Appendix F
IDDE Field Screening Procedures

FIELD INVESTIGATIONS FOR ILLICIT DISCHARGES

1.0 Background

South Carolina Department of Health and Environmental Control (SCDHEC) issued a general permit for small MS4s on November 1, 2013. This general permit became effective on January 1, 2014. As a requirement of the permit number SCR030000, Anderson County must develop a set of standard procedures to investigate, identify, and effectively terminate the source of all illicit connections or discharges. An illicit discharge has been defined by the EPA as "any discharge into a separate storm sewer system that is not composed entirely of stormwater". Typically, illicit discharges enter a storm sewer system either through direct connections, (e.g., sanitary sewer piping), or indirectly from cracked sanitary sewer conveyance systems, spills collected by storm drains, or from contaminants dumped directly into a sewer inlet. Pollutants from these sources can include heavy metals, toxics, oils and grease, solvents, nutrients, viruses, and harmful bacteria. Substantial levels of these contaminants can damage fish and wildlife habitats, decrease aesthetic value, and more importantly, threaten public health, and prevent or eliminate recreational benefits.

The field procedures for detecting and tracking illicit discharges include observations at storm water outfalls for signs of possible contamination from illicit connections, observing the physical characteristics of storm water outfalls, performing elementary chemical analysis, collecting samples for comprehensive laboratory analyses, and documenting relevant information. The procedures outlined in the following paragraphs will be used by the County's Public Works Division to detect and eliminate future illicit discharges. Contact information for the Stormwater Management Department of the Public Works Division can be found on their website: http://www.andersoncountysc.org/web/Storm_Water_00.asp

The Illicit Discharge Program has two primary components: the dry weather screening program and the illicit detection program. The dry weather screening program is the initial screening process to locate outfalls with potential illicit discharges. The illicit detection program represents an additional set of investigative and enforcement procedures to be taken when an outfall screened under the dry weather screening program is confirmed to have an illicit discharge.

2.0 Program to Eliminate Illicit Connections and Improper Disposal

The illicit connections program is composed of a set of investigative procedures to be conducted once a potential illicit connection is identified under the dry weather screening program. Below is an overview of the illicit discharge investigation procedures.

1. Complete the Potential Illicit Discharge Field Sheet when presented with a possible illicit. The Field Sheet and its instructions are included in Appendix A.
2. Check the identified potential illicit for dry weather flow. It is best to conduct this investigation on or near the day of the week and time of day of the initial field screening. If there is no flow, note as such and return to the site during the next dry weather period, but no less than 72 hours later. After three "no flow" conditions, and lacking additional evidence of an illicit discharge the outfall may be removed from the potential illicit discharge list.
3. Upon finding dry weather discharge or other evidence of an illicit discharge (i.e. odor, discoloration of surrounding area, etc.) perform a visual inspection looking for scum, solids, or oil sheen. Also check for odor, flow depth, and flow quantity.
4. Perform field testing for water temperature and pH and obtain a sufficient sample to test for the remaining parameters; total chlorine, detergents/surfactants, phenols, and copper.
5. Record the data in the illicit discharge database.
6. Check the watershed land use information and the facility listing to determine a list of potential discharge points to the system.
7. Track all confirmed illicit discharges to their sources.

A more detailed description of the procedures is described in the next section (3.0 Illicit Investigative Procedures) of this report.

3.0 Illicit Investigative Procedures

The following methodology was derived from a 1993 EPA publication entitled *Investigation of Inappropriate Pollutant Entries into Storm Drain Systems - A User's Guide.* Chart 1 is an outline of the major topics that will be presented in the following sections.

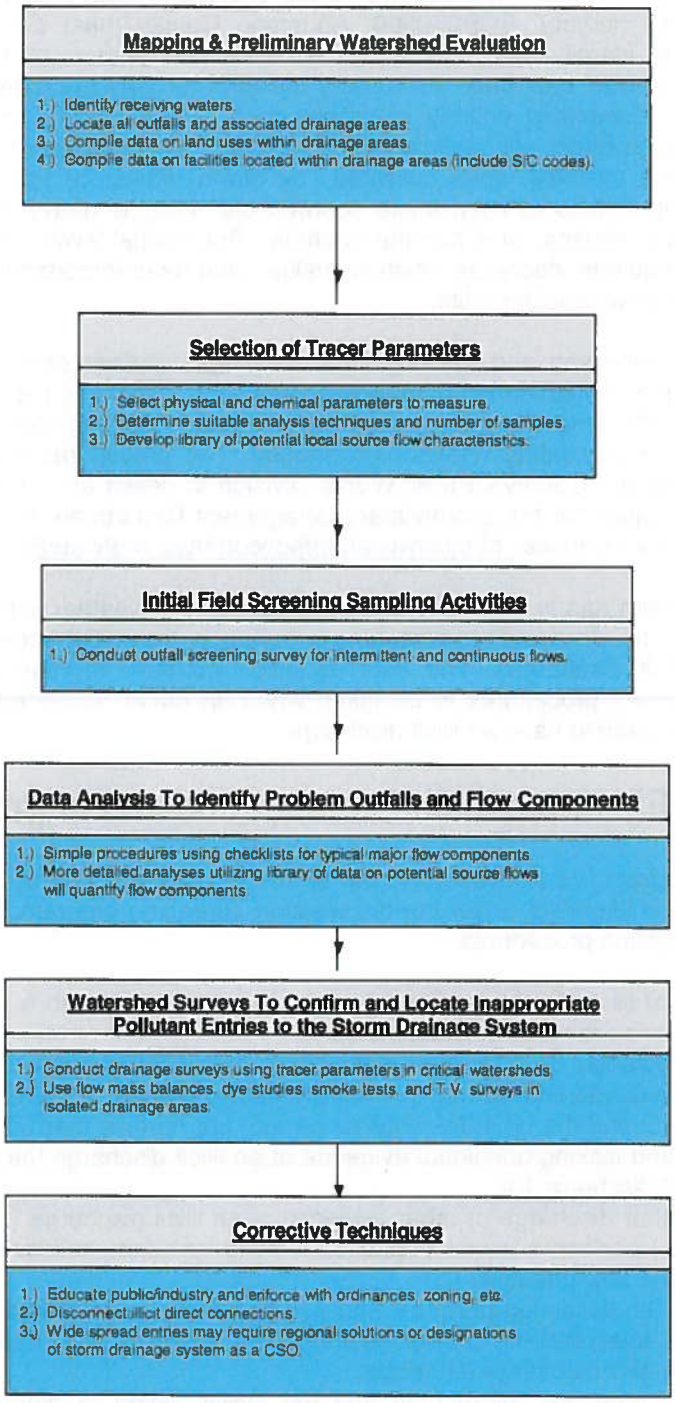

Chart 1. Outline of Major Topics

Chart 2, *Flowchart for Investigative Procedure's* separates the storm drainage outfalls into three general categories to determine which outfalls and drainage areas require further analyses and investigation.

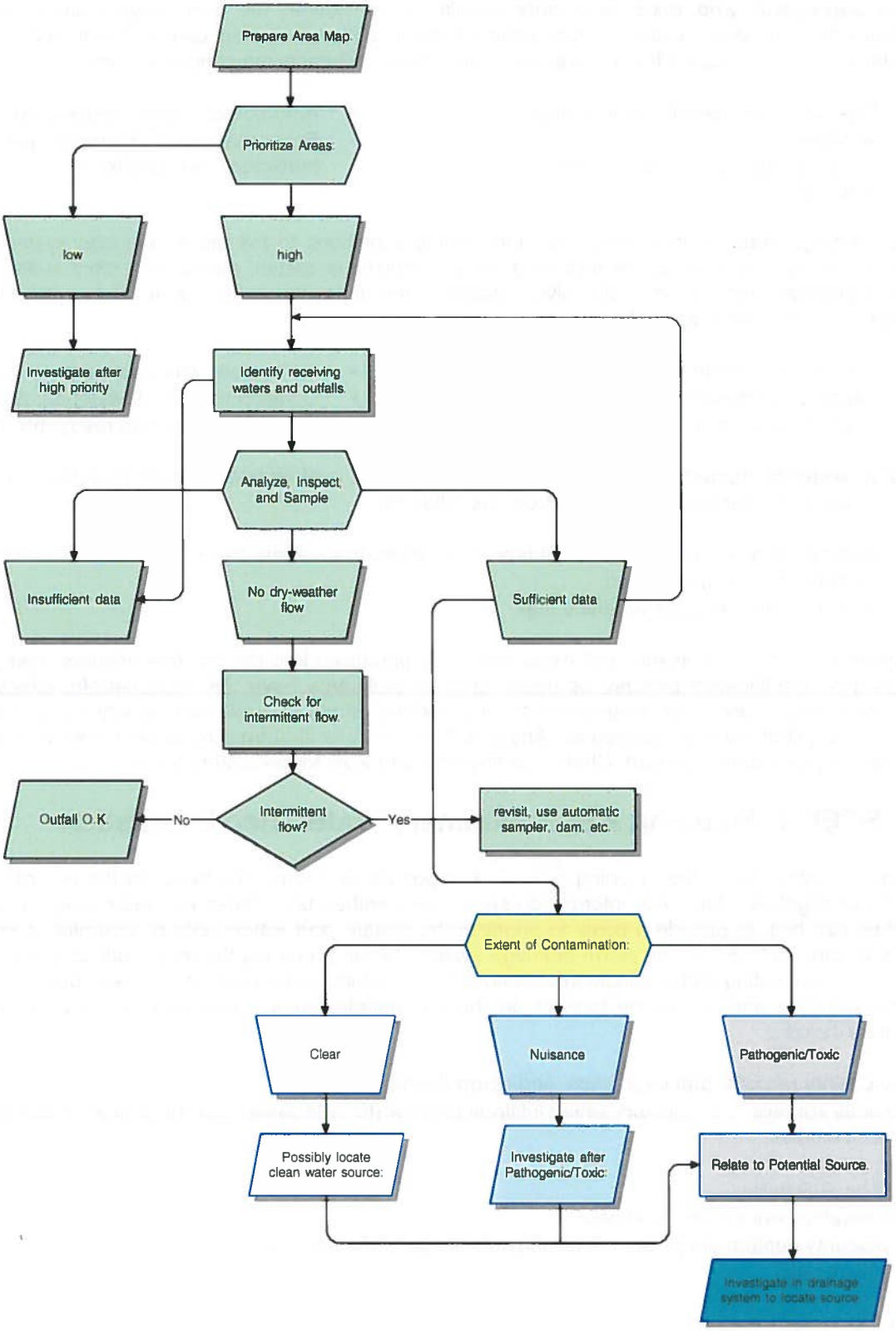

Chart 2. Flowchart for Investigative Procedures

The three general categories are as follows:

Storm Water Pollutant Categories

1. The ***pathogenic and toxic pollutants*** should be considered the most severe since contact or consumption of storm water contaminated by these pollutants could cause illness and significant water treatment problems for downstream users. These pollutants may originate from:

    - Sanitary, commercial, and industrial wastewater;
    - Inappropriate household toxicant disposal;
    - Automobile engine de-greasing; and
    - Excessive use of chemicals (pesticides, herbicides, and fertilizers).

2. ***Nuisance pollutants*** offer aquatic life threatening conditions to the storm drainage system. These pollutants can cause excessive dissolved oxygen depletions, tastes, odors, and colors in downstream water supplies, algal blooms, offensive floatables, and noticeably turbid water. These pollutants may originate in residential areas from:

    - Sanitary wastewaters;
    - Laundry wastewaters;
    - Lawn irrigation runoff;
    - Automobile wash waters;
    - Construction site dewatering; and
    - Washing of concrete ready-mix trucks.

3. ***Clean water*** discharged through a storm drainage system is often found during an outfall inventory. Clean water discharges can originate from the following:

    - Natural springs in urban areas that have been piped to a nearby creek or stream;
    - Infiltrating groundwater; and
    - Infiltration from potable waterline leak.

Pathogenic or toxic, and nuisance pollutants should be prioritized in a manner that ensures prompt action in the source identification process as these types of pollutants have the most harmful effects to the environment. Any future outfall inventories or illicit tracking efforts by Anderson County should make use of the following illicit tracking procedures. Any outfall inventory or illicit tracking project already in progress can enter the procedural flowchart, Chart 1, at any time and work towards completion.

3.1 STEP 1: Mapping and Preliminary Watershed Evaluation

The data collected during the mapping process is important as it forms the basis for the rest of the more detailed investigation. Maps with information such as watershed boundaries and land usage inside each watershed can help to provide a basis to prioritize the outfalls and watersheds by potential to contribute non-storm water entries into the storm drainage system. When preparing the maps, full advantage should be taken of any existing and available information. The receiving waters and storm water drainage outfalls must be identified and accurately located on the appropriate maps. Possible sources of documented information include:

- City/County records, drainage maps, and storm drainage maps;
- Previous surveys, e.g., sanitary sewer infiltration/inflow (I/I) and sewer system evaluation survey (SSES) studies;
- Topographic maps;
- Existing GIS data;
- Pre-development stream locations;
- City/County department personnel having knowledge of the area; and
- Aerial surveys.

Outfall Catchment Areas

The drainage area for each outfall must be delineated on all maps used in the illicit tracking process. Adding the facility inventory information to the drainage areas will enable potential pollutant source locations to be assigned to the correct outfall. Land use coverages can also be of use when determining

which kind of pollutants can populate individual watershed areas. Ultimately, maps should be produced having the following information:

- Drainage areas with complete descriptions;
- Outfall locations;
- NPDES permittees;
- Critical land uses;
- Drainage boundaries for each outfall;
- City/County limits;
- Major streets; and
- Streams.

Table 1 can be used to identify the local industries in each drainage area most likely to contribute non-stormwater entries into the storm drainage system. The categories considered in this table include loading and unloading of dry bulk or liquid materials, outdoor storage or processing, water usage (cooling and process waters), dust or particulate generating processes, and illicit or inadvertent industrial connections. The likelihood of an industry producing dry weather or wet weather discharges in each of these categories was rated on the basis of high (H), moderate (M), or low (L) potential and not applicable (N/A) if there was no relationship evident.

Table 1. Sources of Industrial Non-Stormwater Entries Into Storm Drainage System

Industrial Categories			Loading/Unloading		Outdoor Storage/ Processing	Water Usage		Particle Generation Process	Illicit/ Inadvertent Connections
Major Class.	SIC Group	Industrial Description	Dry Bulk	Liquid		Cooling	Process		
Primary Industries									
20		Food & Kindred Products							
20	201	Meat Products	H	L	H	H	H	L	H
20	202	Dairy Products	H	H	N/A	H	H	N/A	H
20	203	Canned, Frozen, and Preserved Fruits, Vegetables, and Food Specialties	H	H	H	H	H	M	H
20	204	Grain Mill Products	H	H	L	H	H	H	H
20	205	Bakery Products	H	M	N/A	N/A	H	M	L
20	206	Sugar & Confectionery Products	H	M	N/A	L	M	H	L
20	207	Fats & Oils	H	H	N/A	M	H	N/A	M
20	208	Beverages	H	H	N/A	H	H	M	L
21		Tobacco Products	H	M	N/A	N/A	M	H	M
22		Textile Mill Products	H	L	N/A	H	H	M	H
23		Apparel & Other Finished Products Made From Fabrics & Similar Materials	H	L	N/A	N/A	M	M	L
Material Manufacture									
24		Lumber & Wood Products, Except Furniture	H	L	H	N/A	M	H	L
25		Furniture & Fixtures	H	M	N/A	N/A	L	M	L
26		Paper & Allied Products	H	H	H	H	H	H	H
27		Printing, Publishing, & Allied Industries	H	M	N/A	N/A	M	H	L
31		Leather & Leather Products	H	H	L	L	H	H	H
32		Stone, Clay, Glass, & Concrete Products	H	M	H	L	H	H	L
33		Primary Metal Industries	H	M	H	H	H	H	H
34		Fabricated Metal Products, Except Machinery & Transportation Equipment	H	H	L	H	H	H	H
37		Transportation Equipment	L	H	L	H	H	L	H
Chemical Manufacture									
28		Chemicals & Allied Products							
	281	Industrial Inorganic Chemicals	H	H	N/A	H	H	H	H
	282	Plastics Materials & Synthetic Resins, Synthetic	H	H	L	H	M	L	H
	283	Drugs	L	L	N/A	H	M	L	L
	284	Soaps, Detergents, & Cleaning Preparations; Perfumes, Cosmetics, and Other Toilet Preparations	H	H	N/A	H	H	H	H
	285	Paints, Varnishes, Lacquers, Enamels & Allied Products	H	H	N/A	L	H	H	L
	286	Industrial Organic Chemicals	H	H	N/A	H	H	H	M
	287	Agricultural Chemicals	L	L	N/A	H	L	L	L
29		Petroleum Refining & Related Industries							

Industrial Categories			Loading/Unloading		Outdoor Storage/ Processing	Water Usage		Particle Generation Process	Illicit/ Inadvertent Connections
Major Class.	SIC Group	Industrial Description	Dry Bulk	Liquid		Cooling	Process		
	291	Petroleum Refining	L	H	H	H	L	N/A	H
	295	Asphalt Paving & Roofing Materials	H	H	H	N/A	M	M	L
30		Rubber & Misc. Plastic Products	H	H	N/A	H	H	H	M
Transportation & Construction									
15		Building Construction General Contractors & Operative Builders	M	L	H	N/A	L	H	L
16		Heavy Construction Other Than Building Construction Contractors	M	L	H	N/A	L	H	L
Retail									
52		Building Materials, Hardware Garden Supply, & Mobile Home Dealers	H	L	H	N/A	L	N/A	L
53		General Merchandise Stores	H	M	L	N/A	L	N/A	L
54		Food Stores	H	H	N/A	N/A	M	L	L
55		Automotive Dealers & Gasoline Service Stations	H	H	H	N/A	M	L	M
56		Apparel & Accessory Stores	H	L	N/A	N/A	L	N/A	L
57		Home Furniture, Furnishings, and Equipment Stores	H	L	L	N/A	L	N/A	L
58		Eating & Drinking Places	H	M	N/A	N/A	M	N/A	M
Other									
		Coal Steam Electric Power	H	L	H	H	L	H	L
		Nuclear Steam Electric Power	N/A	L	N/A	H	L	N/A	N/A

The industrial categories listed in Table 1 were defined according to the 1987 Standard Industrial Classification Manual codes (SIC code). The industries were classified according to six main categories. The category for "Primary Industries" includes facilities involved in the production of food products and other basic goods. The category of "Material Manufacturing" includes those industries producing materials such as lumber, paper, glass, and leather. Similarly, the "Chemical Manufacturing" category includes those industries making products such as plastics, paints, detergents, fertilizers, pesticides, and other related substances. "Transportation and Construction" primarily concerns the discharge of contaminants from building or other types of outdoor development. The "Retail" category includes establishments engaged in the selling of merchandise or offering merchandise related services. Finally, all other industries, which did not fit into any of the above classifications, were placed into an "Other" category. Those industries, which are not specifically listed, should have characteristics resembling the industries of the major groups with which they are classified by SIC code.

The mapping information presented in this section, together with the information to be obtained as described in Section 3.2 (Selection of Tracer Parameters), Section 3.3 (Initial Field Screening Sampling Activities), and Section 3.4 (Data Analysis to Identify Problem Outfalls and Flow Components), will be used to rank the outfalls in order of priority for further investigations.

3.2 STEP 2: Selection of Tracer Parameters

Chemical Parameters

Regulation 61-9 122.26(d) (1) requires that only major outfalls with observed dry weather flow be sampled. It has been determined that the following chemical parameters are sufficient in helping to detect the major pollutants found in the storm water runoff from the major land use categories, and thus enabling the identification of the sources of the polluted storm water.

- pH;
- Phenols;
- Total chlorine;
- Copper; and
- Surfactants.

pH
The normal pH of ground water typically ranges from 6 to 9. Values outside of this range may be an indicator of an illicit discharge. pH alone is not a sufficient indicator of an illicit discharge and should only be considered in relation to other parameters that are out of range for a particular sample. Water with values less than 6 are acidic and may indicate discharges from textile mills, pharmaceutical manufacturers, metal fabricators and companies that produce resins, fertilizers, or pesticides. Wastes containing sulfuric, hydrochloric, or nitric acids are a common source of contamination. Water with values greater than 9 may indicate discharges from industries such as the following; textile mills, metal plating facilities, steel mills, ready mix concrete plants, and producers of rubber and plastic. Wash water used to clean floors and industrial machinery may also produce alkaline wastewater.

Copper
Elevated levels of copper may indicate discharges from cooling, boiler, or industrial re-circulation systems. Copper sulfate is typically used as an algaecide in all of these systems. Copper can also be an indicator of discharges from an automobile manufacturing or maintenance facility. The normal/allowable sampling range for copper is 0.0 – 0.5 mg/L.

Phenols
Elevated levels of phenols may indicate industrial wastewater discharges. Caution should be exercised, however, since phenols may also be present in other waste streams. Phenols should be considered in relation to other parameters in determining the potential source. The normal/allowable sampling range for phenols is 0.0 – 0.399 mg/L.

Surfactants/Detergents
Typically, the presence of surfactants and detergents will indicate a connection to either an automobile wash facility or a laundry facility. High surfactants/detergents and elevated temperatures are a good indicator of laundry facilities. Lower levels of surfactants/detergents may indicate a connection to a residential laundry or industrial facility. A normal range of 0.0 – 0.06 mg/L should be used for sampling. Regardless of the results, however, there should be no visible foam at the discharge.

Chlorine
The absence of chlorine may indicate a natural water source. However, due to chlorine's ability to quickly dissipate with exposure to UV, caution should be used when making judgments based on its absence. Generally, only potable water sources will contain chlorine. Therefore, the presence of chlorine insures that the source is not a natural water source. Very high levels (above 5.0mg/l) of chlorine typically indicate connection to a swimming pool or other potable water source. A normal range is 0.0 – 0.5 mg/L.

Table 2 on the following page is a list of additional chemicals that may be associated with a variety of different industrial activities. If the industrial activities in an outfall watershed are known, it may be possible to examine the dry-weather (non-storm water) outfall flow for specific chemicals to identify which industrial activities may be responsible for the dry-weather flow.

Table 2. Listing of Industrial Related Chemicals

Chemical	Industry
Acetic Acid	Acetate rayon, pickle and beetroot manufacture
Alkaline	Cotton and straw kiering, cotton manufacture, mercerizing, wool scouring, and laundries
Ammonia	Gas, coke, and chemical manufacture
Arsenic	Sheep-dipping and felt mongering
Chlorine	Laundries, paper mills, and textile bleaching
Chromium	Plating, chrome tanning, and aluminum anodizing
Cadmium	Plating
Citric Acid	Soft drinks and citrus fruits
Copper	Plating, pickling, and rayon
Cyanides	Plating, metal cleaning, case-hardening, and gas manufacturer
Fats, oils	Wool scouring, laundries, textiles, and oil refineries
Fluorides	Gas, coke, and chemical manufacturer, fertilizer plants, transistor manufacturer, metal refining, ceramic plants, and glass etching
Formalin	Manufacture or synthetic resins and penicillin
Hydrocarbons	Petrochemicals and rubber factories
Hydrogen Peroxide	Textile bleaching, and rocket motor testing
Lead	Battery manufacture, lead mining, paint manufacture, and gasoline manufacture
Mercaptans	Oil refining, and pulp mills
Mineral Acids	Chemical manufacture, mines, Fe and Cu pickling, brewing, textiles, photo-engraving, and battery manufacture
Nickel	Plating
Nitro Compounds	Explosives and chemical works
Organic Acids	Distilleries and fermentation plants
Phenols	Gas and coke manufacture, synthetic resin manufacture, textiles, tanneries, tar, chemical, and dye manufacture and sheep-dipping
Silver	Plating, and photography
Starch	Food, textile, and wallpaper manufacture
Sugars	Dairies, foods, sugar refining, and preserves
Sulfides	Textile, tanneries, gas manufacture, and rayon manufacture
Sulfites	Wood process, viscose manufacture, and bleaching
Tannic Acid	Tanning, and sawmills
Tartaric Acid	Dyeing, wine, leather, and chemical manufacture
Zinc	Galvanizing, plating, viscose manufacture, and rubber process

Source: Van der Leeden, et al., 1990

Furthermore, the detection of a variety of other parameters during the physical inspection can be useful indicators of outfall problems. The following is a description of these *physical parameters*:

Odor
The odor of storm water discharges will vary widely. Odor can be a good indicator of the type of pollutant in the water. For instance, storm water discharges may smell like sewage, oil, gasoline, or may contain a chemical smell. Decomposition of organic materials can also cause a distinctive sulfur odor. Odors may vary greatly with changes in temperature and time of year.

Color
Color can also be an important factor in determining the source of an illicit discharge. The particular color should be noted and tracked upstream as far as possible. Sewage will typically have a gray or brown color, whereas industrial wastes may have a variety of colors.

Turbidity
Turbidity is a measure of the amount of suspended matter in the water and affects the clarity of the discharge. Discharges from industrial facilities are often highly turbid. Although erosion can also create highly turbid water, this should not be the case during dry weather flows. Each inspection should note the relative degree of turbidity.

Floatables
Floatables are solids and liquids that float on the surface of the water. Floatables may include substances such as animal fats, food products, trash, oils, plant materials, solvents, foams, or gasoline. Floatables can often lead directly to the manufacturing process or other source of the illicit discharge. A full description of the type and quantity of the floatables and a photograph of the discharge should be included in the report.

Residue
Residue left on the conveyance system can be an indicator of an illicit discharge. Discoloration of the pipe or channel should be tracked upstream. It is also important to note the location of the discoloration or stain within the conveyance system. For example, is it just a line of residue half way up the pipe or is the pipe completely stained for some depth?

Vegetation
Vegetation growing in the immediate discharge area should be noted in relation to vegetation growing in the general vicinity of the outlet. Certain discharges can cause substantial changes in plant growth. Discharges containing a high nutrient content may cause increased growth while discharges with severe changes in pH may cause a decrease in growth. Although vegetation patterns may serve as an indicator of non-storm water discharges, they are also difficult to interpret. Time of year, rainfall patterns, exposure to sun all affect plant growth and may be contributing factors to the changes in vegetation patterns. Caution should be used when considering vegetation as an indicator of an illicit discharge.

Structural Damage
Like residue, structural damage to the conveyance system can also be an indicator of an illicit discharge. Structural damage is typically more noticeable in concrete pipes. Acidic discharges may cause cracking, spalling, or deterioration of the concrete. The location of the damage within the pipe and the distance upstream will be important in determining the type of pollutant and the source of the discharge.

Temperature
Water temperature that varies greatly from the ambient air temperature or receiving surface water is a good indicator that there may be an illicit discharge to the system.

Table 3 describes the physical observation choices that are offered on the Potential Illicit Discharge Field Sheet.

Table 3. Interpretations of Physical Observation Parameters and Likely Associated Flow Sources

Physical Observation Parameter	Description
Odor – Most strong odors, especially gasoline, oils, and solvents, are likely associated with high responses to the toxicity screening test. Typical obvious odors include: gasoline, oil, sanitary wastewater, industrial chemicals, decomposing organic wastes, etc.	
Sewage:	Smell associated with stale sanitary wastewater, especially in pools near outfall.
Sulfide (rotten eggs):	Industries (e.g. meat packers, canneries, dairies, etc.; and stale sanitary wastewater.
Petroleum/Gas:	Petroleum refineries or facilities associated with vehicle maintenance and operation or petroleum product storage.
Chlorine:	Laundries, paper mills, textile bleaching, swimming pool, or other potable water source
Rancid-sour:	Food preparation facilities (e.g. restaurants, hotels, etc.)
Color – Important indicator of inappropriate industrial sources. Industrial dry-weather discharges may be of various colors, but dark colors, such as brown, gray, or black, are most common.	
Yellow:	Chemical, textile, and tanning plants
Brown:	Meat packers, printing plants, metal works, stone and concrete works, fertilizer application, and petroleum refining facilities
Green:	Chemical plants and textile facilities
Red:	Meat packers
Gray:	Dairies
Orange:	Iron staining due to construction or other land altering activities
Turbidity – Often affected by the degree of gross contamination. Dry-weather industrial flows with moderate turbidity can be cloudy, while highly turbid flows can be opaque. High turbidity is often a characteristic of undiluted dry-weather industrial discharges.	
Cloudy:	Sanitary wastewater, concrete or stone operations, fertilizer facilities, and automotive dealers
Opaque:	Food processors, lumber mills, metal operations, and pigment plants
Floatable Matter – A contaminated flow may contain floating solids or liquids directly related to industrial or sanitary wastewater pollution. Floatables of industrial origin may include animal fats, spoiled food, oils, solvents, sawdust, foams, packing materials, or fuel.	
Oil Sheen:	Petroleum refineries or storage facilities and vehicle service facilities
Sewage:	Sanitary wastewater
Deposits and Stains – Refer to any type of coating near the outfall and are usually of a dark color. Deposits and stains often will contain fragments of floatable substances. These situations are illustrated by the grayish-black deposits that contain fragments of animal flesh and hair which often are produced by leather tanneries, or the white crystalline powder which commonly coats outfalls due to nitrogenous fertilizer wastes.	
Sediment:	Construction site erosion
Oily:	Petroleum refineries or storage facilities and vehicle service facilities
Vegetation – Vegetation surrounding an outfall may show the effects of industrial pollutants. Decaying organic materials coming from various food product wastes would cause an increase in plant life, while the discharge of chemical dyes and inorganic pigments from textile mills could noticeably decrease vegetation. It is important not to confuse the adverse scouring effects of high storm water flows on vegetation with highly toxic dry-weather intermittent flows.	
Excessive growth:	Food product facilities
Inhibited growth:	High storm water flows, beverage facilities, printing plants, metal product facilities, drug manufacturing, petroleum facilities, vehicle service facilities and automobile dealers

Physical Observation Parameter	Description
Damage to Outfall Structures – Another readily visible indication of industrial contamination. Cracking, deterioration, and spalling of concrete or peeling of surface paint, occurring at an outfall are usually caused by severely contaminated discharges, usually of industrial origin. These contaminants are usually very acidic or basic in nature. Primary metal industries have a strong potential for causing outfall structural damage because their batch dumps are highly acidic. Poor construction, hydraulic scour, and old age may also adversely affect the condition of the outfall structure which are not indications of upstream contaminating entries.	
Concrete cracking:	Industrial flows
Concrete spalling:	Industrial flows
Peeling paint:	Industrial flows
Metal corrosion:	Industrial flows

Parameter Analysis Technique

The outfall containing the suspected illicit discharge will serve as the starting point for the investigation. The outfall will be tested for chlorine, copper, phenols, and surfactants/detergents using a HACH DR2700Spectrophotometer, or equivalent. Temperature, pH, and the other physical parameters previously mentioned will also be checked and recorded.

Using the visual and physical descriptions listed at the end of this section, likely sources of the illicit discharge can be identified. Typically, the majority of illicit discharges and connections will be either wash water or a sanitary sewer source. These potential sources should be cross checked with the watershed's facility inventory to determine potential connections. The investigator then works upstream looking for the connections. This part of the investigation will be explored in more detail in STEP 5. Watershed Surveys to Confirm and Locate Inappropriate Pollutant Entries to the Storm Drainage System.

3.3 STEP 3: Initial Field Screening Sampling Activities

Before the field data can be collected, preliminary mapping and land use evaluation work is needed. STEP 1 described the preliminary work and the likely data sources for the information that is needed before the field investigations can begin, where available. The most important preliminary information required is outfall locations, outfall drainage areas, commercial and industrial activities in each drainage area, and locations of septic tanks in the individual drainage areas.

Dry Weather Screening Procedures

Water bodies and outfalls served as the basis for identifying the field screening areas. Dry weather screening only takes place more than seventy-two hours after a storm event greater than 0.1 inches.

The creeks/streams are traversed and channels and pipes are located and screened. Screening involves marking the approximate location of the outfall in a GIS database and attributing it for the following:

- Inspection date and time;
- Site description;
- Outfall size;
- Discharge color;
- Discharge odor;
- Presence and type of floatables;
- Discharge turbidity;
- Deposits/stains;
- Vegetative condition; and
- Presence or absence of flow.

Samples are taken in 1000 mL-sample bottles, and the pH and temperature are taken in the field using a Hach Senslon or equivalent pH/Temperature meter. Physical observation parameters are also observed and recorded on site. Samples are taken to a mobile laboratory and tested for Total Chlorine, Copper, Phenols, and Surfactants. The samples are processed on a Hach DR/2000/2010 Spectrophotometer. At least four, but no more than 24 hours later, a second sample is taken and the same test procedures are performed. A detailed description of the standard operating procedures used to collect samples in the field screening process can be found in Appendix B.

Outfalls that drain a minimum of fifty acres or have a diameter exceeding 36-inches or that drain a minimum of two acres or have a diameter greater than 12 inches in an industrial area are classified as major outfalls. According to Regulation 61-9 122.26(d) (1), only major outfalls with observed dry weather flow are required to be sampled.

3.4 STEP 4: Data Analysis to Identify Problem Outfalls and Flow Components

Once the field screening and sampling activities have been completed for an area, a data analysis should proceed to identify problem outfalls and flow components. The field screening data is to be used as an initial effort to identify the outfalls needing more detailed drainage area investigations, which would identify specific pollutant sources. These field screening and sampling activities included physical, chemical, and relative toxicity evaluations of outfall and/or discharge conditions. If possible, start to track potential illicits to their source immediately upon having test results that are out of the normal range or if there is a visual/olfactory indicator of a potential illicit discharge because of the potential for illicits to be intermittent in nature.

One of the purposes of the procedure presented here is to separate storm drain outfalls into general categories with a known level of confidence. The categories as presented in section 3.0 are:

(1) Pathogenic or toxic pollutant sources,
(2) Nuisance and aquatic life threatening pollutant sources, and
(3) Unpolluted water sources.

The pathogenic and toxic pollutant source category should be considered the most severe. Pathogenic or toxic, and nuisance pollutants should be prioritized in a manner that ensures prompt action in the source identification process as these types of pollutants have the most harmful effects to the environment. The effects of the pollutants on the receiving waters cause significant, negative impacts to the receiving water organisms and could cause disease upon water contact or consumption. It can also cause significant downstream water treatment problems for consumers.

Indicators of Contamination

A simple review of the outfall characteristics of a suspected illicit discharge outfall can present key indicators of contamination. Indicators of contamination (negative indicators) are clearly apparent visual or physical parameters indicating obvious problems and are readily observable at the outfall during the field screening activities. This is the simplest method for identifying grossly contaminated dry-weather outfall flows. Table 4 shows chemical and physical properties of industrial non-stormwater entries into the storm drainage system. The table summarizes possible chemical and physical characteristics of non-stormwater discharges that could come from various industries. The properties considered are pH, total dissolved solids, odor, color, turbidity, floatable materials, vegetation, and damage to outfall structure. The descriptions in each of these categories contain the most likely conditions for a non-stormwater discharge coming from a particular industry. It should be noted that outfalls may be affected by several industrial sources simultaneously, especially if draining industrial parks. The initial watershed analysis, discussed in STEP 1, which needs to describe the industrial and commercial facilities that are operating in each outfall's watershed, will be of great assistance in identifying which industries may be contributing dry-weather entries into the storm drainage system.

Simple Checklist for Major Flow Component Identification

Chart 3. Illicit Discharge Decision Diagram is a flow chart describing the analysis strategy to identify the major non-stormwater discharge sources. The first indicator is the presence or absence of flow. If no dry-weather flow exists at an outfall, then indications of intermittent flows must be investigated. Specifically, stains, deposits, odors, unusual stream-side vegetation conditions, and damage to outfall structures can all indicate intermittent non-stormwater flows. However, frequent visits to outfalls over long time periods are needed to confirm that only stormwater flows occur. The other points on the flow chart serve to indicate if major contaminating sources are present, or if the water is uncontaminated water. It must be noted that this chart does not take into consideration the quantities of the pollutant component contributions as it only indicates whether a particular characteristic exists.

The illicit discharge decision diagram allows for the determination of the type of dry-weather flow. The diagram determines if a flow is (1) not a contaminated non-stormwater source, (2) a wash water source (treated potable water), or (3) a contaminated wastewater source. The following descriptions will help in the determination of the type of flow at a potential illicit discharge outfall.

Treated Potable Water

A number of tracer parameters may be useful for distinguishing treated potable water from natural waters:

- Major ions or other chemical/physical characteristics of the flow components can vary substantially depending upon whether the water supply sources are groundwater or surface water, and whether the sources are treated or not. Specific conductance may also serve as a rough indicator of the major water source.
- Fluoride can often be used to separate treated potable water from untreated water sources. Untreated water sources can include local springs, groundwater, regional surface flows or non-portable industrial waters. If the treated water has no fluoride added, or if the natural water has fluoride concentrations close to potable water fluoride concentrations, then fluoride may not be an appropriate indicator.
- Hardness can also be used as an indicator if the potable water source and the baseflow are from different water sources. An example would be if the baseflow is from hard groundwater, and the potable water is from softer surface supplies.
- If the concentration of chlorine is high, then a major leak of disinfected potable water is likely to be close to the outfall. Because of the rapid dissipation of chlorine in water (especially if some organic contamination is present) it is not a good parameter for quantifying the amount of treated potable water observed at the outfall.

Water from potable water supplies (that test positive for fluorides, or other suitable tracers) can be relatively uncontaminated, e.g., potable waterline leakage or irrigation runoff, or heavily contaminated, e.g., sanitary wastewater.

Sanitary Wastewaters

In areas containing no industrial or commercial sources, sanitary wastewater is probably the most severe dry-weather contaminating source of storm drain flows. The following parameters can be used for quantifying the sanitary wastewater components of the treated potable water portion:

- Surfactant analysis may be used in determining the presence of sanitary wastewaters. However, surfactants present in water originating from potable water sources could indicate sanitary wastewaters, laundry wastewaters, car washing wastewater, or any other waters containing surfactants. If surfactants (or fluorescence) are not present, then the potable water could be relatively uncontaminated (potable waterline leaks or irrigation runoff).
- The presence of fabric whiteners (as measured by fluorescence using a fluorometer in the laboratory or field) can also be used in distinguishing laundry and sanitary wastewaters.

- Sanitary wastewaters often exhibit predictable trends during the day in flow and quality. In order to maximize the ability to detect direct sanitary wastewater connections into the storm drainage system, it would be best to survey the outfalls during periods of highest sanitary wastewater flows (mid to late morning hours).
- The ratio of surfactants to ammonia or potassium concentrations may be an effective indicator of the presence of sanitary wastewaters or septic tank effluents. If the surfactant concentrations are high, but the ammonia and potassium concentrations are low, then the contaminated source may be laundry wastewaters. Conversely, if ammonia, potassium, and surfactant concentrations are all high, then sanitary wastewater is the likely source. Some researchers have reported low surfactants in septic tank effluents. Therefore, if surfactants are low, but potassium and ammonia are both high, septic tank effluent may be present.
- Obviously, odor and other physical characteristics, e.g. turbidity, coarse and floating solids, foaming, color, and temperature would also be very useful in distinguishing sanitary wastewater from washwater or laundry wastewater sources. However, these indicators may not be very obvious for small levels of sanitary wastewater contamination.

3.5 STEP 5: Watershed Surveys to Confirm and Locate Inappropriate Pollutant Entries to the Storm Drainage System.

After initial outfall surveys have indicated the presence of contamination (illicit discharge), further detailed analyses are needed to identify and locate the specific containment source(s) (e.g., residential, commercial, and/or industrial) in the drainage area. For source identification and location, upstream survey techniques should be used in conjunction with an in-depth watershed evaluation. Information on watershed activities can be obtained from aerial photography and/or zoning maps. Upstream survey techniques will include:

- The analysis of the dry-weather flow at several manhole points along the storm drainage system to narrow the location of the contaminating source;
- Tests for specific pollutants associated with known activities within the outfall catchment area; and
- The measurement of water flow rate and temperature.

In order to identify the specific contaminant sources in the drainage system, further detailed watershed analyses, including follow-up drainage area and on-site investigations, are needed.

3.5.1 Follow-up Drainage Area and On-site Investigations

Investigations to Storm Drainage System - Further drainage area investigations upstream of identified problem outfalls will be conducted after the outfall studies have indicated dry-weather discharge problems. In order to be cost-effective, only a sub-sample of manholes located in a drainage area identified as having significant non-stormwater sources should be tested for the tracers. As an example, the main storm drain trunk sewer could be divided into tenths (every 10 manholes in the trunk line) and the manholes closest to these subdivisions would be sampled. This would identify the upper limit of the drainage area above which the major sources are not located. A location may also be identified where the downstream pollutants are no longer appearing in the sampling results. This would mark the downstream limit of the contributing area for the tracers in concern. After the main trunk drainage reach is identified that contains the major non-stormwater sources, the branch storm drain lines can be similarly subdivided (but into fewer sections each, perhaps about three) and evaluated. Depending on the drainage area and complexity of the storm drainage system, this scheme could be suitably modified to enable the identification of relatively small areas responsible for the non-stormwater pollutant entries into the storm drainage system. These small areas would then be subject to the more intensive on-site investigations by smoke test, dye studies, and TV inspections.

Inadequate Storm and Sanitary Drainage Systems - The drainage system analysis procedure may find that the drainage system is contaminated by widespread sanitary wastewater entries, possibly due to

sanitary and storm drainage systems in extremely poor condition. This situation may require that the drainage system undergo extensive and costly repairs. It may be more appropriate to consider the storm drainage system as a combined sewer and examine control alternatives that have been developed for combined sewer systems. This would also save further detailed drainage system analysis costs.

Industrial and Commercial On-site Investigation – These drainage system surveys will be followed by industrial and commercial on-site investigations (e.g. dye and smoke studies, and TV inspections) to locate specific sources of non-stormwater pollutant entries into the drainage system. Additionally, aerial photography can be very useful during later phases of non-stormwater discharge control projects.

3.5.2 Locating an Industrial Source

Hypothetical examples were taken from Section 7 of the 1993 EPA publication entitled *Investigation of Inappropriate Pollutant Entries into Storm Drain Systems - A User's Guide* and included in Appendix C in order to demonstrate how dry-weather discharges can be characterized so that their likely industrial sources can be identified. These examples show how observations of outfall conditions and simple chemical analyses, combined with a basic knowledge of wastewater characteristics of industrial and commercial operations located in the drainage area, can be used to identify the possible pollutant sources. The initial activities include pollutant analyses of outfalls being investigated. This requires the characterization of the non-stormwater flows, the identification of the likely industries responsible for the observed discharges, and finally, locating possible specific sources in the watershed.

3.6 STEP 6: Corrective Techniques

Just as it is important to track, locate, and eliminate existing illicit discharges to the MS4, it is equally important to prevent problems from developing at all, and to provide an environment in which future problems will be avoided. Pollution prevention practices should focus on activities such as:

- Public education;
- An organized systematic program of disconnecting commercial and industrial non-stormwater entries into the storm drainage system;
- Tackling the problem of widespread septic system failure;
- Disconnecting direct sanitary sewerage connections;
- Rehabilitating storm or sanitary sewers to abate contaminated water infiltration; and
- Developing zoning and ordinances.

Some of the above bulleted items will be further discussed in this section to provide suggestions that could be incorporated into a pollution prevention program.

3.6.1 Public Education

Educating the public can significantly reduce the amount of pollutants that end up in the storm drainage system if done as continuing process of public participation and involvement. The "public" can be subdivided into categories which are representative of the problem areas with respect to unauthorized entries to storm drainage systems. The subcategories of the public are:

- Industrial;
- Commercial;
- Residential; and
- Governmental.

3.6.2 Citizen Complaints

The following procedure shall be established to handle complaints of illegal dumping or discharges to the storm sewer system.

- Call or written complaint received by Anderson County.
- Complaint logged in the illicit connections database.
- Work order issued to investigate complaint upon receipt.
- Complaint investigated.
- A detailed report of the results of the investigation should be filed and the complainant notified.

3.6.3 Enforcement Procedures

Anderson County has created an Emergency Response Plan containing standard procedures for responding to illicit discharges. This document can be found in Appendix E. The County has also outlined particular response times for certain aspects of their IDDE program.

Documenting Illicit Discharges

The County will document illicit discharges as soon as practicable, but within three (3) business days from discovery. Staff will store documentation of the illicit discharge, and any supporting information, both in hard copy form and electronically on the County's server. See section 3.4 for information on the storage of electronic data.

Tracing the Source of Illicit Discharges

The County will follow the standard operating procedures for identifying and tracking any instances of illicit discharges in their SMS4. Once identified, the County will begin tracing the source of the illicit as soon as practicable, but no later than two (2) business days.

Identifying the Source of the Illicit Discharge

Once the source of the illicit discharge has been discovered, the County will notify the discharger as soon as practicable, but no later than three (3) business days. See the Emergency Response Plan in Appendix E for more information.

Notifying Other MS4's

If the County discovers an illicit discharge or connection that originates in a traditional permittee's MS4, they will notify the operator as soon as practicable, but no later than three (3) business days.

Notifying Non-traditional Parties

If illicit connections or discharges are discovered in other areas, the County will notify the other operator as soon as practicable, but no later than three (3) business days.

Citizen Complaints

The County will respond to citizen complaints of illicit discharges, illicit connections and improper disposal as soon as practicable, but no later than two (2) business days from the reporting date. County staff will follow the standard operating procedures for illicit discharge identification, tracking and reporting.

Upon identification of the source of the illicit discharge or illegal dumping, the responsible party will be notified to cease the improper practices. All appropriate regulatory agencies will be notified of the discharge and may vary depending on the type of discharge and its location. SCDHEC will be notified of

enforcement actions taken. The violator may be fined or summoned in accordance with Ord. No. 2007-029, § 1(Exh. A), 9-18-07 and will be given a specific deadline to eliminate the illicit connection by either:

- Rerouting the flow to the sanitary sewer (if appropriate);
- Constructing and post construction on-site treatment facilities;
- Permitting the connection (if applicable); or
- Removing the source of the illicit discharge.

During the stated time period for rectification per the above referenced ordinance, inspections may be conducted to verify compliance with the order to cease and desist further discharges and any clean up procedures required to mitigate damages caused by the discharge. Upon elimination of an illicit, quantify the reduction in pollution from the discharge in the illicit connections database to be included in the annual report.

3.6.4 Data Management

Stormwater structure data should be managed in one database for each watershed. These databases allow the user to input multiple samplings/inspections for any structure and provide for the tracking of flows and building of storm sewer system information into the database.

Two databases will be used to track all field screening and illicit connection activities. The field screening database will house the results of field screening activities for each outfall and is used to generate reporting of the field activities by outfall and to allow rapid analysis of the data.

The illicit connections database will be used to store the results of the illicit connection investigations of each outfall, generate reports and assist in data analysis.

Table 4. Chemical and Physical Properties of Industrial Non-Stormwater Entries into Storm Drainage Systems

Industrial Categories Major Classifications SIC Group Numbers		Odor	Color	Turbidity	Floatables	Debris and Stains	Damage to Outfall Structures	Vegetation	pH	Total Dissolved Solids
Primary Industries										
201	Meat Products	Spoiled Meats, Rotten Eggs and Flesh	Brown to Reddish Brown	High	Animal Fats, Byproducts, Pieces of Processed Meats	Brown to Black	High	Flourish	Normal	High
202	Dairy Products	Spoiled Milk Rancid Butter	Gray to White	High	Animal Fats, Spoiled Milk Products	Gray to Light Brown	High	Flourish	Acidic	High
203	Canned and Preserved Fruits and Vegetables	Decaying Products Compost Pile	Various	High	Vegetable Waxes, Seeds, Skins, Cores, Leaves	Brown	Low	Normal	Wide Range	High
204	Grain Mill Products	Slightly Sweet and Musty Grainy	Brown to Reddish Brown	High	Grain Hulls and Skins, Straw & Plant Fragments	Light Brown	Low	Normal	Normal	High
205	Bakery Products	Sweet and or Spoiled	Brown to Black	High	Cooking Oils, Lard, Flour, Sugar	Gray to Light Brown	Low	Normal	Normal	High
206	Sugar and Confectionery Products	N/A	N/A	Low	Low Potential	White Crystals	Low	Normal	Normal	High
207	Fats and Oils	Spoiled Meats, Lard or Grease	Brown to Black	High	Animal Fats, Lard	Gray to Light Brown	Low	Normal	Normal	High
208	Beverages	Flat Soda, Beer or Wine, Alcohol, Yeast	Various	Moderate	Grains and Hops, Broken Glass, Discarded Canning Items	Light Brown	High	Inhibited	Wide Range	High
21	Tobacco Manufacturers	Dried Tobacco, Cigars, Cigarettes	Brown to Black	Low	Tobacco Stems and Leaves, Papers and Fillers	Brown	Low	Normal	Normal	Low
22	Textile Mill Products	Wet Burlap, Bleach, Soap, Detergents	Various	High	Fibers, Oils, Grease	Gray to Black	Low	Inhibited	Basic	High
23	Apparel and Other Finished Products	NA	Various	Low	Some Fabric Particles	N/A	Low	Normal	Normal	Low

Industrial Categories Major Classifications SIC Group Numbers		Odor	Color	Turbidity	Floatables	Debris and Stains	Damage to Outfall Structures	Vegetation	pH	Total Dissolved Solids
Material Manufacturers										
24	Lumber and Wood Products	N/A	N/A	Low	Some Sawdust	Light Brown	Low	Normal	Normal	Low
25	Furniture and Fixtures	Various	Various	Low	Some Sawdust, Solvents	Light Brown	Low	Normal	Normal	Low
26	Paper and Allied Products	Bleach, Various Chemicals	Various	Moderate	Sawdust, Pulp Paper, Waxes, Oils	Light Brown	Low	Normal	Wide Range	Low
27	Printing, Publishing, and Allied Industries	Ink, Solvents	Brown to Black	Moderate	Paper Dust, Solvents	Gray to Light Brown	Low	Inhibited	Normal	High
31	Leather and Leather Products	Leather, Bleach, Rotten Eggs or Flesh	Various	High	Animal Flesh and Hair, Oils & Grease	Gray to Black, Salt Crystals	High	Highly Inhibited	Wide Range	High
33	Primary Metal Industries	Various	Brown to Black	Moderate	Ore, Coke, Limestone, Millscale, Oils	Gray to Black	High	Inhibited	Acidic	High
34	Fabricated Metal Products	Detergents, Rotten Eggs	Brown to Black	High	Dirt, Grease, Oils, Sand, Clay Dust	Gray to Black	Low	Inhibited	Wide Range	High
32	Stone, Clay, Glass, and Concrete Products	Wet Clay, Mud, Detergents	Brown to Reddish Brown	Moderate	Glass Particles, Dust from Clay or Stone	Gray to Light Brown	Low	Normal	Basic	Low