

## **APPENDIX K**

### **SPECIFIC CONSIDERATIONS FOR INDUSTRIAL SOURCES OF INAPPROPRIATE POLLUTANT ENTRIES TO THE STORM DRAINAGE SYSTEM**

(Adapted from Pitt, 2001)



## Industrial Site Surveys

Additional pollutants associated with local commercial and industrial activities need to be monitored during outfall screening activities if these activities exist in the watersheds of interest. This monitoring will assist in identifying the classes of commercial or industrial activities responsible for the contamination. The first step in this process is to identify which industrial and commercial activities may contribute non-storm water discharges to the drainage system. The review of industrial user surveys or reports that are available needs to be done initially. It may be necessary to also send a questionnaire to industries in the watershed that are draining to the storm drainage system to identify the specific activities that may affect runoff quality and dry weather discharges. Site inspections will still be required because questionnaires may not be returned or may give incorrect details (either deliberately or unknowingly).

Industrial areas are known to contribute excessive wet-weather storm water discharges, along with contaminated dry weather entries into the storm drainage system. Therefore, additional industrial site investigations are needed to identify activities that most obviously contribute these contaminants to the storm drainage system. Figure K.1 is an example industrial site survey form prepared by the Non-Point Source and Land Management Section of the Wisconsin Department of Natural Resources (Bannerman, 2003). This form has been used to help identify industrial activities that contribute dry- and wet-weather non-storm water entries into the storm drainage system.

This form only considers outside sources that would affect the storm drainage system by entering through inlets or through sheetflow runoff into drainage channels. This sheet does not include any information concerning indoor activities, or direct plumbing connections to the storm drainage system. However, the information included on this sheet can be very helpful in devising runoff control programs for industrial areas. This information most likely affects wet-weather discharges much more than dry weather discharges. Obvious dry weather leaching or spillage problems are also noted on the form.

Table K.1 presents the types of activities in industrial areas that may contribute dry weather discharges to storm drainage systems. This table can be used to rank the most likely industries that may produce non-storm water discharges to a storm drainage system in an area. This table is used in conjunction with the industrial site survey form to catalog specific activities in the watershed that may need correction. After a listing of the candidate activities is known in the watersheds, additional tracer parameters may then be selected to add to the screening efforts.

### Likely Dry Weather Discharge Characteristics for Different Industries

#### *Chemical and Physical Properties*

Table K.1 summarizes possible chemical and physical characteristics of non-storm water discharges, which could come from various industries. The properties considered are pH, total dissolved solids, odor, color, clarity, floatable materials, vegetation, and structural damage potential. The descriptions in each of these categories contain the most likely conditions for a non-storm water discharge coming from a

particular industry. It should be noted that a combination of just a few of these characteristics, or perhaps all of them, might occur at an outfall affected by a potential source. In addition, outfalls are likely to be affected by several sources simultaneously, further confusing the situation. Again, a

complete watershed analysis describing the industrial and commercial facilities operating in each outfall watershed will be of great assistance in identifying which industries may be contributing harmful dry weather discharges to the storm system.

City: \_\_\_\_\_ Industry Name: \_\_\_\_\_  
 Site Number: \_\_\_\_\_ Photo # \_\_\_\_\_  
 Street Address: \_\_\_\_\_ Roll# \_\_\_\_\_  
 Type of industry: \_\_\_\_\_  
 Instructions: Fill in blanks or circle best answer in following (use back of sheet if necessary):

Material/waste Storage Areas

1. Type of material/waste: \_\_\_\_\_
2. Method of storage: pile tank dumpster other: \_\_\_\_\_
3. Area occupied by material/waste (acres): \_\_\_\_\_
4. Type of surface under material/waste: paved unpaved
5. Material/waste is disturbed: often sometimes never unsure
6. Description of spills (material, quantity & frequency): \_\_\_\_\_
7. Nearest drainage (feet) and drainage type: \_\_\_\_\_
8. Control practice: berm tarp buffer none other: \_\_\_\_\_
9. Tributary drainage area, including roofs (acres): \_\_\_\_\_
10. Does storage area drain to parking lot: yes no unsure

Heavy equipment storage

1. Type of equipment: \_\_\_\_\_
2. Area covered by equipment (acres): \_\_\_\_\_
3. Type of surface under equipment: paved unpaved
4. Nearest drainage (feet) and drainage type: \_\_\_\_\_
5. Control practice: berm tarp buffer none other: \_\_\_\_\_
6. Tributary drainage area, including roofs (acres): \_\_\_\_\_
7. Does storage area drain to parking lot: yes no unsure

Air pollution

1. Description of settleable air pollutants (types & quantities): \_\_\_\_\_
2. Description of particulate air pollutant controls: \_\_\_\_\_

Railroad yard

1. Size of yard (number of tracks): \_\_\_\_\_
2. General condition of yard: \_\_\_\_\_
3. Description of spills in yard (material, quantity & frequency): \_\_\_\_\_
4. Type of surface in yard: paved unpaved
5. Nearest drainage (feet) and drainage type: \_\_\_\_\_
6. Type of control practice: berm buffer other: \_\_\_\_\_
7. Does yard drain to parking lot: yes no unsure
8. Tributary drainage area, including roofs (acres): \_\_\_\_\_

Loading Docks

1. Number of truck bays: \_\_\_\_\_
2. Type of surface: paved unpaved
3. Description of spills in yard (material, quantity & frequency): \_\_\_\_\_
4. Nearest drainage (feet) and drainage type: \_\_\_\_\_
5. Type of control practice: berm buffer other: \_\_\_\_\_
6. Does loading area drain to parking lot: yes no unsure
7. Tributary drainage area, including roofs (acres): \_\_\_\_\_

**Figure K.1: Industrial Inventory Field Sheet**

Source: (Source: *Bannerman, 2003*)

Appendix K: Specific Considerations for Industrial Sources

Table K.1: Chemical and Physical Properties of Industrial Non-Storm Water Discharges									
Industrial Categories Major Classifications SIC Group Numbers	Odor	Color	Turbidity	Floatables	Debris and Stains	Structural Damage	Vegetation	pH	Total Dissolved Solids
<b>Primary Industries</b>									
20: Food and Kindred Products									
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 & 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 Confectionary Products	NA	NA	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	Mod.	Grains, Hops, Broken Glass, Discarded Canning Items	Light Brown	High	Inhibited	Wide Range	High
21: Tobacco Manufactures	Dried Tobacco, Cigars, Cigarettes	Brown to Black	Low	Tobacco Stems & 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	NA	Low	Normal	Normal	Low
<b>Material Manufacture</b>									
24: Lumber & Wood Products	NA	NA	Low	Some Sawdust	Light Brown	Low	Normal	Normal	Low
25: Furniture & Fixtures	Various	Various	Low	Some Sawdust, Solvents	Light Brown	Low	Normal	Normal	Low
26: Paper & Allied Products	Bleach, Various Chemicals	Various	Mod.	Sawdust, Pulp Paper, Waxes, Oils	Light Brown	Low	Normal	Wide Range	Low
27: Printing, Publishing, and Allied Industries	Ink, Solvents	Brown to Black	Mod.	Paper Dust, Solvents	Gray to Light Brown	Low	Inhibited	Normal	High
31: Leather & Leather Products	Leather, Bleach, Rotten Eggs or Flesh	Various	High	Animal Flesh & Hair, Oils, Grease	Gray to Black, Salt Crystals	High	Highly Inhibited	Wide Range	High
33: Primary Metal Industries	Various	Brown to Black	Mod.	Ore, Coke, Limestone, Millscale, Oils	Gray to Black	High	Inhibited	Acidic	High

<b>Table K.1: Chemical and Physical Properties of Industrial Non-Storm Water Discharges</b>									
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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	Mod.	Glass Particles Dust from Clay or Stone	Gray to Light Brown	Low	Normal	Basic	Low
<b>Chemical Manufacture</b>									
28: Chemicals & Allied Products									
2812 Alkalies and Chlorine	Strong Halogen or Chlorine, Pungent, Burning	Alkalies – NA; Chlorine - Yellow to Green	Low	NA	Alkalies – White Carbonate Scale Chlorine - NA	High	Highly Inhibited	Basic	High
2816 Inorganic Pigments	NA	Various	High	Low Potential	Various	Low	Highly Inhibited	Wide Range	High
282 Plastic Materials and Synthetics	Pungent, Fishy	Various	High	Plastic Fragments, Pieces of Synthetic Products	Various	Low	Inhibited	Wide Range	High
283 Drugs	NA	Various	High	Gelatin Byproducts for Capsulating Drugs	Various	Low	Highly Inhibited	Normal	High
284 Soap, Detergents & Cleaning Preparations	Sweet or Flowery	Various	High	Oils, Grease	Gray to Black	Low	Inhibited	Basic	High
285 Paints, Varnishes, Lacquers, Enamels and Allied Products (SB - Solvent Base)	Latex - Ammonia SB - Dependent Upon Solvent (Paint Thinner, Mineral Spirits)	Various	High	Latex - NA SB - All Solvents	Gray to Black	Low	Inhibited	Latex-Basic SB - Normal	High
286 Indust. Organic Chemicals									
2861 Gum and Wood Chemicals	Pine Spirits	Brown to Black	High	Rosins and Pine Tars	Gray to Black	Low	Inhibited	Acidic	High
2865 Cyclic Crudes, & Cyclic Intermediates Dyes, & Organic Pigments	Sweet Organic Smell	NA	Low	Translucent Sheen	NA	Low	Highly Inhibited	Normal	Low
287 Agricultural Chemicals									
2873 Nitrogenous Fertilizers	NA	NA	Low	NA	White Crystalline Powder	High	Inhibited	Acidic	High
2874 Phosphatic Fertilizers	Pungent Sweet	Milky White	High	NA	White Emorphous Powder	High	Inhibited	Acidic	High
2875 Fertilizers, Mixing Only	Various	Brown to Black	High	Pelletized Fertilizers	Brown Emorphous Powder	Low	Normal	Normal	High
29: Petroleum Refining and Related Industries									
291 Petroleum Refining	Rotten Eggs, Kerosene, Gasoline	Brown to Black	High	Any Crude or Processed Fuel	Black Salt Crystals	Low	Inhibited	Wide Range	High

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30 Rubber & Miscellaneous Plastic Products	Rotten Eggs, Chlorine, Peroxide	Brown to Black	Mod.	Shredded Rubber Pieces of Fabric or Metal	Gray to Black	Low	Inhibited	Wide Range	High
<b>Transportation &amp; Construction</b>									
15 Building Construction	Various	Brown to Black	High	Oils, Grease, Fuels	Gray to Black	Low	Normal	Normal	High
16 Heavy Construction	Various	Brown to Black	High	Oils, Grease, Fuels, Diluted Asphalt or Cement	Gray to Black	Low	Normal	Normal	High
<b>Retail</b>									
52 Building Materials, Hardware, Garden Supply, and Mobil Home Dealers	NA	Brown to Black	Low	Some Seeds, Plant Parts, Dirt, Sawdust, or Oil	Light Brown	Low	Normal	Normal	Low
53 Gen. Merchandise Stores	NA	NA	NA	NA	NA	Low	Normal	Normal	Low
54 Food Stores	Spoiled Produce, Rancid, Sour	Various	Low	Fragments of Food, Decaying Produce	Light Brown	Low	Flourish	Normal	Low
55 Automotive Dealers & Gasoline Service Stations	Oil or Gasoline	Brown to Black	Mod.	Oil or Gasoline	Brown	Low	Inhibited	Normal	Low
56 Apparel & Accessory Stores	NA	NA	Low	NA	NA	Low	Normal	Normal	Low
57 Home Furniture, Furnishings, & Equip. Stores	NA	NA	Low	NA	NA	Low	Normal	Normal	Low
58 Eating & Drinking Places	Spoiled Foods Oil & Grease	Brown to Black	Low	Spoiled or Leftover Foods	Brown	Low	Normal	Normal	Low
<b>Coal Steam Electric Power</b>	NA	Brown to Black	High	Coal Dust	Black Emorphous Powder	Low	Normal	Slightly Acidic	Low
<b>Nuclear Steam Electric Power</b>	NA	Light Brown	Low	Oils, Lubricants	Light Brown	Low	Normal	Normal	Low

*Other Chemicals Indicative of Manufacturing Industrial Activities*

Table K.2 lists the various chemicals that may be associated with a variety of different industrial activities. It may be possible to examine non-storm water outfall flow for specific chemicals, such as shown on this list to identify which specific manufacturing industrial activities may be contributing the flows.

**Example Problems for Locating an Industrial Source**

*Locating An Industrial Source*

Hypothetical examples have been created 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 on the non-storm water flows, the identification of the likely industries responsible for the observed discharges, and finally, locating the possible specific sources in the watershed.

The industries identified in a hypothetical storm water drainage area (from the watershed analysis) included a vegetable cannery, general food store, fast food restaurant, cheese factory, used car dealer, cardboard box producer, and a wood treatment company. The methods used to determine the most likely industrial source of the dry weather discharges are considered

for three hypothetical situations of outfall contamination.

*Case Example 1*

The hypothetical results of the pollutant analysis for the first situation found constant dry weather flow at the outfall. The measurements indicated a normal pH (6) and low total dissolved solids concentrations (300 mg/L). Other outfall characteristics included a strong odor of bleach, no distinguishing color, moderate turbidity, sawdust floatables, a small amount of structural corrosion, and normal vegetation.

The significant characteristic in this situation is the sawdust floatables (see Figure K.2). The industries that could produce sawdust and have dry weather flow drainage to this pipe are the cardboard box company and the wood treatment company. According to their SIC codes, these companies would fall under the category of "Paper and Wood Products." Looking up these two industries by their corresponding SIC group numbers in Table K.1 and comparing the listed properties indicates that the paper industry has a strong potential for the odor of bleach. Wood products does not indicate any particular smell.

Based upon these data, the most likely industrial source of the non-storm water discharge would be the cardboard box company. Table A.1 (Appendix A) indicates a high potential for direct connections at paper and wood product facilities. At this point, further testing should be conducted at the cardboard box company to determine if the constant source of contamination is coming from cooling waters, process waters, or direct piping connections (process waters are the most likely source, given the bleach and sawdust characteristics).

<b>Table K.2: Significant Chemicals in Industrial Wastewaters</b>	
<b>Chemical</b>	<b>Industry</b>
Acetic acid	Acetate rayon, pickle and beetroot manufacture
Alkalies	Cotton and straw kiering, cotton manufacture, mercerizing, wool scouring, laundries
Ammonia	Gas and coke manufacture, chemical manufacture
Arsenic	Sheep-dipping, fell mongering
Chlorine	Laundries, paper mills, textile bleaching
Chromium	Plating, chrome tanning, aluminum anodizing
Cadmium	Plating
Citric acid	Soft drinks and citrus fruit processing
Copper	Plating, pickling, rayon manufacture
Cyanides	Plating, metal cleaning, case-hardening, gas manufacture
Fats, oils	Wool scouring, laundries, textiles, oil refineries
Fluorides	Gas and coke manufacture, chemical manufacture, fertilizer plants, transistor manufacture, metal refining, ceramic plants, glass etching
Formalin	Manufacture of synthetic resins and penicillin
Hydrocarbons	Petrochemical and rubber factories
Hydrogen peroxide	Textile bleaching, rocket motor testing
Lead	Battery manufacture, lead mining, paint manufacture, gasoline, manufacture
Mercaptans	Oil refining, pulp mills
Mineral acids	Chemical manufacture, mines, Fe and Cu pickling, brewing, textiles, photo-engraving, 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; sheep-dipping
Silver	Plating, photography
Starch	Food, textile, wallpaper manufacture
Sugars	Dairies, foods, sugar refining, preserves, wood process
Sulfides	Textiles, tanneries, gas manufacture, rayon manufacture
Sulfites	Wood process, viscose manufacture, bleaching
Tannic acid	Tanning, sawmills
Tartaric acid	Dyeing; wine, leather, and chemical manufacture
Zinc	Galvanizing, plating, viscose manufacture, rubber process
Source: Klein (1962). <i>River Pollution 2: Causes and Effects</i> . Butterworth & Co. presented in <i>The Water Encyclopedia</i> , D. Todd, Water Information Center, Port Washington, N.Y., 1979.	

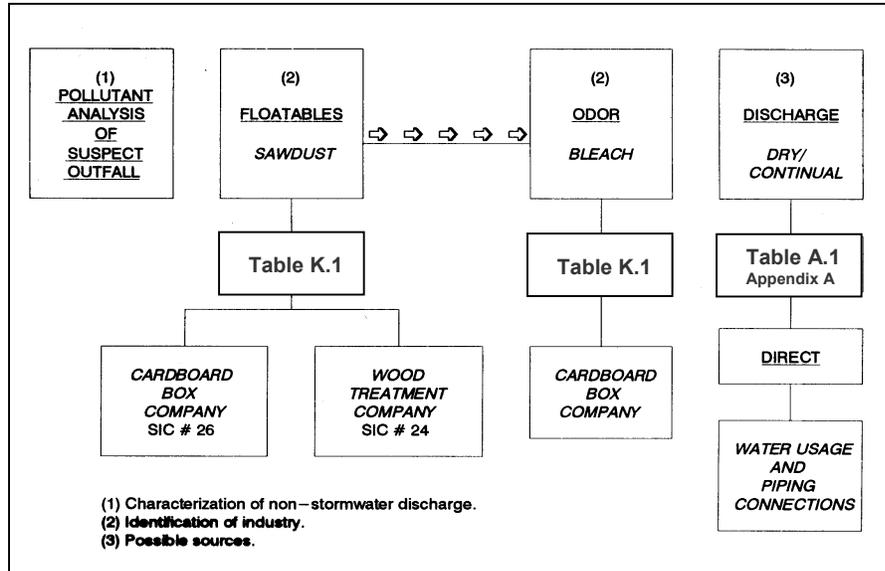


Figure K.2: Flowsheet for Case Example 1

*Case Example 2*

Pollutant analysis for the second situation found intermittent dry weather discharges at the outfall. The test measurements indicated an acidic pH (3) and high total dissolved solids concentrations (approximately 6,000 mg/L). Other characteristics included a rancid-sour odor, grayish color, high turbidity, gray deposits containing white gelatin-like floatable material, structural damage in the form of spalling concrete, and an unusually large amount of plant life.

The rancid-sour smell and the presence of floatable substances at this outfall indicate that some type of food product is probably spoiling. This narrows the possible suspect industries to the fast food restaurant, cheese factory, vegetable cannery, and food store (see Figure K.3). The corresponding SIC categories for each of these industries are “Eating and Drinking Places” (SIC# 58), “Dairy Products” (SIC# 202), “Canned and Preserved Fruits and Vegetables” (SIC# 203), and “Food Stores” (SIC# 54).

Comparison of the properties listed in Table K.1 for these SIC codes indicates that elevated plant life is common to industrial wastes for the “Dairy Products” and “Food Stores” categories. However, the deciding factor is the acidic pH, which is only listed for “Dairy Products”. Thus, the white gelatin-like floatables are most likely spoiled cheese byproducts from the cheese factory, which are also the probable cause of the sour-rancid smell.

Since dry weather entry to the storm drainage system occurs intermittently, flow could be caused by either a direct or indirect connection. To locate the ultimate source of this discharge coming from the cheese factory, both direct and indirect industrial situations are considered under the category of “Food Processing” with SIC code of 2020 in Table A1 (see Appendix A). Thus, further examination of the loading dock procedures, water usage, and direct piping connections should be conducted since these categories all exhibit some potential for pollution in dairy production.

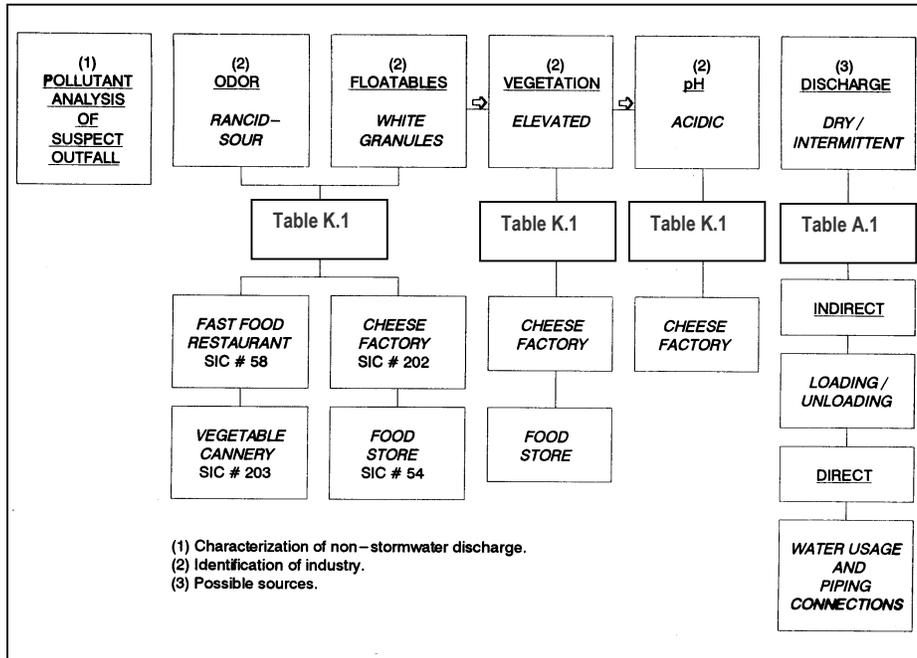


Figure K.3: Flowsheet for Case Example 2

Case Example 3

The results of the test measurements for the final situation found a normal pH (6) and low total dissolved solids (about 500 mg/L). Signs of contaminated discharges were found at the outfall only during and immediately following rainfalls. Other outfall properties observed included an odor of oil, deep brown to black color, a floating oil film, no structural damage, and inhibited plant growth (see Figure K.4).

According to Table K.1, the fast food restaurant and the used car dealer are the only two industrial sources in this hypothetical drainage area with a high potential for causing oily discharges. Their respective SIC categories are “Eating and Drinking Places” (SIC# 58) and

“Automotive Dealers” (SIC# 55).

Comparison of the properties shown in Table K.1 indicates inhibited vegetation only for the second category. Thus, the most likely source of the discharge is the used car dealer.

Furthermore, the source of contamination must likely be indirect, since the discharge occurs only during wet weather. Reference to Table A.1 (see Appendix A) under the category of “Car Dealers,” indicates a medium potential for indirect contamination. This fact, plus the knowledge that most used cars are displayed outdoors, makes it clear that surface runoff is probably carrying spilled automotive oil into the storm drain during rains.

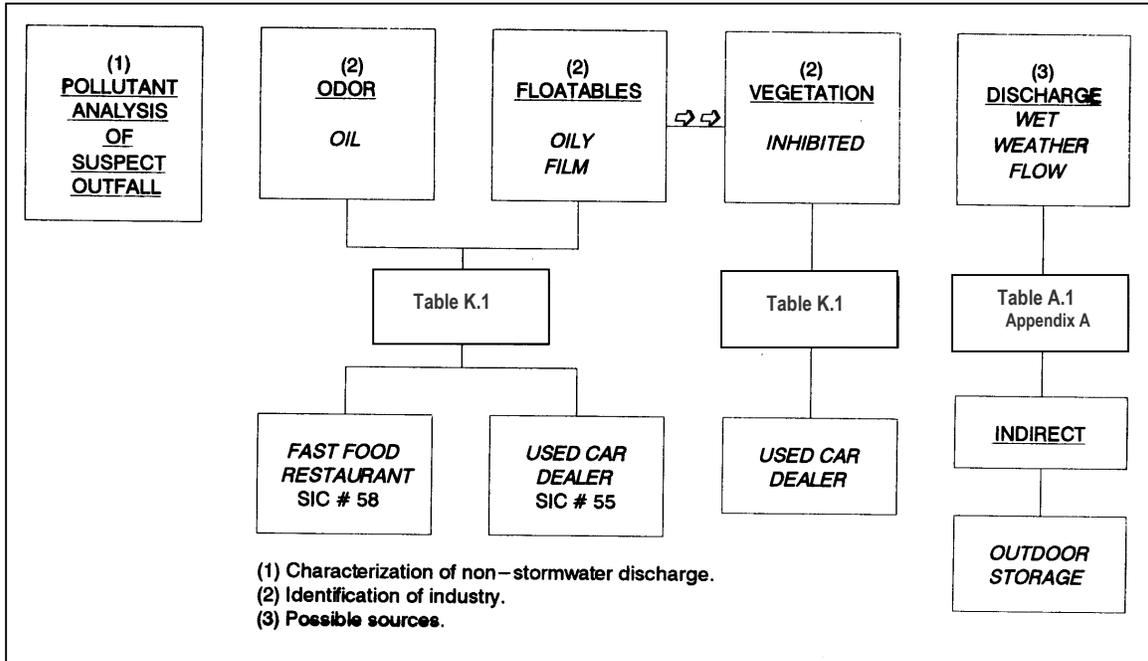


Figure K.4: Flowsheet for Case Example 3

## References

Bannerman, R. 2003. Personal communication with Dr. Robert Pitt, University of Alabama.

Klein, L. 1962. "River Pollution 2: Causes and Effects." in D. Todd. 1979. *The Water Encyclopedia*. Water Information Center. Port Washington, N.Y.

Pitt, R. 2001. *Methods for Detection of Inappropriate Discharges to Storm Drainage Systems: Background Literature and Summary of Findings*. IDDE Project Support Material.