, estimate flow)_____ GPM Tide:_____

Time:_____ Days Prior Rain:_____

Odor: None Musty Sewage Sulfide (Rotten Eggs) Other _____

Color: Clear Green Brown White Blue Grey Other _____

Turbidity: Clear (Lt) Cloudy (Mod) Opaque (Hvy) Suspended Solids Other _____

Vegetative Growth: None Inhibited Growth Algae Sewage fungus Excessive Growth Other _____

Deposits/Stains: None Sediment Garbage Oily Color_____ Other_____

Floatables: Paint Sanitary Waste Surface scum Debris Other _____

Structural Materials: Concrete Metal Plastic Other_____

Structural Conditions: Undamaged Caved-in Corroded Cracked Other _____

Biological Activity: Fish (list)_____ Turtles (list)_____ Others _____
Waterfowl/Wading birds (list)_____

Picture Taken: Yes/No Film/ Digital

Field Analysis (Parameters Optional)

Air Temp:_____(^{o}C) Water Temp:_____(^{o}C) Dissolved Oxygen(DO):_____(mg/l)

pH: _____ Ammonia:_____ (mg/l) Chlorine:_____(mg/l)

Phosphate(PO_4):_____(mg/l) Detergents (O.B's): _____ Other:_____

Lab Analysis (Parameters Optional)

Bacterial counts:_____ Other:

Comments:

Inspector Data

Investigator: Signature: Date:

Charcoal Packet Processing

Equipment List

Charcoal: Activated, Coconut, 8-12 Mesh,
(Use 5 grams per packet)

Packets: Fiberglass mesh (18 x 14)
Cut into 3.25" x 5.5" pieces, fold in half, fill with charcoal and heat seal or staple closed

KOH Solution: 5% potassium hydroxide dissolved in 70% isopropyl alcohol
Elute each charcoal packet in 20 ml of solution

Liquid Tracing Dye: Fluorescein

Latex gloves

30 ml glass vials with screw caps

6 ounce whirl pack plastic bags (write on and puncture proof)

Black light

Packet Placement

- Background charcoal packets need to be placed one week prior to dye testing
- Packets are placed at areas where dye is suspected to surface and should be in a shaded or dark location
- Background packets are retrieved and replaced with new test packets, dye is then introduced into the system. Background packets can be analyzed or frozen for later laboratory analysis

Packet Retrieval

- Test packets are retrieved after one week and replaced with a second set of test packets
- Use new latex gloves at each site to prevent cross contamination
- Place each test packet in a separate whirl pak bag
- Label bag with the name of property or resident, retrieval date, and address or exact location

Charcoal packet processing and elution

- Cut corner of test packet and empty charcoal into 30 ml glass vial. Add 20 ml KOH solution to vial

- Label vial with name of property or resident, date, and location with indelible ink

- Visually read the vial for the presence/absence of fluorescent dye within 24 hours of the elution. Take a second reading within 48 hours. This should be done for each packet, therefore there will be two (2) readings for each packet. The first and second reading should be done by different staff persons.

- If the results are difficult to determine, shine a strong beam of light through the sample, in a dark room, to look for fluorescence. Record the results as positive, flashlight positive, or negative.

Quality Control

- When the KOH solution is prepared, use the following control procedure:
  1- Fill a 250 ml beaker with 150 ml of cold tap water. Submerge a charcoal packet in the beaker for 15 minutes
  2- Fill a second 250 ml beaker with 150 ml cold tap water and a drop of fluorescent dye. Submerge a charcoal packet in this beaker for 15 minutes
  3- Follow the elution instructions for both packets
  4- Record the results. The packet in the tap water should produce a negative result and the packet in the dye water should produce a positive result. If any other results are observed the quality of the KOH solution, charcoal, dye, etc. should be checked.

- Field duplicates should be completed on 10% of the samples. This means that two (2) packets should be placed together and the results compared for consistency. Place test packets side by side, not one in front of the other.

- All supplies that come into contact with the packets or elutant should be analyzed for tracer dyes prior to packet placement, ie. Placement anchors, glass vials, tape, markers, labels, etc.

- Charcoal packets should be constructed and stored in a way so they are not contaminated

Optical Brightener Kit Checklist

For field:

- Small, dark (non-transparent) rubbermaid container (to hold contents below)
- Untreated cotton pads
- ½ in. Wire mesh cages
- Monofilament fishing line (high test)
- Tent stakes
- Wire cutters
- Cable ties
- Zipper seal sandwich bags
- Hand sanitizer/ rubber gloves
- Unexposed, non-fluorescent labels

For interpreting results in office:

- Long wave U.V 4-6 watt fluorescent lamp

For cleaning:

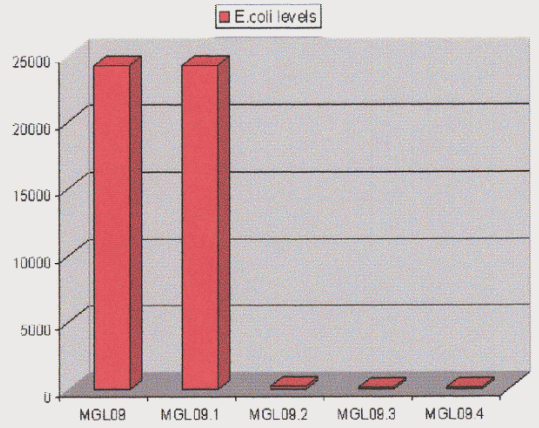
- Bucket
- Clorox
- Cleaning brush

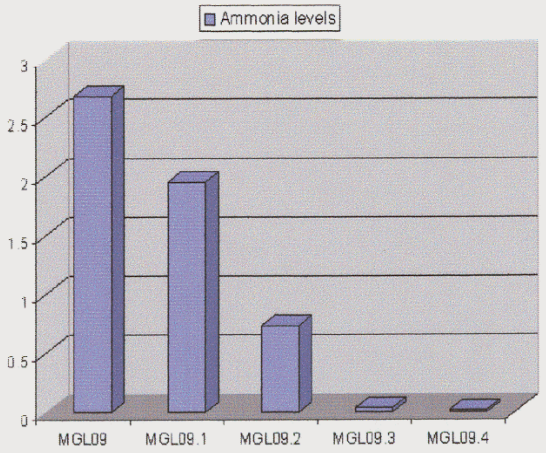
Optical Brightener Data Sheet Subwatershed Area: Collected by:

Site ID	DOP	DOR	No. days	Flow (GPM)	O.B. +/-	Total Rain	Observations

Optical Brightener Observation Form

DATE	SITE ID#	Observer %	Observer Initials	QAQC %	QAQC Initials





Magnolia Creek
Station MGL 09

Sampling Equipment Checklist

Field Maps

Field data sheets

Waterproof marker

Handheld GPS (if available)

Sampling Bottles

Ice chest / Ice

Meters: YSI (DO), pH

Thermometer

Deionized water for cleansing meters after calibration

Bucket with rope

Telescoping sampling stick with attached sampling bottle

Rubber gloves and/or hand sanitizer

High beam cordless spotlight

Rubber boots / Waders

Manhole hooks

Traffic cones / Safety Vests

Spray paint

Cell phone / Two-way radios

Camera/film or Digital

Sunglasses, sunscreen, and bugspray

Other_____

Other_____

Other_____

Run: **Collector:** **Rain:** **Wind Dir:**

Date: **Sunrise:** **Days Prior (72053):** **Wind Spd:**

Station												
Time												
Color (0080)												
Turbidity (82078)												
Sample Depth												
Flow (00061)												
Flow Severity(01351)												
Salinity (00480)												
Conductivity (00094)												
DO (00300)												
pH (00400)												
Air Temp. (00020)												
Water Temp.(00010)												
Observations												

Data Entry Signature: _____ QA/QC Signature: _____

Summary of Illicit Connection Investigation

Location of Illicit Connection (Address):

Contamination Effect: Pathogenic Toxic Nuisance
(Circle all that apply)

Type of Connection: Direct Infiltration Inflow Other_____
Comments:

Flow: Continuous Intermittent GPM's _____
Comments:

Source of Flow: Sewage Potable Water Swimming Pool Other_____
Comments:

Land Use: Residential Commercial Industrial Agricultural
(Circle all that apply)

What tests were used:

What supplies are needed to fix the problem:

What are the estimated costs of remediation:

Responsibility: City/County/MUD Resident(Customer)
Comments:

Name of Responsible Party:

if Resident Responsibility: Address: Phone #:

Who Discovered Flow: Citizen Complaint Inspector City Crew Other_____
Comments:

Investigator: Date: Total Manhours:

Table 1. Field Survey Parameters and Associated Non-Stormwater Flow Source Categories

Parameter	Natural Water	Potable Water	Sanitary Wastewater	Septic Tank Effluent	Industrial Water	Wash Water	Rinse Water	Irrigation Water
Odor	-	-	+	+	+	+/-	-	-
Color	-	-	-	-	+	-	-	-
Turbidity	-	-	+	+	+	+	+/-	-
Vegetation	-	-	+	+	+	+/-	-	+
Deposit/Stains	-	-	+	-	+	+/-	+/-	-
Floatables	-	-	+	-	+	+/-	+/-	-
Structural Damage	-	-	-	-	+	-	-	-
Temperature Change	-	-	+/-	-	+	+/-	+/-	-
pH	-	-	-	-	+	-	-	-
Ammonia	-	-	+	+	-	-	-	-
Surfactants	-	-	+	-	-	+	-	-
Fluorescence	-	-	+	+	-	+	-	-
Conductivity	-	-	+	+	+	+/-	+	+

+ High Concentration Association
- Low Concentration Association
+/- Variable Concentration Association

*Turner, Collie, and Braden Inc.

Investigation Checklist

Field Maps
Field data sheets
Telescoping sampling stick with attached sampling bottle
Meters
- Ph meter
- DO / Specific Conductivity
Parameter Kits
- Chlorine
- Ammonia
- Phosphate
- Optical Brightener
Fluorescent Tracing Dye
Thermometer
Dye
Manhole hooks
Rubber gloves and/or hand sanitizer
High beam spotlight
Rubber boots
Traffic cones
Cell phone / Two-way radios
Sunglasses, sunscreen, and/or bugspray
Camera/film or Digital
Other_____
Other_____

Illicit Connections Detection and Elimination Tracer Summary Datasheet

	SITE:					
	TIME:					
	DATE:					
Flow (GPM)	*Value*					
Turbidity	*Value*					
Odor	*Pos/Neg*					
Color	*Pos/Neg*					
Air Temp	Value					
Water Temp	*Value*					
pH level	*Value*					
Ammonia	*Value*					
Chlorine	*Pos/Neg*					
PO4	*Pos/Neg*					
Ecoli	*Value*					
OB's	*Pos/Neg*					
Dye Test	*Pos/Neg*					
	Observation					