HAZARDOUS WASTE CHARACTERISTICS
SCOPING STUDY

U.S. Environmental Protection Agency
Office of Solid Waste

November 15, 1996

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HAZARDOUS WASTE CHARACTERISTICS SCOPING STUDY: EXECUTIVE SUMMARY

U.S. Environmental Protection Agency
Office of Solid Waste

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EXECUTIVE SUMMARY

The U.S. Environmental Protection Agency (EPA), Office of Solid Waste has investigated potential gaps in the current hazardous waste characteristics promulgated under the federal Resource Conservation and Recovery Act (RCRA). This report, the Hazardous Waste Characteristics Scoping Study, presents the findings of that investigation.

THE SCOPING STUDY: AN EARLY STEP

This study is a first step for the Agency in fulfilling a long-standing goal to review the adequacy and appropriateness of the hazardous characteristics. The study also fulfills an obligation in a consent decree with the Environmental Defense Fund (EDF).

The study is by design a scoping study and, therefore, does not conclusively identify particular chemical classes for regulation, or fundamental flaws in the overall regulatory framework requiring immediate regulatory action. However, the study does identify several key areas that merit further analysis due to the significant potential for improving hazardous waste management practices and protection to health and the environment. Thus, the scoping study provides a catalogue of potential gaps in the hazardous waste characteristics.

The Agency considers that this study is one very critical component of a broader array of efforts underway to review and improve the RCRA program, to ensure that regulation is appropriate to the degree of risk posed by hazardous wastes and waste management practices. Efforts involve both regulatory and de-regulatory actions, as appropriate for specific wastes and waste management practices.

STUDY PROCESS AND FINDINGS

Review of Current Characteristics

The review of the current characteristic regulations evaluated the protectiveness of the characteristics against the risks they were intended to address and also risks they were not specifically intended to address. For example, EPA evaluated risks that are now addressed by the Toxicity Characteristic (TC), e.g., direct ingestion of groundwater, by considering new groundwater modeling techniques that have been in use since the promulgation of the current TC levels, as well as any changes to the toxicity values on which the original levels were based. In addition, EPA evaluated risks from other exposure pathways and to ecological receptors, which are both risks not intended to be protected by the original TC.

The review of the current TC regulatory levels suggests that: (1) further analysis of the current TC regulatory levels should be conducted using new groundwater modeling techniques, as well as considering changes to toxicity values for specific constituents; and (2) non-groundwater pathways and ecological receptors--not currently addressed by TC provisions--may be of potential concern. The study included some screening analyses of potential air releases from surface impoundments and land application units. The Agency found that inhalation risk levels for a significant number of current TC constituents at the fenceline (under certain exposure conditions) exceeded the allowable risk levels upon which the TC is based.

Waste piles and land application units may be of special concern for ecological receptors due to surface runoff. Thirteen TC constituents have regulatory levels that are 10,000 or more times higher than Ambient Water Quality Criteria concentrations, with four of these being at least 100,000 times higher, suggesting that the level of protectiveness of the TC may not be very high for ecological receptors.

The study also identifies the need to examine a broader array of leaching procedures, in addition to the Toxicity Characteristic Leaching Procedure (TCLP), to better predict environmental releases from various waste types and waste management conditions. Notable examples are the inability of the TCLP to predict significant releases under highly alkaline conditions or to media other than groundwater, or to serve as a leaching procedure for oily wastes.

The most obvious potential gap identified for the ignitability and reactivity characteristics is the reference to outdated DOT regulations. Other potential gaps identified for these characteristics include the exclusion of combustible liquids and lack of specific test methods for non-liquids for ignitability; exclusion of corrosive solids, not addressing corrosion of non-steel materials and solubilization of non-metals, and whether pH limits are adequately protective for corrosivity; and, an overly-broad definition and lack of specific test methods for reactivity.

Releases from Non-Hazardous Industrial Waste Facilities

The Agency identified actual releases of non-hazardous waste constituents as one means of finding potential problem constituents and management activities. EPA reviewed data on non-hazardous industrial waste management activities that was readily available from state monitoring and compliance files. The Agency focused on wastes that are not currently regulated as hazardous (by virtue of being listed or exhibiting a characteristic) to identify releases potentially causing human health or environmental damages.

The Agency considered three major factors in judging whether a release was an appropriate case study for this evaluation. A release had to meet all three of the following criteria to be included: (1) The source of contamination had to be a waste management unit or other intended final disposal area that received only non-hazardous industrial waste; (2) A release from a waste management unit must have caused contamination at levels of potential concern (constituent-specific concentrations that exceed federal standards or state guidelines or regulations); and, (3) Documented evidence must be available to support the exceedences referred to in (2).

EPA found 112 environmental release case studies in 12 states with readily available (and not necessarily representative) data on non-hazardous waste management units. The releases were found from facilities in 15 (2-digit) Standard Industry Classification (SIC) industries. The top four categories were: SIC 49: Electric, Gas, and Sanitary Services (refuse-side only); SIC 26: Paper & Allied Products; SIC 28: Chemical & Allied Products; and, SIC 20: Food & Kindred Products.

Over 90 percent of the releases were from landfills or surface impoundments and nearly all (98 percent) involved groundwater contamination. This is most likely because groundwater monitoring is the most common method for detecting releases from waste management units.

Many of the chemical constituents most commonly detected above a regulatory level are already addressed in the current TC, even though the release occurred from non-hazardous waste management. The 20 constituents most commonly detected above a regulatory level are inorganics. The constituents that exceeded state groundwater protection standards or health-based federal drinking water standards most frequently were lead, chromium, cadmium, benzene, arsenic and nitrates. All of these, with the exception of nitrates, are current TC constituents. Organic constituents, both TC and non-TC, were also identified in the case studies, however, they were detected less frequently than the inorganic toxicity characteristic constituents.

This collection of release descriptions is not statistically representative of problem industries nor intended to identify particular problem facilities. The Agency believes that the case studies are indicative of the type of releases associated with the management of non-hazardous wastes in the types of facilities identified. The Agency also believes that information on releases from past waste management practices is useful in demonstrating the potential for human health or environmental damage.

Non-TC Chemical Constituents

In reviewing chemicals and chemical classes not currently regulated by the TC, EPA found in excess of 100 constituents that potentially occur in waste and may pose significant risks. EPA reviewed 37 regulatory or advisory lists of chemicals to identify possible constituents of non-hazardous wastes. EPA also compiled a list of chemicals which are “known” to be constituents of non-hazardous wastes because they were identified in the environmental release case studies or other Agency data sources on non-hazardous industrial wastes. EPA screened these chemicals and narrowed the list to possible constituents of non-hazardous waste that, by virtue of their toxicity, fate and transport properties, or exposure potential, could pose significant risks to human health and/or the environment.

These chemicals were both inorganics and organics, and include volatiles, non-volatile organics, PAHs and pesticides. Because of the large number of constituents identified as candidates and the limited time available for the scoping study, no risk analyses were conducted. However, it may be a reasonable next step to assess the potential risks for a subset of these constituents.

Natural Resource Damages/Large-Scale Environmental Problems

The Agency examined the potential for broad environmental impacts from non-hazardous waste management. These impacts may include damages to natural resources which diminish the value and usability of a resource without threatening human health, as well as possible contributions to regional and global environmental problems.

With respect to groundwater contamination, over 80 percent of the facilities identified in the case studies discussed earlier had releases exceeding secondary drinking water standards (non-health based standards). These releases were identified because exceedence of secondary standards may reduce the useability and, therefore, the value of the groundwater. Iron, chloride, sulfate and manganese were among the most frequently detected constituents exceeding secondary standards.

In reviewing air deposition of toxic constituents to great waters, the Agency found a number of TC constituents, as well as some other chemicals identified in the study. However, it was not possible to assess the importance of waste to air deposition of toxics to the great waters.

State-Only Hazardous Waste Regulations

Some states have adopted hazardous waste identification rules that are broader or more stringent than federal RCRA Subtitle C regulations. These expansions reflect state judgements about gaps in the federal program. Data on hazardous waste regulations from eight states, California, Michigan, New Hampshire, Oregon, Rhode Island, Texas, Washington, and New Jersey were considered. Several states regulate additional constituents beyond the TC list (25 for California, 9 for Michigan, and 1 for Washington). California also applies a more aggressive leaching test, the waste extraction test (WET) to wastes. California also has a test for combinations of hazardous constituents, in which a combined concentration of the listed constituents cannot exceed 0.001 percent as a total in the waste. Four states also apply acute toxicity values (LD50 or LC50) for human or ecological toxicity to the whole waste.

NEXT STEPS

The potential gaps and areas of health and environmental concern identified here will require further, more detailed examination before regulatory action can be undertaken. For example, the study highlights risks to ecological receptors and possible inhalation risks to humans as potential gaps, as well as further evaluation of the adequacy of the TCLP. These topics were found to be potential gaps in more than one area of the study and will likely be specific areas of further investigation.

Following release of this report, the Agency will engage in a variety of outreach activities in identifying appropriate next steps. While the Agency considers this a final report, comments from interested members of the public are solicited and will be used to help identify and structure follow-on activities. As noted above, revisions to the characteristics program will likely, in the long run, involve both regulatory and de-regulatory activities.

CHAPTER 1. INTRODUCTION

The U.S. Environmental Protection Agency (EPA), Office of Solid Waste has investigated potential gaps in the current hazardous waste characteristics promulgated under the federal Resource Conservation and Recovery Act (RCRA). This report, the Hazardous Waste Characteristics Scoping Study, presents the findings of that investigation. Chapter 1 presents background information on the Scoping Study as follows:

- Section 1.1 describes the purpose and scope of the Scoping Study;
- Section 1.2 discusses relevant aspects of the RCRA hazardous waste and non-hazardous waste programs;
- Section 1.3 summarizes the methodology used to prepare the Scoping Study; and
- Section 1.4 outlines the remaining chapters and appendices of the Study.

1.1 Purpose and Requirements of the Hazardous Waste Characteristics Scoping Study

As stipulated under an amended consent decree with the Environmental Defense Fund (EDF) (presented in the text box below), the Agency has investigated potential gaps in the coverage of the existing RCRA hazardous waste characteristics. The purpose of this Study is to identify potential gaps in coverage and to investigate the nature and extent of such gaps. Based on the results of the Study, EPA will seek input from interested parties and determine the appropriate course of action to further address any significant potential gaps identified in the Study.

1.2 Regulatory Background

Agreement for Hazardous Waste Characteristics Scoping Study

The Administrator shall perform a study of potential gaps in the coverage of the existing hazardous waste characteristics. The purpose of the study is to investigate if there are gaps in coverage, and the nature and extent of the gaps identified. The potential gaps in coverage to be addressed in the study [shall] incorporate both waste management practices and possible impacts to human health and the environment. With respect to waste management practices, the study shall, at a minimum, address releases from non-hazardous waste surface impoundments; waste piles; land treatment units; landfills; and various forms of use constituting disposal such as road application, dust suppression or use in a product applied to the land. Human health and environmental impacts to be addressed by the study shall include, but not be limited to: (a) impacts via non-groundwater exposure pathways, both direct and indirect, to human and ecological receptors; (b) impacts via the groundwater pathway to ecological receptors; (c) the potential for formation of non-aqueous phase liquids in groundwater; and (d) impacts via the groundwater pathway to human receptors caused by releases of toxic constituents not included in the current toxicity characteristic, such as EPA-classified carcinogens, priority pollutants identified in the Clean Water Act, and solvents used for purposes other than degreasing. The Administrator shall complete the study by November 15, 1996, and shall provide the plaintiff with two copies of the study immediately upon completion.

Environmental Defense Fund, Inc. v. Browner, Civ. No. 89-0598, order granting stipulated motion of EDF and EPA for amendment of consent decree. May 17, 1996, pp. 18-19.

This report focuses on wastes that are not currently regulated as hazardous (by virtue of being listed or exhibiting a characteristic). Industrial wastes are classified either as "hazardous waste" and managed under Subtitle C of the Resource Conservation and Recovery Act (RCRA) or as "non-hazardous waste" and managed under Subtitle D of RCRA, primarily under state programs. In the context of this report, the term "non-hazardous industrial waste" broadly refers to waste that is neither municipal solid waste, special waste, nor considered a hazardous waste under Subtitle C of RCRA. A brief description of the Agency's hazardous and non-hazardous waste classification systems is provided below.

Subtitle C of RCRA, as amended, establishes a federal program for the comprehensive regulation of hazardous waste. Section 1004(7) of RCRA defines hazardous waste as

> "a solid waste, or a combination of solid wastes, which because of its quantity, concentration, or physical, chemical, or infectious characteristics may: (a) cause, or significantly contribute to an increase in mortality or an increase in serious irreversible, or incapacitating reversible, illness; or (b) pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, disposed of, or otherwise managed."

Under RCRA Section 3001, EPA is charged with defining which solid wastes are hazardous by identifying the characteristics of hazardous waste and listing particular hazardous wastes.

Current hazardous waste characteristics are ignitability, corrosivity, reactivity, and toxicity. The Agency's definitions of ignitability and reactivity have not changed materially since their adoption in 1980.[1] The Agency's definition for corrosivity was last revised in 1993.[2] The Agency's current definition of toxicity was promulgated in 1990,[3] replacing the Extraction Procedure (EP) leach test with the Toxicity Characteristic Leaching Procedure (TCLP) and adding 25 organic chemicals to the list of toxic constituents of concern and establishing their regulatory levels. The Agency's definition of toxicity was last revised in 1993;[4] however, this revision did not alter the framework for defining this characteristic.

A solid waste is classified as listed hazardous waste if it is named on one of the following four lists developed by EPA:

- Nonspecific source or F wastes (40 CFR 261.31). These are generic wastes, commonly produced by manufacturing and industrial processes. Examples include spent halogenated solvents used in degreasing and wastewater treatment sludge from electroplating processes as well as dioxin wastes, most of which are "acutely hazardous" wastes due to the danger they present to human health or the environment.

- Specific source or K wastes (40 CFR 261.32). This list consists of wastes from specifically identified industries such as wood preserving, petroleum refining, and

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[1] 45 *Federal Register* 33084, May 19, 1980.

[2] 58 *Federal Register* 46049, August 31, 1993.

[3] 55 *Federal Register* 26987, June 29, 1990.

[4] 58 *Federal Register* 46049, August 31, 1993.

organic chemical manufacturing. These wastes typically include sludges, still bottoms, wastewaters, spent catalysts, and residues.

- Discarded commercial chemical products or P and U wastes (40 CFR 261.33(e) and (f)). The third and fourth lists consist of specific commercial chemical products and manufacturing chemical intermediates. They include chemicals such as chloroform and creosote, acids such as sulfuric acid and hydrochloric acid, and pesticides such as DDT and kepone.

Disposal of non-hazardous solid waste is regulated under Subtitle D of RCRA. Subtitle D wastes include municipal solid waste, special waste, and industrial waste.

- Municipal solid waste includes household and commercial solid waste. Household waste is defined as any solid waste (including garbage, trash, and sanitary waste in septic tanks) derived from households (including single and multiple residences, hotels and motels, bunkhouses, ranger stations, crew quarters, campgrounds, picnic grounds, and day-use recreation areas) (40 CFR 258.2). Commercial waste refers to all types of solid waste generated by stores, offices, restaurants, warehouses, and other non-manufacturing activities, excluding residential and industrial wastes (40 CFR 258.2).

- Special waste, as used in this document, refers to oil and gas exploration and production waste, fossil fuel combustion wastes, cement kiln dust, and solid waste from the extraction, beneficiation, and processing of ores and minerals (40 CFR 261.4).

- Non-hazardous industrial waste refers to solid waste generated by manufacturing or industrial processes that is not a hazardous waste regulated under Subtitle C of RCRA or a special waste (40 CFR 258.2).

Under Subtitle D, the management of non-hazardous industrial waste in land-based units must comply with 40 CFR Part 257, which establishes minimum federal standards for the management and siting of land-based units. Individual states are responsible for implementing 40 CFR Part 257 under their own authority. They have adopted statutory and regulatory frameworks for management of non-hazardous industrial wastes. These requirements vary widely from one state to another in terms of their design and operating requirements, monitoring requirements, and other management requirements such as recordkeeping, closure, post-closure care, and financial responsibility. Even within a given state, the non-hazardous industrial waste requirements may vary from facility to facility depending on the characteristics of the wastes managed and the environmental setting of the waste management unit. The Agency is currently developing "voluntary guidelines" for non-hazardous industrial waste management to better ensure that this waste is managed in a manner that is protective of human health and the environment.

1.3 Approach for Studying Potential Gaps in the Hazardous Waste Characteristics

As shown in Exhibit 1-1, the general approach EPA used to perform the Scoping Study has nine steps. Each of these steps is discussed below.

Step 1: Characterize Releases from Non-Hazardous Industrial Waste Management

The Agency conducted detailed investigations to identify specific instances of environmental contamination resulting from the management of non-hazardous industrial wastes. These case studies provide real-world information on releases of these wastes into the environment, the chemicals released and their concentrations, and the waste management practices and industries involved. The preliminary findings of such research were presented in a draft report entitled "Hazardous Waste Characteristics Scoping Study: Environmental Release Descriptions" (September 24, 1996). EPA held a public meeting on October 10, 1996 to explain and obtain comments on the draft report. EPA has considered and, where appropriate, incorporated these comments in preparing this Scoping Study. Chapter 2 summarizes these investigations and Appendix A presents the individual environmental release descriptions.

Step 2: Categorize Risks Associated with Non-Hazardous Industrial Waste Management

This step identifies categories of risks to human health and the environment that may result from non-hazardous industrial waste management. The underlying premise of this step is that a gap in the hazardous waste characteristics is any significant risk to human health or the environment associated with non-hazardous industrial waste management that could be, but is not, addressed by the current characteristics. Thus, this assessment deals with both:

- Hazards that the current hazardous waste characteristics were intended to address, namely physical hazards such as fire and explosion and toxic groundwater contamination near waste management facilities; and
- Hazards that the characteristics were not intended to address, such as non-groundwater pathway exposures to toxins, damages to ecological receptors, and natural resource damages.

EPA identified risks by types of receptors, types of toxic effects and physical hazards, exposure pathways, and time and spatial scales, as described in Section 3.1. The search for potential risks used broad definitions of risk and adverse effects and addressed all aspects of non-hazardous industrial waste management, without any prejudgment as to the likelihood that a risk was significant, whether it could be best addressed by the characteristics, or whether it was already addressed by other regulations. The results of this risk classification step were used in identifying and evaluating potential gaps, as described below.

Step 3: Review the Existing Characteristics

The identification of potential gaps continues with a review of the existing definitions of the characteristics. This step is next for two reasons. First, limitations in the characteristics' effectiveness in reducing the risks they were intended to address may constitute important potential gaps. When the characteristics were promulgated, the Agency identified physical hazards and acute toxic hazards during transport and disposal activities and chronic exposure to groundwater contaminated with waste

Insert Exhibit 1-1 Scoping Study Approach

constituents as being among the most important waste management risks. Reducing these risks remains an important goal of the characteristics. Second, this analysis lays the groundwork for evaluating other potential gaps.

Step 3 begins by examining the definitions and test methods of the ignitability, corrosivity, and reactivity (ICR) characteristics, which are essentially unchanged since they were promulgated in 1980. EPA reviewed the assumptions and approaches used to develop these characteristics and compared the characteristics to approaches taken to controlling similar hazards under other federal and state regulatory schemes. Step 3 also examines the definition of the toxicity characteristic (TC), which was designed to protect against human health risks from exposure to hazardous waste constituents released to groundwater. EPA reviewed new information on the toxicity, fate, and transport of the TC constituents and improvements in groundwater modeling since the TC was revised in 1990. The Agency also examined the potential risks from TC constituents through inhalation, surface water, and indirect pathways and to ecological receptors. Chapter 3 describes these analyses.

Step 4: Identify Gaps Associated with Non-TC Chemicals

Potential gaps in the hazardous characteristics from non-TC chemicals are identified by, first, identifying two groups of constituents:

- **"Known" non-hazardous industrial waste constituents:** constituents "known" to be present in non-hazardous industrial wastes, based on the data gathered in the environmental release descriptions in Step 2, EPA's 1987 Telephone Screening Survey of non-hazardous industrial waste management facilities, EPA effluent guideline development documents, and recent hazardous waste listing determinations.

- **"Possible" non-hazardous industrial waste constituents:** constituents on various regulatory or advisory lists, which were screened for their toxicity, fate, and transport properties and for a proxy of their occurrence in non-hazardous industrial waste, using available environmental release data from the 1994 Toxics Release Inventory.

Then, these two lists of constituents are evaluated and compared and chemicals are classified by physical properties, chemical composition, use, and origin. Finally, potential gaps were identified by applying multiple hazard-based screening criteria to specific chemicals and chemical classes. Chapter 4 describes these analyses.

Step 5: Identify Potential Gaps Associated with Certain Natural Resource Damages and Large-Scale Environmental Problems

As discussed above, steps 3 and 4 respectively examine potential gaps inherent in the current hazardous waste characteristics and associated with adverse human health or localized ecological effects from constituents not addressed by the toxicity characteristic. Step 5 addresses a third set of risks associated with non-hazardous industrial waste management: damages to natural resources that may not have direct human health or ecological effects, and large-scale environmental problems. The specific risks addressed are:

- Pollution of groundwater by constituents that diminish the value and usability of the resource without threatening human health;

- Air pollution through odors that harm the quality of life but may not have severe health effects; and

- Large-scale environmental problems, including air deposition to the Great Waters, damages from endocrine disruptors and airborne particulates, global climate change, red tides, stratospheric ozone depletion, tropospheric ozone and photochemical air pollution and water pollution.

Chapter 5 presents these analyses.

Step 6: Review State Expansions of TC and State Listings

Several states have expanded their hazardous waste management programs to regulate as hazardous certain wastes or waste constituents that are not hazardous under the federal program. Step 6 examines how states have expanded their toxicity characteristics and have listed as hazardous certain wastes that are not listed under the federal program. (Step 3 examines how states have regulated additional wastes by expanding their ICR characteristics.) These expansions beyond the federal hazardous waste identification rules reflect state judgments about gaps in the federal hazardous waste program and thereby constitute potential gaps that may merit further investigation. Chapter 6 presents this analysis. (Chapter 7 summarizes the potential gaps identified in Chapters 3 through 6.)

Step 7: Evaluate the Industries and Waste Management Practices Associated with Potential Gaps

The evaluation of potential gaps asks two basic questions: (1) What do the qualitative and quantitative indicators of risk show about the potential gaps? and (2) To what extent are the risks associated with the potential gaps addressed by other regulations? Steps 7, 8, and 9 address these questions. Step 7 addresses aspects of the first question. Specifically, it assesses the following:

- The amount of non-hazardous industrial wastes generated by various industries;
- The frequency with which various chemicals were detected or reported in releases from various industries;
- The management methods associated with the major non-hazardous industrial waste generators; and
- The management practices associated with documented environmental releases of non-hazardous industrial wastes.

Because of data limitations, EPA could not evaluate all potential gaps against all of these criteria. Instead, this step focuses principally on the potential gaps identified in Steps 3 and 4. Chapter 8 presents this analysis.

Step 8: Assess Regulatory Programs' Coverage of Potential Gaps

The second major issue in evaluating potential gaps is the extent to which the risks are controlled by existing regulatory or other environmental programs. As noted above, risk-related gaps were identified solely in terms of their relationship to non-hazardous industrial waste management, and not with regard to whether they might be controlled under regulatory or other programs. Chapter 9 discusses how major federal and state regulatory programs may address some of the risks represented by the potential gaps. To the extent that they are already addressed or could be addressed more effectively by programs other than the hazardous waste regulations, the potential gaps may not merit further attention by the RCRA Subtitle C program.

Step 9: Present Integrated Evaluation of Nature and Extent of Potential Gaps

In the final step of the methodology, which is presented in Chapter 10, EPA integrates and summarizes all of the lines of evidence relating to particular potential gaps in the hazardous waste characteristics. The summary is presented in the form of several tables. This section also reviews the major data gaps and uncertainties of the analysis.

1.4 Report Outline

This Scoping Study is organized in the same order as the methodology outlined above.

Chapter 2	characterizes releases from non-hazardous industrial waste management;
Chapter 3	categorizes risks associated with potential gaps in the characteristics and reviews the existing characteristics to identify potential gaps;
Chapter 4	identifies potential gaps associated with non-TC chemicals;
Chapter 5	identifies potential gaps associated with certain natural resource damages and large-scale environmental problems;
Chapter 6	identifies potential gaps in the characteristics by reviewing how selected states have expanded the TC and listed wastes that are not listed as hazardous under the federal program;
Chapter 7	summarizes the potential gaps identified in Chapters 3 through 6;
Chapter 8	evaluates the extent of the risks presented by potential gaps;
Chapter 9	discusses how major federal and state regulatory programs address the risks represented by the potential gaps; and
Chapter 10	presents an integrated summary evaluation of the nature and extent of potential gaps and the associated major analytical limitations and describes the framework that the Agency will apply in developing a plan for addressing potential gaps in the hazardous waste characteristics identified in this Study.

The Study also includes several appendices. Appendix A describes the individual environmental releases summarized in Chapter 2. Appendix B discusses several data sources used to identify environmental releases that were not successful in finding releases meeting EPA's stringent selection criteria. Appendix C provides a detailed comparison of the ICR characteristics to related approaches under other federal and state programs. Finally, a separate background document contains detailed information and analysis that supplements the screening-level risk analysis presented in Chapter 3 and the identification of "possible" non-hazardous industrial waste constituents in Chapter 4.

CHAPTER 2. RELEASES FROM NON-HAZARDOUS INDUSTRIAL WASTE MANAGEMENT UNITS

This chapter presents the methodology and results of the Agency's efforts to identify contamination resulting from the management of non-hazardous industrial wastes. The Agency prepared a draft report entitled "Hazardous Waste Characteristics Scoping Study: Environmental Release Descriptions" which was released for public comment on September 25, 1996 (see 61 *Federal Register* 50295). This chapter summarizes the revised report, incorporating relevant comments on the draft report.

This chapter is composed of three sections:

- Section 2.1 discusses the criteria, information sources, and methodology used to select releases to include in the report;
- Section 2.2 summarizes the release descriptions and presents findings of the study; and
- Section 2.3 presents the major limitations of the study.

The environmental release descriptions described in this chapter are presented in Appendix A of this Scoping Study.

2.1 Methodology

Based on 1985 data, 7.6 billion tons of non-hazardous industrial waste are generated and managed on-site annually by 17 major industries in the United States. Despite this large volume of non-hazardous industrial waste, EPA has few data concerning the releases, human health impacts, or environmental damages caused by such wastes. To identify such releases for purposes of the Scoping Study, the Agency reviewed readily available information from a wide variety of data sources. The purpose of this review was not to estimate risks posed, but rather to characterize releases due to non-hazardous industrial waste management practices. This section discusses the criteria and methodology used to select releases.

2.1.1 Criteria For Selecting Releases

The Agency considered three major factors in judging whether a release is an appropriate case study for this report. To be included, a release had to meet all three of the criteria described below:

1. **Source of Release.** The source of contamination had to be a waste management unit that received only non-hazardous industrial waste. Releases were excluded if:
    a. Evidence suggested that the management unit also received municipal solid waste, special waste, or RCRA hazardous waste. Many facilities manage municipal, hazardous, and special wastes in the same waste management units as non-hazardous industrial waste. Releases from such units were not included in this report.

    b. The source of contamination could not be attributable solely to a non-hazardous industrial waste management unit. Releases were excluded where contamination (1) was detected at or near the facility, but the source of contamination was unknown; (2) was not from a waste management unit (e.g., was a product spill); or (3) was from a combination of non-hazardous industrial waste unit(s) and municipal, special, or hazardous waste unit(s).

   c. The source of contamination was industrial wastewater discharges that are point source discharges regulated under Section 402 of the Clean Water Act, as amended.

   d. The management method employed would be illegal in most states today. (Facilities were included if management practices would be legal today, even if no longer employed at a particular facility.)

2. **Evidence of Damage.** For purposes of the study, "damage" is considered to be a release exceeding one of the levels described below. All exceedences were examined for purposes of this scoping study. Exceedences may not actually represent significant risks. To be included in the Study, a release from a waste management unit must have caused contamination at levels of potential concern for that contaminated medium. Levels of potential concern used for this criterion were often based on federal or state drinking water standards for groundwater contamination and exceedences of background concentrations for soil contamination. Federal drinking water standards include maximum contaminant levels (MCLs) and secondary maximum contaminant levels (SMCLs)[1]. State drinking water standards, which are often stricter than the federal standards, also were considered. Releases were not included if contaminant concentrations were above background concentrations but below levels of potential concern. If at least one contaminant was detected at concentrations above a federal or state standard, then data were collected and presented for all contaminants detected at that site.

3. **Test of Proof.** Documented evidence must prove that a damage or danger from a non-hazardous industrial waste management unit has occurred. Evidence was accepted if it met one or more of the following three tests:

   a. <u>Scientific investigation</u>. Damages were found to exist as part of the findings of a scientific study. Such studies include both extensive formal investigations (e.g., in support of litigation or a state enforcement action) and the results of technical tests (e.g., monitoring of wells);

   b. <u>Administrative ruling</u>. Damages were found to exist through a formal administrative ruling, such as the conclusions of a site report by a field inspector, or through existence of an enforcement action that cited specific health or environmental dangers; and/or

   c. <u>Court decision</u>. Damages were found to exist through a ruling of a court of law or through an out-of-court settlement.

2.1.2 Approach For Identifying Releases

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[1] SMCLs are based on aesthetic considerations (e.g., taste and odor) and are not federally enforceable.

The Agency investigated eight major data sources to identify potential releases:

- State Industrial D programs;
- State Superfund programs;
- Federal Superfund program;
- Draft EPA report on construction and demolition waste landfills;
- Federal RCRA corrective action program;
- Other federal and state data sources;
- Newspapers; and
- Other literature searches.

EPA identified 112 facilities with environmental releases from 4 of the 8 data sources. As a result, this section summarizes the methodologies used to investigate only the four sources that resulted in case studies. Detailed descriptions of the other four methodologies are presented in Appendix B. Draft release descriptions were sent to facility owners/managers for data verification before inclusion in this final report.

Public Involvement

In the limited time available for preparing this Scoping Study, the Agency implemented a number of measures to involve the public in this aspect of the data collection effort. Specifically, the Agency contacted the States and facilities identified in the release descriptions to solicit comments on draft versions of the release descriptions. Concurrently, the Agency released a draft version of its "Hazardous Waste Characteristics Scoping Study: Environmental Release Description" report to the public for comment and review on September 25, 1996 (see 61 *Federal Register* 50295). This report was made available through the RCRA Information Center and the internet via EPA's web page. Next, the Agency conducted a public meeting on October 10, 1996 in Arlington, Virginia to solicit comments on the draft report. Finally, the Agency released a draft version of the individual release descriptions to the public for comment and review on October 29, 1996 (see 61 *Federal Register* 55800).

2.1.2.1 State Industrial D Programs

As specified under RCRA Subtitle D, states are the primary regulators of non-hazardous solid waste, also known as Subtitle D waste. EPA's role is largely limited to establishing guidelines for the development and implementation of state plans, providing technical assistance, and approving plans that comply with these requirements. States are responsible for developing and implementing their own plans. EPA identified states with potential case studies, then reviewed the state files for those potential case studies.

The Agency is currently preparing voluntary guidelines on management standards for non-hazardous industrial wastes. As part of this effort, in 1995, the Agency contacted representatives from every state in the continental United States and asked them to identify known or potential environmental damages caused by non-hazardous industrial waste management units.[2] The Agency visited and reviewed state files at four of the five states that reported the largest number of potential case studies, California, Texas, North Carolina, New Mexico, and Wisconsin, and prepared a report summarizing the results of the visits.[3] The Agency did not visit California because, at the time, California was preparing a comprehensive report on its Solid Waste Assessment Test (SWAT) program, which included detailed information on environmental releases at non-hazardous industrial waste disposal sites.

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[2] "Issue Paper: Potential Damage Cases From On-Site Disposal of Non-Hazardous Industrial Waste," August 1995.

[3] "Damage Cases: On-Site Disposal of Non-Hazardous Industrial Waste," September 1995.

For the Scoping Study, the Agency chose to investigate seven additional states based on the reported numbers of potential case studies for these States. Overall, the Agency focused its review of non-hazardous industrial waste data on 12 of the 16 states that indicated having at least 10 potential case studies. The Agency limited its review to these 12 states due to significant time constraints associated with the Scoping Study.

12 States Included in Analysis

California
Florida
Louisiana
Michigan
New Mexico
New York
North Carolina
Pennsylvania
Tennessee
Texas
Virginia
Wisconsin

As the first step in identifying relevant releases or case studies, the Agency contacted the states by telephone to discuss the requirements and purpose of the release descriptions. For states that housed their files regionally, the Agency contacted each regional office with potential case studies. After scheduling appointments to review the state files, the Agency visited states to review and collect information about the specific releases of non-hazardous industrial wastes into the environment at concentrations of concern. The Agency did not visit California. During these trips, the Agency reviewed readily available documentation on each potential case study and collected documentation for only those releases that appeared to meet all three of the criteria described in Section 3.1.1. Over 80 percent of the facilities identified as potential case studies were excluded from further review, primarily because the facilities co-disposed non-hazardous industrial waste with municipal, hazardous, or special waste, or because the environmental damages discovered at the facility could not be directly linked to a non-hazardous industrial waste management unit. On an as-needed basis, EPA also made follow-up contact with state personnel most knowledgeable about particular sites to obtain additional relevant information.

To ensure that facility-specific information was accurately compiled and presented, the Agency contacted the states and facilities by telephone to ask them to review the draft release descriptions prepared for this report. The Agency sent each state and facility their release descriptions, asked for their written comments on the descriptions, and incorporated relevant comments.

Review of California's Industrial D Data. In 1984, the California State legislature passed a law that required testing of water and air media at all solid waste disposal sites.[4] The law also required California's State Water Resource Control Board to rank all solid waste disposal sites in groups of 150 each, according to the threat these facilities or sites may pose to water quality. California's legislation requires site operators to submit a water quality "solid waste assessment test" (SWAT) report presenting the following information:

- An analysis of the surface and groundwater on, under, and within one mile of the solid waste disposal site to provide a reliable indication of whether there is any leakage of hazardous waste constituents; and

- A chemical characterization of the soil-pore liquid in those areas that are likely to be affected if the solid waste disposal site is leaking, as compared to geologically similar areas near the solid waste disposal site that are known to not have been affected by leakage or waste discharge.

To expedite the review of California's Industrial D data, the Agency obtained a copy of California's Solid Waste Assessment Test database. The Agency reviewed the database to identify those facilities believed to manage only non-hazardous industrial waste and found to have leaked waste constituents outside the limits of the waste

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[4] California Code of Regulations, Title 23, Section 13273.

management unit at levels above California or federal regulatory standards. California's waste classification system was used to identify facilities believed to manage only non-hazardous industrial waste.

The review of Industrial D data from 12 states identified a total of 104 releases that met the Agency's selection criteria. Hundreds of potential cases were reviewed to identify these releases.

Industrial D Case Studies Satisfying Criteria for Inclusion in the Scoping Study

California	29	Florida	6
Wisconsin	20	New York	6
Tennessee	9	North Carolina	6
Louisiana	7	Michigan	4
New Mexico	7	Virginia	3
Texas	6	Pennsylvania	1

2.1.2.2 State Superfund Programs

Abandoned or uncontrolled hazardous substance sites not addressed by the federal Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) program may be subject to remediation under the state Superfund programs. EPA believes that some of these sites may be contaminated with industrial wastes that would not be hazardous under the current RCRA Subtitle C requirements.

To expedite the process of identifying relevant sites and to cover the largest possible percentage of state Superfund sites, the Agency focused on the states with the largest programs. These states were identified according to the Environmental Law Institute's 1993 *Analysis of State Superfund Programs*.[5] In July 1996, the Agency identified and contacted 13 states listed as having at least 1,000 state Superfund sites. Personnel from each of the 13 states were asked whether they produce publicly available summaries of their state Superfund programs. The Agency obtained the most recent annual state Superfund reports for Missouri, New Jersey, New York, and Texas and obtained a printout of California's database for review. Due to the significant time constraints associated with its analysis, the Agency did not pursue information from other states, which lacked detailed, readily available information on their Superfund program.

State Superfund Programs with ≥ 1,000 Sites

California	✓	New York	✓
Illinois		Ohio	
Indiana		Pennsylvania	
Massachusetts		Tennessee	
Michigan		Texas	✓
Missouri	✓	Wisconsin	
New Jersey	✓		

✓ = State had readily available information.

Short published site descriptions for nearly 1,000 state Superfund sites from 5 states, California, Missouri, New Jersey, New York, and Texas, were reviewed to identify potential case studies that meet the Agency's selection criteria. A total of 60 sites were identified as potential case studies. The Agency contacted the five states by telephone to discuss the availability of existing information on those 60 sites. Two states (New York and Texas) indicated that they had additional information readily available for review. The Agency visited these states' Superfund offices to review and the additional information. The Agency identified one case study from New York as meeting all of the selection criteria.

2.1.2.3 Federal Superfund Program

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[5] Environmental Law Institute, "An Analysis of State Superfund Programs: 50-State Study, 1993 Update," prepared for U.S. Environmental Protection Agency's Office of Emergency and Remedial Response, December 1993.

The Agency investigated several CERCLA data sources to identify releases relevant to the Scoping Study. The vast majority of the CERCLA sites were not expected to meet the Agency's selection criteria for two reasons. First, the majority of the sites are contaminated with RCRA hazardous wastes or with releases or spills from products. These sites will not meet the Agency's selection criteria for source of release. Second, most of the CERCLA sites contaminated with non-hazardous industrial wastes are also expected to be contaminated with hazardous wastes. Therefore, it is unlikely that a non-hazardous industrial waste management unit will be identified as the source of the release at a CERCLA site.

Due in part to the large number (over 1,300) of CERCLA National Priority List (NPL) sites and the relatively small number of sites likely to meet the Agency's three release selection criteria, the Agency attempted to identify potential case study sites through telephone discussions with Regional EPA Superfund personnel and Regional members of the National Association of Remedial Project Managers and the National On-Scene Coordinator Association. Although the Regional Contacts agreed that the Agency should be able to identify at least a few case studies from the CERCLA program, they often were unable to identify specific sites. EPA Superfund staff in Region 4, however, identified two sites apparently meeting the Agency's selection criteria. The Agency visited Region 4's Superfund office and reviewed and copied the relevant files for these two sites. One of the two sites met the Agency's selection criteria.

The following federal Superfund data sources were also reviewed; however no releases meeting the Agency's selection criteria were identified:

- Record of Decision (ROD) database;
- CERCLA Natural Resource Damage Claims;
- CERCLA Characterization Database; and
- Exposure assessments performed by the Agency for Toxic Substances and Disease Registry (ATSDR).

2.1.2.4 Construction and Demolition (C&D) Landfill Report

On May 18, 1995, EPA's Office of Solid Waste published a draft report entitled *Damage Cases: Construction and Demolition Waste Landfills*. The report, prepared in support of EPA's rulemaking (60 *Federal Register* 30963, June 12, 1995) on conditionally exempt small quantity generators (CESQG),[6] presents information on environmental releases from construction and demolition (C&D) waste landfills, which receive materials generated from the construction or destruction of structures such as buildings, roads, and bridges. One purpose of the report was to determine whether the disposal of C&D waste in landfills has threatened or damaged human health or the environment.

The May 1995 report used three criteria to select potential C&D waste landfill damage cases.

- The landfill received predominantly C&D waste, with or without CESQG waste mixed in. C&D landfills known to have received significant quantities of municipal, industrial, or hazardous wastes were excluded.

- The use of the site as a C&D landfill had to be the only potential source of the observed contamination. Sites located near other potential sources of the contamination such as underground storage tanks were excluded.

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[6] Conditionally exempt small quantity generators (CESQGs) are defined as generators of less than 100 kilograms per month of hazardous waste. See 40 CFR 261.5.

- There was documented evidence of groundwater contamination, surface water contamination, or ecological damage at the site. "Contamination" was defined as an increase in chemical constituent concentrations above background or an exceedence of an applicable regulatory standard or criterion attributable to releases from the site.

In preparing the May 1995 report, the Agency searched for C&D landfills meeting these criteria using four information sources: existing studies of C&D landfills, materials available through the federal Superfund program, representatives of EPA Regions, and representatives of state and county environmental agencies.

The Agency identified 11 environmental releases in the May 1995 report. Although one of the Agency's criteria, as listed above, was to eliminate C&D landfills that received significant quantities of municipal or hazardous wastes, 5 of the 11 landfills received municipal, special, or hazardous wastes. Therefore, for purposes of this report, the Agency eliminated these five C&D landfill cases. Eliminating the landfills that managed even small quantities of municipal, special, or hazardous waste, ensures that the reported damages were caused by the non-hazardous industrial wastes, thereby meeting the Agency's selection criteria for the source of the release.

2.1.3 Release Profile Preparation

The release profiles presented in Appendix A to the Scoping Study were prepared using a standard format. This format is discussed below. Because the release profiles were prepared under significant time constraints using readily available data, detailed descriptions of the facility, wastes, and waste management practices could not be developed. The data often provided only a brief description of the facility and focused primarily on the results of the environmental sampling conducted at the facility.

"**Facility Overview**" discusses the facility's operations, how long the facility was or has been in operation, the location of the facility, surrounding land uses, the geologic and hydrogeologic conditions at the facility, and other environmental characteristics, provided this information was available.

"**Media Affected**" identifies whether the damages are associated with groundwater, surface water, soil, and/or ecological receptors.

"**Wastes and Waste Management Practices**" discusses the type(s) of wastes generated at the facility and the practices employed to manage the wastes including descriptions of the individual waste management units and groundwater monitoring practices, provided this information was available.

"**Extent of Contamination**" discusses the groundwater contamination, surface water contamination, and/or soil contamination at the site. Constituents detected in groundwater or surface water above background levels are identified and compared to applicable state and federal standards. The maximum detected concentration for all tested constituents are given. In reporting exceedences of state or federal standards, EPA attempted to exclude constituents whose upgradient or background concentrations were as high as those in downgradient wells.

"**Corrective Actions/Regulatory Actions**" discusses any corrective or regulatory actions that have been recommended, planned, or taken at the site.

"**Source**" simply identifies the information source(s) used to prepare the release profiles. The main source of information was the facility-specific files located in state offices.

2.2 Results

This section discusses the findings of the review of release data. It begins by summarizing the 112 documented release descriptions using the following five categories:

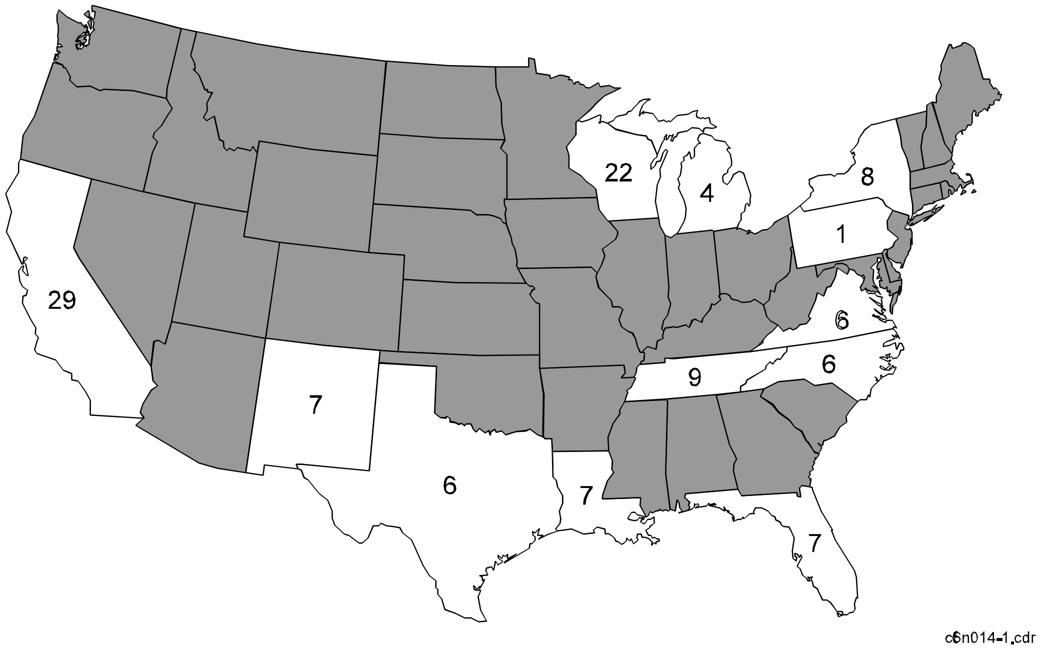
- Number of cases by state;
- Number of cases by industry;
- Number of cases by type of waste management method;
- Type of media affected; and
- Type and level of contaminants.

Later chapters of this report also present these and additional release description data.

2.2.1 Number of Cases By State

The 112 releases described in this chapter were found in 12 states. Because this report is a Scoping Study, these case studies were not intended to be geographically or statistically representative of the number of known or potential releases of non-hazardous industrial wastes identified by the Agency. Although these case studies are not statistically or geographically representative, they do illustrate the type of releases that have occurred from non-hazardous industrial waste management units in various parts of the country, as shown in Exhibit 2-1. The case studies were selected based on the availability of data. Due to the limited time available to collect data, the Agency largely focused its efforts on the states with the most available data on releases from non-hazardous industrial waste management units. This process identified releases in most areas of the nation, except the northwest, northern mountain states, and midwest. The states in these regions either were unable to identify any or identified few potential case studies in the Agency's 1995 efforts to estimate the number of potential releases from non-hazardous industrial waste management units by state.

Exhibit 2-1
Number of Release Descriptions By State



The available data on facilities that manage non-hazardous industrial waste indicate that the states addressed in this report manage some of the largest volumes of non-hazardous industrial waste. Also, seven of the 12 states represented in this report are among the 10 states with the largest number of on-site non-hazardous industrial waste management units in 1985. Exhibit 2-2 identifies the number

Exhibit 2-2
Number of Management Units & Volume of Waste Managed On-Site, by State (1985)

Rank by Number of Units	State	Number of Management Units in 1985[a]	1985 Volume Waste Managed (Million tons/yr.)[a]	Number of Release Descriptions
1	California	2,150	570	29
2	Texas	1,900	590	6
3	Wisconsin	1,720	60	22
4	Pennsylvania	1,475	940	1
5	Georgia	1,080	220	None
6	Illinois	1,005	265	None
7	Ohio	960	155	None
8	Vermont	940	5	None
9	Louisiana	890	170	7
10	North Carolina	855	240	6

Exhibit 2-2 (continued)
Number of Management Units & Volume of Waste Managed On-Site, by State (1985)

Rank by Number of Units	State	Number of Management Units in 1985[a]	1985 Volume Waste Managed (Million tons/yr.)[a]	Number of Release Descriptions
12	Virginia	800	150	6
13	Michigan	785	210	4
14	New York	740	30	8
15	Florida	740	310	7
21	Tennessee	510	245	9
41	New Mexico	140	10	7

[a] Source: "Telephone Screening Survey," U.S. Environmental Protection Agency, 1987.

of on-site management units and the volume of waste managed on-site in states. (See Chapter 8 for further discussion of waste generation by industry.)

2.2.2 Number of Cases By Industry

The releases documented in this report were from facilities in 15 2-digit Standard Industry Classification (SIC) codes. (Industry data are presented at the two-digit level because more specific classification were not readily available for many facilities.) Over 31 percent of the cases involve Electric, Gas, and Sanitary Services facilities (SIC 49). All of these facilities are in the refuse system sector (SIC 4953). The top four SIC codes are SIC 49: Electric, Gas, and Sanitary Services, SIC 26: Paper & Allied Products, SIC 28: Chemical & Allied Products, and SIC 20: Food & Kindred Products. These four industry groups represent nearly 75 percent of the releases studied or evaluated in this report. Exhibit 2-3 identifies the number of cases by industry.

Exhibit 2-3
Number of Case Studies by Industry (SIC)

Electric, Gas, & Sanitary Services (49)	35 (31%)
Paper & Allied Products (26)	27 (24%)
Chemical & Allied Products (28)	11 (10%)
Food & Kindred Products (20)	10 (9%)
Primary Metal Industries (33)	6 (5%)
Nonmetallic Minerals, Except Fuels (14)	4 (4%)
Petroleum & Coal Products (29)	4 (4%)
Fabricated Metal Products (34)	3 (3%)
Transportation Equipment (37)	3 (3%)

Exhibit 2-3 (continued)
Number of Case Studies by Industry (SIC)

Agricultural Production - Livestock (02)	2 (2%)
Electronic & Other Electric Equipment (36)	2 (2%)
Stone, Clay, & Glass Products (32)	2 (2%)
Apparel & Other Textile Products (23)	1 (1%)
Instruments & Related Products (38)	1 (1%)
Industrial Machinery & Equipment (35)	1 (1%)

These findings are generally consistent with the Agency's previous finding that four industries, Paper and Allied Products (SIC 26), Chemicals and Allied Products (SIC 28), Petroleum Refining & Related Industries (SIC 29), and Primary Metal Industries (SIC 33), generated more than 68 percent of the 7.6 billion tons of Industrial D waste managed on-site in 1985.[7] Although these case studies were identified based on available data and other selection criteria, the number of cases identified per industry and the volume of waste generated per industry appear to be positively correlated.

2.2.3 Number of Cases By Type of Waste Management Unit

Four major types of land-based treatment and storage units were identified in the case studies: landfills, surface impoundments, land application units, and waste piles. Exhibit 2-4 presents the number of case studies by waste management unit. Several cases studies discuss more than one unit, therefore, the total number of units is higher than the total number of case studies. Approximately 93 percent of the case studies involved landfills and/or surface impoundments. This finding may partly reflect the greater regulatory attention these units receive from the states, rather than necessarily imply that these units have more frequent releases than other types of waste management units. Over 90 percent of the landfills and 80 percent of the surface impoundments included in the case studies are unlined and over 70 percent of the units are no longer being used to manage non-hazardous industrial wastes.

All 50 states have developed regulations for surface impoundments. Approximately 90, 46, and 18 percent of the states have developed regulations specifically for landfills, land application units, and waste piles, respectively.[8] The large number of surface impoundments identified in this report is consistent with a finding of EPA's 1987 Telephone Screening Survey that slightly more than half of the facilities that generate and manage on-site non-hazardous industrial waste managed their wastes in

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[7] U.S. Environmental Protection Agency, Office of Solid Waste, "Non-Hazardous Waste Management: Priority Industries," draft, July 1993.

[8] U.S. Environmental Protection Agency, Office of Solid Waste, "State Requirements for Non-Hazardous Industrial Waste Management Facilities, September 1995.

Exhibit 2-4
Number of Case Studies By Waste Management Unit

Landfill	73
Surface Impoundment	31
Land Application Unit	12
Waste Pile	4

on-site surface impoundments. The 1987 survey also indicated that 35 percent of the facilities managed their wastes on-site in waste piles, 19 percent in landfills, and 18 percent in land application units.

Many states apply their non-hazardous industrial waste regulations on a site-by-site basis and, therefore, not all facilities in a state are subject to the same data collection and recordkeeping requirements. One recent report indicates that even states with waste pile regulations do not appear to be actively enforcing control, monitoring, and closure requirements, which may partly explain the small number of release descriptions for waste piles.[9]

The large number of landfills and surface impoundments in the release descriptions appears consistent with the type of management units used by the primary industries included in this report. Reportedly, the food processing industry has the largest number of non-hazardous industrial waste surface impoundments and land application units.[10,11] Other major industries identified in this report with a large number of surface impoundments and landfills include the paper, electric power, chemical, mining, and metal finishing industries.

2.2.4 Type of Media Affected

Nearly 98 percent of the case studies involved groundwater contamination. Approximately 31 percent of the case studies involved contamination of surface water or soil. No case studies had documented damages from releases to the air and nearly 30 percent of the case studies affected multiple media.

The predominance of groundwater contamination is consistent with the use of groundwater monitoring as the most common method of detecting releases from waste management units. Surface water is not as routinely monitored as groundwater. Surface water sampling is seldom conducted at a facility until a release is identified. Soil sampling is conducted much less frequently than groundwater monitoring, and like surface water sampling, is seldom conducted until a release has been identified. Few states regulate air emissions from non-hazardous industrial waste management units. Thus, it is not surprising that no cases of damage from releases to the air were documented in the case studies collected for this report.

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[9] "State Regulation of Waste Piles, EI Digest Industrial and Hazardous Waste Management," April 1996, pages 16 to 21.

[10] "Nonhazardous Industrial Surface Impoundments: State Regulations and the Environmental Marketplace," Environmental Information, Ltd., 1996, pages 3 to 7.

[11] "State Requirements for Nonhazardous Waste Land Application Units, EI Digest Industrial and Hazardous Waste Management," May 1996.

2.2.5 Types of Contaminants Released

The number of and types of contaminants routinely analyzed for in groundwater and other types of samples varies among states and facilities. Although most facilities included in the case studies were monitored for a wide range of constituents, the 20 constituents most commonly detected to exceed regulatory levels were inorganics. Approximately 50 constituents were detected three or more times, and 70 constituents were detected fewer than three times. Exhibit 2-5 identifies all of the TC constituents that were detected in the case studies, Exhibit 2-6 presents all of the constituents with SMCLs that were identified in the case studies, and Exhibit 2-7 identifies the other constituents that were detected in at least three case studies. The exhibits also identify the number of cases where each constituent was detected, the number of times the constituent was detected above at least one regulatory level, the regulatory levels, the average maximum and the highest maximum detected concentration identified in the case studies, and the range of the ratio of the highest detected constituent concentrations to regulatory standards. Note, only constituents with regulatory standards are included in Exhibits 2-5, 2-6, and 2-7.

Many inorganic constituents were elevated in groundwater monitoring wells. Constituents that exceeded state groundwater protection standards or federal drinking water standards most frequently were:

- Iron (49 detections)
- Chloride (32 detections)
- Manganese (34 detections)
- Sulfate (29 detections)
- Lead (22 detections)
- Chromium (21 detections)
- Cadmium (17 detections)
- Benzene (16 detections)
- Arsenic (15 detections)
- Zinc (13 detections)
- Aluminum (12 detections)
- Nitrate (12 detections)

Six of the constituents identified above (iron, chloride, manganese, sulfate, zinc, and aluminum) have drinking water standards that are based only on SMCLs.

A total of 25 TC constituents have been detected in the release descriptions. Exhibit 2-5 identifies 20 of the 25 TC constituents detected. Five TC constituents (2,4,6-trichlorophenol, 2,4-dinitrotoluene, o-cresol, p-cresol, and methyl ethyl ketone) were not included in Exhibit 2-5 because there were no federal or state standards established for them. All but 2 of the 20 TC constituents identified in Exhibit 2-5 (carbon tetrachloride, 1,4-dichlorobenzene) were detected above a federal or state standard. The majority (85 percent) of the TC constituents detected above a federal or state standard exceeded the standards by at least 1 time, 60 percent exceeded by 10 times, 50 percent exceeded by 100 times, 20 percent exceeded by 1,000 times, 10 percent exceeded by 10,000 times, and none exceeded by at least 100,000 times. The average maximum detected concentrations for five of the TC constituents (arsenic, benzene, selenium, vinyl chloride, and lindane) exceeded the TC

Exhibit 2-5
TC Contaminants Detected in Case Studies

Constituent	TC Level (mg/l)	Case Studies With Detected Constituents	Case Studies with Detected Concentrations Above Federal/ State Standards	Range of Federal/State Standards (mg/l)	Average Maximum Detected Concentration (mg/l)	Highest Maximum Detected Concentration (mg/l)	Ratio of Highest Detected Concentration to Federal/State Standards
Lead	5	37	22	0.0015 - 0.05	1.3	28	560 - 18,667
Chromium	5	36	21	0.01 - 0.1	2.3	58	580 - 5,800
Arsenic	5	29	15	0.005 - 0.05	28.4	595	11,900 - 119,000
Cadmium	1	28	17	0.0004 - 0.005	0.2	3	600 - 7,500
Barium	100	28	11	0.2 - 2	31.1	630	315 - 3,150
Benzene	0.5	23	16	0.0005 - 0.001	1.4	15	15,000 - 30,000
Mercury	0.2	19	6	0.0002 - 0.002	0.002	0.007	3.5 - 35
Selenium	1	18	6	0.01 - 0.05	2.2	27	540 - 2,700
Trichloroethylene	0.5	15	7	0.0005 - 0.005	0.03	0.14	28 - 280
Vinyl chloride	0.2	13	6	0.0002 - 0.002	2.9	8.6	4,300 - 43,000
Silver	5	12	3	0.01 - 0.1	0.006	0.01	0.1 - 1
Chlorobenzene	100	9	2	0.05	0.025	0.05	1
Chloroform	6	8	2	0.0006 - 0.08	0.11	0.4	105 - 667
Tetrachloroethylene	0.7	7	3	0.005	0.0085	0.026	5
1,4-Dichlorobenzene	7.5	5	0	0.015 - 0.075	0.017	0.035	0.5 - 2.3
Carbon tetrachloride	0.5	4	0	0.005	0.0017	0.004	0.8
Pentachlorophenol	100	2	2	0.001	0.036	0.063	63
Lindane	0.4	2	2	0.0002	0.66	1.2	6,000
1,2-Dichloroethane	0.5	2	2	0.005	0.016	0.02	4
Heptachlor	0.008	1	1	0.0004	0.002	0.002	5

Exhibit 2-6
Contaminants with SMCLs Detected in Case Studies

Constituent/ Property	Case Studies With Detected Constituents	Case Studies with Detected ConcentrationsAbove Federal/State Standards	Range of Federal/State Standards (mg/l)	Average Maximum Detected Concentration (mg/l)	Highest Maximum Detected Concentration (mg/l)	Ratio of the Highest Detected Concentration to Federal/State Standards
pH	66	24	6.5 - 8.5 (unitless)	5.4 (unitless)	12.4 (unitless)	1.5 - 1.9
Iron	54	49	0.15 - 0.3	244	4,400	14,667 - 29,333
Chloride	52	32	125 - 250	1,825	37,200	149 - 297
Sulfate	50	29	125 - 500	2,273	26,000	52 - 208
Total dissolved solids	48	30	500 - 1,000	7,033	98,164	98 - 196
Manganese	39	34	0.0025 - 0.3	10	97	323 - 3,880
Zinc	33	13	0.05 - 5	20	262	52 - 5,240
Copper	17	2	0.13 - 1.3	0.15	0.9	0.7 - 7
Aluminum	12	12	0.05 - 0.2	235	1,933	9,665 - 38,660
Fluorides	12	4	0.44 - 4	12	98	25 - 223

Exhibit 2-7
Other Contaminants Detected in At Least Three Case Studies

Constituent	Case Studies With Detected Constituents	Case Studies with Detected ConcentrationsAbove Federal/State Standards	Range of Federal/State Standards (mg/l)	Average Maximum Detected Concentration (mg/l)	Highest Maximum Detected Concentration (mg/l)	Ratio of the Highest Detected Concentration to Federal/State Standards
Sodium	40	8	20 -160	1,292	15,600	98 - 780
Nitrate	33	12	2 - 10	46	560	56 - 280
Magnesium	32	3	35 - 420	140	1,495	4 - 43
Toluene	20	7	0.07 - 1	0.62	6.7	7 - 96
Phenol	18	10	0.001 - 1.2	6.3	60	50 - 60,000
Ammonia	16	2	2	55.3	410	205
Nickel	14	4	0.08 - 0.1	0.1	0.5	5 - 6.3
Nitrite	11	9	1	18.9	64	64
Xylenes	10	1	0.124 - 10	2	4.8	0.5 - 39
1,1-Dichloroethane	10	0	0.7	0.18	1	1
Acetone	9	1	0.7	1.4	10.6	15
Nitrogen	8	0	2 - 10	8.1	57.6	6 - 29
Dichloromethane	7	4	0.005 - 0.015	0.6	4	267 - 800
Ethylbenzene	7	3	0.14 - 0.7	0.3	0.9	1.3 - 6.4
Vanadium	7	0	0.014	0.1	0.4	31
cis-1,2-Dichloroethylene	7	3	0.07	0.081	0.24	3
Beryllium	7	6	0.004 - 1.1	0.25	1.7	2 - 425
Cyanide	6	2	0.04 - 0.2	0.09	0.4	2 - 10
Boron	6	1	2.9	40.4	82	28
Cobalt	5	0	0.005	0.083	0.16	32
Naphthalene	5	1	0.008	3.3	14.2	1,775
Antimony	5	4	0.006	0.67	3	500
trans-1,2-Dichloroethylene	4	1	0.01	0.0016	0.052	5
Thallium	4	2	0.002	0.0048	0.01	5

regulatory levels established for these constituents and the highest maximum detected concentrations for over half of the identified TC constituents exceed TC regulatory levels.

All SMCLs or similar state standards, except those for foaming agents, color, odor, and corrosivity, were violated by one or more release descriptions. As shown in Exhibit 2-6, the majority (90 percent) of the SMCL constituents exceeded the standards by at least 1 time, 80 percent exceeded by 10 times, 40 percent exceeded by 100 times, 20 percent exceeded by 1,000 times, 10 percent exceeded by 10,000 times, and none exceeded by at least 100,000 times. (Because silver has both a TC level and an SMCL, it is included in Exhibit 2-5 with the other TC constituents.) SMCLs are based on aesthetic considerations (e.g., taste and odor) and are not federally enforceable. Therefore, exceedences of the SMCLs do not necessarily indicate a potential danger to human health or the environment. Sixteen of the case studies (14 percent) were identified based only on an exceedence of an SMCL. This type of contamination is discussed further in Chapter 5.

Exhibit 2-7 identifies 24 other constituents that were detected in the release descriptions. All but four of the constituents in Exhibit 2-7 (1,1-dichloroethane, nitrogen, vanadium, and cobalt) were detected above a federal or state regulatory level. Half (50 percent) of these other constituents exceeded one of the standards by at least 10 times, 13 percent exceeded by 100 times, 4 percent exceeded by 1,000 times, and none exceeded by at least 10,000 times.

Constituents managed in landfills were detected in samples nearly three times more frequently than constituents managed in surface impoundments. All of the constituents presented in Exhibits 2-5, 2-6, and 2-7 are associated with wastes managed in landfills. Approximately 81 percent of the constituents are associated with both landfills and surface impoundments, 33 percent are associated with landfills, surface impoundments, and land application units, 33 percent are associated with landfills, surface impoundments, and waste piles, and 12 percent are associated with all 4 waste management units. The constituents that are associated only with landfills are antimony, beryllium, boron, cobalt, cyanides, silver, and thallium.

Exhibit 2-8 identifies the 10 constituents for each of the 6 industries that were identified most frequently in the case studies. As the exhibit illustrates, inorganics are the most commonly detected chemicals. The commonly detected constituents are chloride, pH, iron, lead, total dissolved solids, manganese, sulfate, magnesium, zinc, and arsenic.

2.3 Major Limitations

The findings presented in this chapter must be interpreted with care for several reasons, including the limited time available to collect data, potentially unrepresentative data, and the Agency's stringent release selection criteria. Each of these major limitations is discussed in detail below.

Data were collected under significant time constraints. The significant amount of data included in this chapter were collected and analyzed over a four-month period. During this time the Agency reviewed previously collected data, readily available databases, and reports; identified and contacted appropriate state and federal personnel; visited state and EPA Regional offices; reviewed facility files; prepared case study summaries; developed a database to analyze the data; performed QA/QC on the data; sent draft case studies to states and facilities for review; prepared a draft report for public review; and incorporated comments into the report, as appropriate. Due to the time constraints of the consent decree, the Agency had to carefully prioritize its efforts and, in doing so,

Exhibit 2-8
Most Common Constituents By Industry

Industrial Classification Code (SIC)	Constituent	Number of Case Studies in Which the Constituent Was Detected
Refuse Systems (495)	pH*	19
	Iron*	14
	Manganese*	13
	Sulfate*	13
	Lead	12
	Chloride*	11
	Magnesium	10
	Nitrate	10
	Total dissolved solids*	10
	Trichloroethylene	10
Paper & Allied Products (26)	pH*	22
	Chloride*	21
	Iron*	21
	Sulfate*	20
	Sodium	15
	Calcium carbonate	12
	Calcium	11
	Magnesium	11
	Zinc	11
	Total dissolved solids*	10
Chemical & Allied Products (28)	Benzene	7
	Chromium	7
	Iron*	7
	Lead	6
	Manganese*	6
	Sulfate*	6

Exhibit 2-8 (continued)
Most Common Constituents By Industry

Industrial Classification Code (SIC)	Constituent	Number of Case Studies in Which the Constituent Was Detected
Chemical & Allied Products (28) (Cont.)	Total dissolved solids*	6
	Zinc	6
	Arsenic	5
	Chloride*	5
Food & Kindred Products (20)	Nitrite	6
	Nitrate	5
	Nitrogen	5
	pH*	4
	Total dissolved solids*	4
	Total filterable residue	4
	Calcium	3
	Chloride*	3
	Magnesium	3
	Sodium	3
Non-Metallic Minerals, Except Fuels (14)	Arsenic	4
	Iron*	4
	Lead	4
	Manganese*	4
	pH*	4
	Cadmium	3
	Chloride*	3
	Copper	3
	Nickel	3
	Potassium	3

Exhibit 2-8 (continued)
Most Common Constituents By Industry

Industrial Classification Code (SIC)	Constituent	Number of Case Studies in Which the Constituent Was Detected
Primary Metal Industries (33)	Lead	4
	Chromium	3
	Aluminum	2
	Arsenic	2
	Barium	2
	Cadmium	2
	Chloride*	2
	Mercury	2
	Nickel	2
	Zinc	2

* Constituents with Secondary Maximum Contaminants.

may have eliminated or missed a number of potential case studies that could have been included in the report if additional data were available and/or additional time was spent collecting and reviewing data.

Data may be unrepresentative and/or out-of-date. In this report, the Agency did not attempt to estimate the proportion of non-hazardous management facilities currently experiencing constituent releases. Due primarily to the limited time available for data collection and analysis, the Agency relied upon readily available data. The Agency did not perform any new sampling or collect new data from facilities managing non-hazardous industrial wastes. Nor did the Agency perform a comprehensive review of previously collected state and federal data for all non-hazardous industrial waste management facilities. State file reviews were conducted in one to three days per state and were limited to those states that indicated having files of release incidents that met the Agency's selection criteria. Although the collection of release descriptions is not statistically representative in any way, these cases are indicative of the type of releases associated with the management of non-hazardous industrial waste.

Because only readily available data were analyzed, the data may not reflect current waste generation and management practices at the particular facility. Environmental contamination resulting from waste disposal practices may take many years to become evident; some releases described in this report occurred over 20 years ago. The documented releases may have resulted from particular waste generation and disposal practices or other conditions that no longer exist. Specifically, process feedstocks, processing operations, waste characteristics, and/or waste management practices may have changed. Facilities may no longer manage their wastes in unlined units or in environmentally sensitive areas. Therefore, releases associated with a waste do not necessarily demonstrate that current waste management practices or regulations need to change. Conversely, the failure of a site to exhibit documented damages at present does not necessarily suggest that waste management has not or will not cause damage. The Agency, however, believes that information on dangers posed by past waste management practices is useful in demonstrating the potential for human health or environmental damages.

The extent to which the findings can be used to draw conclusions concerning the relative performance of waste management practices among states or across industry sectors is also severely limited by variations in recordkeeping, monitoring, and other state requirements. Recordkeeping and monitoring procedures vary significantly among the states. Several states have complete and up-to-date central enforcement or monitoring records on facilities that generate and manage non-hazardous industrial wastes. Where states have such records, information on releases may be readily available. Thus, states with the most complete and accessible monitoring information on non-hazardous industrial wastes may appear to have more releases than states with less centralized information management programs.

Stringent selection criteria. The Agency developed stringent selection criteria to help focus its data collection efforts and to avoid any misrepresentation of release incidents. By focusing solely on releases clearly associated with non-hazardous industrial waste management units, the Agency excluded numerous release incidents caused by accidental releases and spills of products. Although these incidents may have been caused by hazardous constituents similar to those managed in non-hazardous industrial waste management units, and may pose similar hazards, the Agency did not analyze these cases, largely because of the inability of RCRA to prevent product releases.

The Agency also excluded release incidents that could not be linked to specific facilities. Thus, cases of groundwater and surface water contamination caused by multiple facilities were excluded because the source of the releases could not be associated with specific facilities or waste management units.

The Agency also excluded numerous release incidents associated with facilities that manage hazardous, municipal, or special wastes in addition to non-hazardous industrial waste. Facilities that manage hazardous, municipal, or special wastes frequently co-dispose of their non-hazardous industrial wastes in the same or adjacent waste management units. Due to the close proximity of these different units, sampling results generally cannot identify the specific unit associated with the release. Thus, the Agency excluded cases where non-hazardous industrial waste was managed in the same or adjacent waste management units as hazardous, municipal, or special wastes, because the source of the release could not clearly be associated with the non-hazardous industrial waste.

CHAPTER 3. POTENTIAL GAPS ASSOCIATED WITH HAZARDOUS WASTE CHARACTERISTICS DEFINITIONS

This chapter examines how well the existing hazardous waste characteristics address the types of risk they were intended to address, that is, their target risks. It also addresses certain other or non-target risks that are closely associated with the definitions of the hazardous characteristics. This evaluation of potential gaps begins by examining the characteristics' definitions and test methods. This approach is used for two reasons. First, limitations in the characteristics' effectiveness in reducing their target risks may themselves constitute important potential gaps. When the characteristics were promulgated, the Agency identified physical hazards and acute toxic hazards during transport and disposal activities, along with chronic exposure to groundwater contaminated with specific waste constituents, as being among the most important waste management risks. Reducing these risks remains an important goal of the characteristics. Second, this analysis lays the groundwork for evaluating other potential gaps. Specifically, risk-based screening methods are used to evaluate non-target risks from non-ground-water pathways associated with the toxicity characteristic (TC) analytes. The findings of that analyses are used to identify potential gaps associated with a wider universe of known and possible non-hazardous industrial waste constituents, as discussed in Chapter 4.

This chapter revisits many of the assumptions and approaches used to develop the existing hazardous waste characteristics. The ignitability, corrosivity, and reactivity (ICR) characteristics are essentially unchanged since their initial promulgation in 1980. The TC characteristic was revised in 1990, but has not changed materially since then. Potential gaps in these characteristics may be identified if the state of knowledge about risks addressed by the characteristics has improved since the characteristics were promulgated; risks that were not specifically addressed may now be identified as more important, such as risks from releases to surface water, inhalation, and indirect pathways and ecological risks. In addition, the tests used to identify wastes with hazardous characteristics do not reliably identify all of the risks the characteristics were intended to address.

The following sections address these issues. Section 3.1 reviews the statutory and regulatory language related to the types of risks the hazardous waste characteristics were intended to address and discusses the major categories of waste management risks addressed and not addressed by the current characteristics. Sections 3.2 through 3.4 discuss potential gaps associated with the ignitability, corrosivity, and reactivity characteristics, respectively. In addition, a detailed comparison of the ICR characteristics can be found in Appendix C. Section 3.5 discusses the potential gaps associated with the toxicity characteristic, including updated risk information on the TC analytes. Section 3.6 evaluates the toxicity characteristic leaching procedure (TCLP) as a predictor of constituent releases and potential risk.

3.1 Types of Risks Addressed by RCRA Hazardous Waste Characteristics

3.1.1 Statutory and Regulatory Framework

The RCRA hazardous waste characteristics are a vital part of the comprehensive program of hazardous waste management established by Subtitle C of RCRA, as amended. Three provisions of the RCRA statute are particularly relevant to identifying and expanding the hazardous waste characteristics (and listing hazardous wastes).

- First, Section 1004(7) defines hazardous waste as "a solid waste, or combination of solid wastes, which because of its quantity, concentration, or physical, chemical, or infectious characteristics may (A) cause, or significantly contribute to an increase in mortality or an increase in serious irreversible, or incapacitating reversible, illness; or (B) pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, or disposed of, or otherwise managed." This definition indicates the general types of risks that the hazardous waste management regulations are meant to address.

- Second, Section 3001(a) requires EPA to "develop and promulgate criteria for identifying the characteristics of hazardous waste, and for listing hazardous wastes, . . . taking into account toxicity, persistence, and degradability in nature, potential for accumulation in tissue, and other related factors such as flammability, corrosiveness, and other hazardous characteristics. Such criteria shall be revised from time to time as may be appropriate."

- Third, Section 3001(b) requires EPA to "promulgate regulations identifying the characteristics of hazardous waste, and listing particular hazardous wastes, . . . which shall be based on the criteria promulgated under [Section 3001(a)] and shall be revised from time to time thereafter as may be appropriate." The Section also requires EPA to "identify or list those hazardous wastes which shall be subject to the [hazardous waste regulations] solely because of the presence in such wastes of certain constituents (such as identified carcinogens, mutagens, or teratogens) at levels in excess of levels which endanger human health."

In response to the mandate of Section 3001(a), EPA promulgated two sets of criteria for identifying the characteristics of hazardous waste in 40 CFR 261.10(a). The first set of criteria reflects the statutory definition of hazardous waste and the types of risks that the characteristics are intended to address:

> "(1) The solid waste may
>
> > (i) cause, or significantly contribute to, an increase in mortality or an increase in serious irreversible, or incapacitating reversible, illness; or
> >
> > (ii) pose a substantial present or potential hazard to human health or the environment when it is improperly treated, stored, transported, disposed, or otherwise managed."

The second set of criteria considers implementation factors:

> "(2) The characteristic can be
>
> > (i) measured by an available standardized test method which is reasonably within the capability of generators of solid waste or private sector laboratories that are available to serve generators of solid waste; or
> >
> > (ii) reasonably detected by generators of solid waste through their knowledge of their waste."

As stated in the May 19, 1980, final rule, EPA adopted the second set of criteria because the primary responsibility for determining whether wastes exhibit a characteristic rests with generators, for whom standard and available testing protocols are essential.[1] This Scoping Study addresses these criteria for the current

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[1] 45 *Federal Register* 33108-33110, May 19, 1980.

characteristics in only a general way. The Agency, however, will carefully consider these factors when deciding the appropriate course of action for addressing any potential gaps in coverage that are identified in this Study.

The following sections review the nature of the risks to human health and environment potentially posed by non-hazardous industrial waste management. These risks are associated with physical hazards, acute toxic hazards to humans, chronic toxic hazards to humans, risk to non-human receptors, and other hazards. In the discussion below, risks addressed by the hazardous waste characteristics are distinguished from those risks not directly or adequately addressed. The purpose of this section is to develop a preliminary list of possible gaps in the characteristics. At this stage, few judgments are made as to the nature and severity of any potential gaps. Instead, the remainder of this Report investigates these potential gaps.

3.1.2 Risks Associated with Physical Hazards

Physical hazards include agents that cause direct physical harm such as thermal burns, wounds, contusions, or eye injuries, in contrast to agents causing harm through chemical burns or toxic effects. These hazards are controlled primarily through the ignitability, corrosivity, and reactivity (ICR) characteristics. EPA patterned these characteristics after similar regulations promulgated by the U.S. Department of Transportation, the National Fire Protection Association, and other organizations.

The ICR characteristics are intended primarily to protect waste management and transportation workers against hazards often associated with hazardous materials. These hazards include flammability, explosivity, and the propensity to react violently with other wastes, corrode containers, and directly injure skin and eyes during transport or management activities. In addition, these characteristics are intended to prevent the facilitated release and transport of hazardous waste constituents. For example, the corrosivity test is designed, in part, to identify wastes that, because of their acidity or basicity, may facilitate the solubilization of metals from wastes. This solubilization increases the potential impact of metals in groundwater, thereby increasing the likelihood of risks to human health via contaminated groundwater.

For the purposes of this Scoping Study, the question is: What physical risks may arise from the management of non-hazardous industrial wastes that are currently not covered by the characteristics? Several potentially significant physical risks are not effectively addressed by the hazardous characteristics. Some of the potential gaps arise from specific definitions of the ICR characteristics. These potential gaps, which are discussed in more detail in Sections 3.2 through 3.4, include:

- The lack of coverage of corrosive solids;
- The decision not to address liquids with moderate flash points;

- Limitations in the test procedures prescribed for reactivity; and
- Potential limitations of pH as an adequate indicator of corrosivity.

These issues relate to protecting waste management and transportation workers from physical injuries, except where explosions or fire might release toxic particulates that could harm nearby residents. Physical hazards to residents near management facilities are not considered, based on the assumption that the general public has limited access to non-hazardous industrial waste management facilities.

Other physical concerns relate to facilitated pollutant transport. For example, the corrosivity characteristic was not intended to address corrosion to liners or any materials other than steel or to prevent facilitated transport of organic chemicals through solubilization in discarded solvents. EPA considered, and decided to omit, a “solvent override” provision in the 1990 TC rule that would have classified as hazardous wastes with more than a specified concentration of hazardous organic solvents. The Agency, however, left open the possibility that such a provision could be reconsidered if additional data warrant it.[2] A related issue is the potential formation of dense and light non-aqueous phase liquids (DNAPLs and LNAPLs). They are a potential concern both because they may facilitate pollutant transport and they have the potential for damaging groundwater resources and generating high remediation costs. Section 4.4 discusses the issue of DNAPL and LNAPL formation.

3.1.3 Acute Toxic Hazards to Humans

The hazardous waste characteristics address some potential health risks from acute exposures to toxic chemicals. They limit the potential for release of toxic chemicals during transportation, storage, treatment, and disposal and resulting from fires, explosions, or violent reactions. There are no specific quantitative benchmarks that define acceptable acute exposure limits, however. The main focus of the ICR characteristics is on protecting workers, although the general public is implicitly protected under the assumption that protecting on-site workers would protect more distant resident populations as well. Sections 3.2 through 3.4 discuss potential gaps in the ICR characteristics.

The characteristics were not intended to protect against other acute systemic toxicity hazards. Direct contact with a waste, in theory, could result in the absorption of an acutely toxic dose of a waste constituent from a non-corrosive waste. The Agency, however, considered this scenario to be highly improbable for non-hazardous industrial waste mismanagement. Similarly, acute exposures via contaminated surface or groundwater are possible, but were considered much less likely to be important than chronic toxicity under most circumstances. Because the TC focuses on the groundwater pathway, with the attendant long-term transport and dilution of pollutants, EPA assumed that chronic exposures would be dominant in determining the potential for adverse health effects. Section 3.5.6 discusses the potential for acute adverse effects of exposure to the TC analytes and Section 4.6 addresses acute risks from non-TC constituents.

3.1.4 Chronic Toxicity Risks to Humans

As noted above, EPA intended the TC to be the major vehicle for controlling chronic health risks, although the reactivity and corrosivity characteristics also were intended to prevent releases that facilitate exposure to waste constituents. Although RCRA Section 3001 identifies a range of types of toxic effects of concern (toxicity, carcinogenicity, mutagenicity, and teratogenicity), the implementation of the TC is limited to 40 chemicals for which toxicity and groundwater fate and transport data were available when the Agency revised the characteristic in 1990. In addition, the levels of protectiveness achieved by the TC leachate concentration standards were determined using fate and transport models and assumptions that were current at the time. To the extent that the

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[2] 55 *Federal Register* 11809, March 29, 1990.

toxicity data and groundwater fate and transport models have changed or improved in the six years since the TC was promulgated, its expected level of protectiveness may also have changed. Section 3.5 discusses in detail potential gaps associated with the level of protectiveness of the TC in light of recent advances in toxicology and groundwater modeling.

The TC was not intended to address several potentially important risks. These risks have been identified as significant contributors to risks from some hazardous waste constituents and management technologies, and might apply to non-hazardous industrial waste management as well. Probably the most important risks potentially not directly addressed by the TC are associated with exposure pathways other than groundwater. The TC did not attempt to address these risks because groundwater was thought to be the dominant risk pathway for waste management. Upon re-examining potential non-hazardous industrial waste management and mismanagement scenarios, however, EPA recognizes that other pathways also may be important.

One pathway not directly addressed by the TC is the direct inhalation of volatile or particulate-bound waste constituents to air from waste management units during normal operation or after closure. Such exposures to on-site workers and off-site receptors through direct inhalation may be significant for some constituents. Other potentially important pathways include the surface water pathway and “indirect” pathways arising from air releases (e.g., air deposition to crops), runoff, and the discharge of contaminated groundwater to surface water. Also, bioaccumulation of certain contaminants in aquatic and/or terrestrial food chains could result in human exposures through the consumption of contaminated fish, shellfish, livestock, and game animals. In Section 3.5, a screening-level risk assessment and other information clarify the significance of these pathways for the TC analytes. Chapter 4 extends the screening-level analysis to non-TC constituents.

3.1.5 Risks to Non-Human Receptors

Neither the TC nor the ICR characteristics were established specifically to reduce risks to non-human receptors. Such risk reduction, to the extent that it occurs, is a byproduct of the control of human health risks. For example, by preventing pollutant releases from fires and explosions or reducing pollutant transport, the characteristics protect the environment as well as human health. The quantitatively-defined levels of protection incorporated into the TC leachate concentration limits were based on human toxicity considerations; they do not consider toxicity to non-human receptors. While the exposure levels accepted as protective of human health may be generally protective of wildlife populations, notable exceptions arise both from the ecotoxicological properties of some chemicals and from differences between human and non-human receptor exposure patterns.

The question therefore can be asked: To what extent is the TC protective of ecological receptors? As in the case of human health risks, the TC does not directly protect against risks from chemicals not on the TC list. Similarly, it is not clear how protective the existing TC levels are for the various exposure pathways that are most important for aquatic and terrestrial receptors. In the case of ecological receptors, as is the case for human health, both direct and indirect exposure pathways may be significant. These issues are addressed in more detail in Section 3.5 and Chapter 4 of this report.

3.1.6 Other Risks Associated with Non-Hazardous Industrial Waste Management

In establishing the existing hazardous waste characteristics, the Agency focused exclusively on human health risks directly associated with local effects of accidents and on chemical contamination of the environment in the near vicinity of the management units. In Chapter 5 of this study, EPA has taken a broader view, and has expanded the scope of the risk identification to include risks other than those originally considered, even indirectly, in establishing the hazardous waste characteristics. These additional categories of risks include damages to natural resources and contributions to large-scale environmental problems.

Non-hazardous industrial waste management has the potential to adversely affect the value or utility of natural resources, such as wetlands, groundwater, and air, without posing human health risks. For example, releases from non-hazardous industrial waste management units have polluted previously usable groundwater with constituents generally not considered toxic, such as iron, manganese, chloride, and total dissolved solids. The regulatory criteria violated by these releases, such as Secondary Maximum Concentration Levels (SMCLs) developed under the Safe Drinking Water Act, are not directly health-related, but relate instead to the aesthetic properties or usability of the water. Therefore, even though no health risk is predicted, the water is rendered unusable and the environment is thereby damaged. Similarly, odor from non-hazardous industrial waste management may be seen as an air resource damage, reducing the quality of life for affected individuals, even in the absence of direct health effects.

The last category of risks are associated with the possible contribution of non-hazardous industrial waste management to large-scale environmental problems, including:

- Air deposition to the Great Waters;
- Damages from airborne particulates;
- Global climate change;
- Potential damages from endocrine disruptors;
- Red tides;
- Stratospheric ozone depletion;
- Tropospheric ozone and photochemical air pollution; and
- Water pollution.

The possible relationship between non-hazardous industrial waste management and these risks is less clear than for the previously identified risks.

As summarized in Exhibit 3-1, Section 3.1 has presented an intentionally broad inventory of potential risks to human health and the environment associated with the management of non-hazardous industrial wastes not currently identified as hazardous. This list provides a catalogue of risks for evaluation against the existing characteristics in the rest of this chapter and the following chapters.

Exhibit 3-1. Risks Potentially Associated with Non-Hazardous Industrial Waste Management

Types of Risks	Risks Intended to be Addressed By Characteristics	Risks Not Intended to be Addressed by Characteristics
Physical Hazards	• Burns and injuries to waste management and transportation workers from fire, explosions, and violent reactions • Skin, eye injury from direct contact with corrosive substances (workers) • Facilitated transport of chemicals (primarily inorganics) in groundwater	• Physical injuries to the general public • Facilitated transport of organics from solubilization • DNAPL/LNAPL generation
Acute Toxicity Risks to Humans	• Adverse effects from inhalation of toxic gases and particulates (workers)	• Inhalation of toxic gases and particulates by public ● Acute health risks from other exposure pathways (direct contact, ingestion of contaminated water or food)
Chronic Toxicity Risks to Humans	• Risks of cancer and non-cancer effects from consumption of groundwater contaminated by TC constituents (public)	• Chronic health risks to workers • Chronic risks from exposures to non-TC chemicals (public and workers) • Chronic risks associated with non-groundwater pathways: -- inhalation of volatilized materials and particulates other than those released from fire or explosion -- ingestion of surface water contaminated by runoff or groundwater discharge -- risks to public from direct contact with waste, contaminated soil, and in direct pathways (ingestion of contaminated crops, fish, game) • Risks from specific types of toxins: -- reproductive toxins -- endocrine disruptors
Toxic Risks to Nonhuman Receptors	--	• Aquatic toxicity • Toxicity to terrestrial organisms • Sediment toxicity • Bioaccumulation/biomagnification • Groundwater exposure
Other Risks	--	• Damages to groundwater, surface water, and air affecting their usability or quality • Non-hazardous industrial waste management contribution to large-scale environmental problems, such as air deposition to the Great Waters, damages from airborne particulates, global climate change, potential damages from endocrine disruptors, red tides, stratospheric ozone depletion, tropospheric ozone and photochemical air pollution, and water pollution.

3.2 Ignitability Characteristic

This section describes potential gaps related to the definition of the RCRA ignitability characteristic and its test methods. The basic approach taken in identifying potential gaps for ignitability as well as for corrosivity and reactivity was to review the original 1980 rulemaking record and to compare the characteristic to approaches taken to controlling similar hazards under other regulatory schemes, including the U.S. Department of Transportation's (DOT's) hazardous materials regulations, the U.S. Occupational Safety and Health Administration's (OSHA's) worker health hazards standards, and state hazardous waste management standards.

3.2.1 Definition of Ignitability

The ignitability characteristic is intended to “identify wastes capable of causing fires during routine transportation, storage and disposal, and wastes capable of exacerbating a fire once started." These risks include generally recognized fire hazards to waste management and transportation workers, such as burns and inhalation smoke or fumes, and the potential generation and facilitated transport in air of toxic particulates and fumes that could harm the general public. According to 40 CFR 261.21, a solid waste exhibits the characteristic of ignitability if a representative sample of the waste has any of the following properties:

- Is a liquid, other than an aqueous solution containing less than 24 percent alcohol by volume and has flash point less than 60°C (140°F), as determined by:
    - -- A Pensky-Martens Closed Cup Tester, using the test method specified in ASTM Standard D-93-79 or D-93-80 (incorporated by reference, see § 260.11),
    - -- A Setaflash Closed Cup Tester, using the test method specified in ASTM standard D-3278-78 (incorporated by reference, see § 260.11), or
    - -- An equivalent test method approved by the Administrator under procedures set forth in §§ 260.20 and 260.21;
- Is not a liquid and is capable, under standard temperature and pressure, of causing fire through friction, absorption of moisture or spontaneous chemical changes and, when ignited, burns so vigorously and persistently that it creates a hazard;
- Is an ignitable compressed gas as defined in 49 CFR 173.300 and as determined by the test methods described in that regulation or equivalent test methods approved by the Administrator under §§ 260.20 and 260.21; or
- Is an oxidizer as defined in 49 CFR 173.151.

3.2.2 Potential Gaps Related to Definition of Ignitability

Potential Ignitability Gaps

- Excludes DOT Combustible Liquids (liquids with flash point above 140 but below 200 degrees Fahrenheit)
- Excludes Aqueous Flammable Liquids (alcohol solutions of concentrations < 24 percent) that are capable of flashing, but not supporting combustion
- References outdated DOT Regulations
- No test methods for non-liquids

Liquids with flash point at or above 140 °F not covered. The RCRA ignitability characteristic includes liquid wastes with flash point less than 60°C (140°F). When promulgating the original characteristic, EPA acknowledged choosing a definition for ignitable liquid wastes that excluded some potential wastes that would meet the definition of hazardous materials under DOT regulations. The DOT definition of flammable liquid includes liquids with flash point not more than 60.5°C (141°F), or any material in liquid phase with a flash point at or above 37.8°C (100°F) that is intentionally heated and offered for transportation or transported at or above its flash point in a bulk packaging. The DOT definition of combustible liquid includes liquids with flash point above 60.5°C (141°F) and below 93°C (200°F). Thus, the RCRA ignitability characteristic covers wastes that would be classified as DOT flammable liquids, but not DOT combustible liquids. Consistent with DOT regulations, OSHA includes such "combustible" liquids in its definition of *health hazard*, and Rhode Island regulates them as hazardous wastes.

In a background document supporting the promulgation of the original characteristics,[3] EPA stated that the RCRA ignitability flash point limit of 140°F reflects conditions likely to be encountered during routine waste management. In support of this conclusion, the Agency referenced seven studies documenting temperatures and conditions at waste management units. The information available to the Agency at the time was limited, however. Furthermore, two of these studies reported temperatures of greater than 140°F. One study reported temperatures of approximately 160°F near the surface of a landfill, noting that aerobic conditions near the surface of landfills often result in relatively high temperatures.

Data are still limited regarding whether temperatures greater than 140°F are encountered during non-hazardous industrial waste management, in what situations and how frequently this occurs, and what maximum temperatures are reached (particularly in hotter regions of the nation). One relevant issue is whether temperatures exceeding 140°F may be encountered during mismanagement (as opposed to routine waste management). Examples of possible mismanagement scenarios for ignitable wastes include:

- Wastes stored in closed, heat-containing facilities (e.g., metal sheds, upper floor warehouse spaces, or metal trucks) in hot climates and/or sunlight; and

- Wastes mixed in waste management units in a manner that might generate heat through chemical reactions, especially in the presence of hot climate or sunlight.

No information is readily available regarding the universe of "combustible" industrial wastes currently being managed as non-hazardous. Nevertheless, some liquid materials with flash points generally in this range can be identified, as shown in Exhibit 3-2. Examples include certain alcohols, low molecular weight esters, ethylene glycol ethers, kerosene, jet fuels, certain petroleum byproducts, many "tints and paints," and individual chemicals including benzaldehyde, benzonitrile, and bromobenzene. If these materials are disposed of or are present in wastes, the wastes may be combustible, in spite of not being hazardous by the ignitability characteristic. In addition, mixtures of materials of differing flash points may fall into this category.

Exclusion for aqueous liquids containing less than 24 percent alcohol may warrant reexamination. At the time of the original rulemaking, some commenters argued that liquid wastes such as wine and some latex paints that exhibit low flash points because of their alcohol content do not sustain combustion because of the high percentage of water and therefore should not be designated as characteristically hazardous waste. EPA agreed and excluded from the ignitability characteristic aqueous solutions containing less than 24 percent of alcohol by volume. A

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[3] U.S. Environmental Protection Agency, Office of Solid Waste, Background Document: Resource Conservation and Recovery Act Subtitle C -- Identification and Listing of Hazardous Wastes, Section 261.21-Characteristics of Ignitability, May 2, 1980, p. 10-11.

similar exclusion is found in DOT regulations. EPA stated that it hoped "to undertake further study to determine whether another exclusion limit is more appropriate and to evaluate tests which might be capable of identifying wastes which exhibit this phenomenon."[4] EPA also intended to evaluate possible supplemental test methods to evaluate flammability hazards for these types of wastes.

The exclusion for aqueous liquids containing alcohol has caused confusion during implementation and enforcement concerning whether it applies only to ethanol or more broadly to all alcohols. The exclusion also focuses on aqueous alcohol solutions, rather than on the underlying target of liquids with low flash points that do not sustain combustion. (Tests for sustained combustion are now available: ASTM has methods D-4206 and D-4207.) In addition, the rationale that certain liquids should not be considered ignitable if they do not sustain combustion may not be valid where an excluded aqueous solution could flash and ignite a co-managed non-hazardous waste that would sustain combustion.

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[4] 45 *Federal Register* 33108.

Exhibit 3-2
Materials Formerly Classified by DOT as Combustible Liquids
(which generally are not RCRA ignitable)

"Adhesive"

Ethylhexaldehyde

Source: Suspect Chemicals Handbook, 1988.
n.o.s. = not otherwise specified.
Note: Current DOT Hazardous Materials Table in 49 CFR 172.101 does not distinguish combustible liquids from flammable liquids. The above list was taken from a 1987 version of DOT regulations that classified some materials as combustible liquids. This list is intended to provide examples of materials "that may be combustible (i.e., liquids with 141ºF < flash point < 200ºF)."

References to DOT regulations are outdated. The ignitability characteristic refers to a DOT definition of ignitable compressed gas (49 CFR 173.300) that has been withdrawn. Current DOT regulations at 49 CFR 173.115 define *flammable gas,* which is any material that is a gas at 20°C (68°F) or less and 101.3 kPa (kilopascals equal to 14.7 pounds per square inch) of pressure. The complete definition includes any material that has a boiling point of 20°C (68°F) or less at 101.3 kPa (14.7 psi)) that (1) is ignitable at 101.3 kPa (14.7 psi) when in a mixture of 13 percent or less by volume with air; or (2) has a flammable range at 101.3 kPa (14.7 psi) with air of at least 12 percent regardless of the lower limit. Likewise, the term *oxidizer* is no longer defined at 49 CFR 173.151. It is now found at 49 CFR 173.127. These out-of-date citations constitute a potential gap because they may cause regulatory confusion and misinterpretation and thereby may impede efficient and effective compliance and enforcement.

3.2.3 Potential Gaps Related to Ignitability Test Methods

No test method is specified for non-liquids. The ignitability characteristic does not specify a test method for non-liquid wastes. In a background document supporting the original rulemaking, EPA stated that non-liquid wastes may present a hazard by virtue of their capacity to ignite and burn as a result of friction, moisture absorption, or spontaneous reaction under the normal temperatures and pressures encountered in waste management.[5] The Agency noted that such wastes are akin to reactive wastes and can directly injure workers or others as a result of fire, induced explosions, or induced generation of toxic gases at almost any point in the waste management process. Examples of potential ignitable non-liquid wastes include soils highly contaminated with gasoline or other ignitable substances and sorbents used to cleanup spills of ignitable substances.

In explaining the final rulemaking, the Agency stated that, although "EPA would have preferred providing a test method for identifying ignitable solids, it has determined . . . that there are no test methods capable of accurately identifying the small class of ignitable solids to which its regulation is directed. EPA is presently working with the Department of Transportation and other organizations to correct this deficiency."[6] Since then, EPA has identified a test method that may be suitable for identifying ignitable solids. Method 1030 ("Ignitability of Solids") has been proposed for inclusion in the Third Edition of the EPA test methods manual "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," EPA Publication SW-846.[7] The method is appropriate for pastes, granular materials, solids that can be cut into strips, and powdery substances.

3.3 Corrosivity

3.3.1 Definition of Corrosivity

According to 40 CFR 261.22, a solid waste exhibits the characteristic of corrosivity if a representative sample of the waste has either of the following properties:

- Is aqueous and has a pH less than or equal to 2 or greater than or equal to 12.5, as determined by a pH meter using Method 9040 in "Test Methods for the Evaluation of Solid Waste, Physical/Chemical Methods," incorporated by reference in § 260.11; or

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[5] <u>Background Document</u>, supra footnote 2, p. 14.

[6] 45 *Federal Register* 33108.

[7] 60 *Federal Register* 37974, July 25, 1995.

- Is a liquid and corrodes steel (SAE 1020) at a rate greater than 6.35 mm (0.250 inch) per year at a test temperature of 55°C (130°F) as determined by the test method specified in NACE (National Association of Corrosion Engineers) Standard TM-01-69 as standardized in "Test Methods for the Evaluation of Solid Waste, Physical/Chemical Methods," EPA Publication SW-846, as incorporated by reference in § 260.11.

The first part of this definition encompasses wastes exhibiting low or high pH, which “can cause harm to human tissue, promote the migration of toxic contaminants from other wastes, react dangerously with other wastes, and harm aquatic life.” Specifically, the Agency identified skin and eye damage to transporters who are directly exposed to the waste as a primary focus of this characteristic. The pH limits also were intended to address the potential solubilization of heavy metals allowing migration to groundwater, reactions with incompatible wastes resulting in fires, explosions, generation of flammable or toxic gases, generation of pressure inside vessels, and the dispersal of toxic vapors, mists, and particulates.

The other part of the corrosivity characteristic relates to the corrosivity of waste to steel containers. The Agency identified this aspect of corrosivity as a hazard because “wastes capable of corroding metal can escape from the containers in which they are segregated and liberate other wastes.” The consequences of liberating wastes from containers during transportation or storage include harm from direct contact, violent reactions, and the release of waste components to the environment.

3.3.2 Potential Gaps Related to Definition of Corrosivity

Non-liquids are not covered. The current RCRA corrosivity characteristic is limited to liquids. Other regulatory programs, however, also cover corrosive non-liquids. For example:

- DOT regulates corrosive liquids and solids as hazardous materials;
- The OSHA definition of health hazard includes all corrosives regardless of physical form;
- The Basel Convention definitions of hazardous materials are not limited to liquids; and
- At least four states (California, New Hampshire, Rhode Island, and Washington) include non-aqueous wastes in their definitions of corrosivity. New Hampshire and Rhode Island specifically include corrosive gases as well as corrosive solids.

Potential Corrosivity Gaps

- Excludes corrosive non-liquids
- pH limits may not effectively protect against some types of injury
- Corrosion to materials other than steel is not directly addressed
- Solubilization of non-metals (e.g., by organic solvents) is not addressed
- Excludes irritants and sensitizers
- pH test methods may not accurately predict hazards

The states that include non-liquids in their corrosivity characteristics specify mixing the non-aqueous waste with water and then testing for pH. The rationale for this approach is that the waste is likely to come into contact with water during land-based management. In addition, EPA has developed Method 9045 (Soil and Waste pH), which can be used to test some corrosive solid wastes. Finally, Method 1120 (Dermal Corrosion) may be applied to solids, liquids, and emulsions (see additional discussion below under "potential gaps related to corrosivity test methods").

pH limits may not cover some hazards. EPA originally proposed pH limits of 12.0 or greater and 3.0 or less, and a majority of commenters argued that these limits were too stringent. The commenters argued that the limit of 12.0 or greater would regulate as hazardous many lime-stabilized wastes and sludges, thereby discouraging use of a valuable treatment technique, and that the pH limit of 3.0 or less would regulate a number of substances generally thought to be innocuous (e.g., cola drinks) and many industrial wastewaters prior to neutralization. EPA agreed with these commenters and promulgated pH limits of 12.5 or greater and 2.0 or less in the 1980 final rule.

The more stringent proposed pH limits were based on studies of eye tissue damage. These studies indicated that pH extremes above 11.5 and below 2.5 generally are not tolerated by human corneal tissue.[8] EPA decided that basing pH limits on eye tissue damage was unnecessarily conservative. Thus, eye damage is a hazard not fully addressed by the corrosivity characteristic.

The corrosivity characteristic also was intended to prevent harm to ecological receptors caused by the release of hazardous wastes with high- or low-pH. In discussing aquatic life in the original background document,[9] EPA noted that the optimum pH range for freshwater fish is 6.5 to 9.0 and that an increase or decrease of 2 pH units beyond the optimum range causes severe effects. Levels of pH of 11.0 or greater and 3.5 or less are fatal to all species of fish. EPA also noted that altering surface water pH can reduce the productivity of food organisms essential to fish and wildlife. The pH limits of the corrosivity characteristic (2.0 and 12.5) are well beyond the safe range for aquatic life, but wastes presumably would be significantly diluted before the point of exposure to aquatic life. EPA did not conduct a risk assessment of such potential hazards (e.g., modeling the pathway of waste released to surface water and exposure to aquatic life) and thus it is not known under what circumstances high- or low-pH wastes could cause harm to aquatic receptors.

Corrosion of materials other than steel is not directly addressed. In the second part of the corrosivity characteristic, EPA uses steel corrosion as an indicator of corrosivity. EPA adopted this aspect of corrosivity because "wastes capable of corroding metal can escape from the containers in which they are segregated and liberate other wastes."[10] EPA adopted DOT's corrosion standard, noting that the rate at which a waste corrodes a material commonly used in container construction (low carbon steel) is a suitable measure of its hazardousness.

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[8] U.S. Environmental Protection Agency, Office of Solid Waste, Background Document: Resource Conservation and Recovery Act, Subtitle C-Identification and Listing of Hazardous Wastes, Section 261.22-Characteristic of Corrosivity, May 2, 1980, p. 5.

[9] Id., pp. 9-10.

[10] 45 *Federal Register* 33109.

The reliance on the steel corrosion rate may create a potential gap if there are plausible mismanagement scenarios where wastes are stored, transported, or disposed in containers made from materials more easily corroded than low carbon steel (e.g., plastic by organic solvents) or are disposed in solid waste management units lined with materials such as clay or synthetics. Also, there may be a potential gap in the characteristic if waste management scenarios result in conditions where wastes are subject to higher temperatures than the 130°F test temperature.

Solubilization of hazardous constituents. The corrosivity characteristic also was intended to address the potential for high- and low-pH materials to solubilize potentially toxic waste constituents. EPA offers the example that a drop in pH from 4.0 to 2.0 increases the solubility of red mercury oxide or chromium hydroxide in water approximately 100 times.[11] The general concern is for inorganic ions that may be converted to more soluble species. This characteristic does not address the potential solubilization of organic constituents by organic liquids such as solvents, nor does it address the formation of non-aqueous phase liquids (NAPLs) by such materials. EPA considered including a solvents "override" in the TC characteristic,[12] but did not do so. The solvents override would have caused wastes with high concentrations of solvents to be classified as hazardous on the basis of potential NAPL formation. The issue of NAPL formation is discussed in more detail in Chapter 5.

Lack of coverage of sensitizers and irritants. At least two types of materials that may pose potential hazards to humans through direct contact are not included in the corrosivity characteristic or any other characteristic: irritants and sensitizers. OSHA includes irritants in its definition of *health hazard* and defines *irritant* as a material that is not corrosive, but which causes a reversible inflammatory effect on living tissue by chemical action at the site of contact. A chemical is a skin irritant if, when tested on the intact skin of albino rabbits by the methods of 16 CFR 1500.41 for four hours exposure or by other appropriate techniques, it results in an empirical score of five or more. A chemical is an eye irritant if so determined under the procedure listed in 16 CFR 1500.42 or other appropriate techniques. (See 29 CFR 1910.1200.)

OSHA also includes sensitizers in its definition of health hazard. A *sensitizer* is defined as a material that causes a substantial proportion of exposed people or animals to develop an allergic reaction in normal tissue after repeated exposure to the chemical. (See 29 CFR 1910.1200.)

This analysis did not identify any specific non-hazardous industrial wastes that are irritants or sensitizers. Irritants and sensitizers, however, are common categories of materials and these properties are often identified in laboratory testing of materials. A major issue regarding this potential gap is whether any irritants and/or sensitizers pose a hazard in wastes that reaches the statutory level of hazard intended to be covered by RCRA Subtitle C.

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[11] Ibid, p. 6.

[12] 55 *Federal Register* 11809, March 29, 1990.

3.3.3 Potential Gaps Related to Corrosivity Test Methods

Use of pH as an indicator has limitations. EPA chose pH as a measure of corrosivity because "wastes exhibiting low or high pH can cause harm to human tissue, promote the migration of toxic contaminants from other wastes, react dangerously with other wastes, and harm aquatic life."[13] The ability of some substances to damage human tissue, however, may not be adequately indicated by a pH measurement. Other regulatory and advisory bodies (e.g., DOT, OSHA, Basel Convention) use criteria based on full thickness destruction of human skin.

Since the original rulemaking in 1980, Method 1120 (Dermal Corrosion) has been developed commercially. The dermal corrosion assay system is an *in vitro* test method which determines the corrosive potential of a substance toward human skin. It can be used to test liquids (aqueous or non-aqueous), solids (water soluble or insoluble), and emulsions. Method 1120 is essentially the same method that DOT uses. It replaced previous tests (e.g., Draize test) that used live animals with a test that uses a proprietary synthetic pig collagen material.

3.4 Reactivity

3.4.1 Definition of Reactivity

The reactivity characteristic is “intended to identify wastes, which because of their extreme instability and tendency to react violently or explode, pose a problem at all stages of the waste management process.” This characteristic was intended to reduce physical risks to transportation and disposal workers and to avoid incidents that could result in the release of toxic constituents into the air consequent to an explosion or violent reaction. 40 CFR 261.23 states that a solid waste exhibits the characteristic of reactivity if a representative sample of the waste has any of the following properties:

- Is normally unstable and readily undergoes violent change without detonating;
- Reacts violently with water;
- Forms potentially explosive mixtures with water;
- When mixed with water, generates toxic gases, vapor, or fumes in a quantity sufficient to present a danger to human health or the environment;
- Is a cyanide or sulfide bearing waste which, when exposed to pH conditions between 2 and 12.5 can generate toxic gases, vapors or fumes in a quantity sufficient to present a danger to human health or the environment;
- Is capable of detonation or explosive reaction if it is subjected to a strong initiating source or if heated under confinement;

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[13] 45 *Federal Register* 33109.

- Is readily capable of detonation or explosive decomposition or reaction at standard temperature and pressure; or

- Is a forbidden explosive as defined in 49 CFR 173.51, or a Class A explosive as defined in 49 CFR 173.53 or a Class B explosive as defined in 49 CFR 173.88.

3.4.2 Potential Gaps Related to Definition of Reactivity

Potential Reactivity Gaps

- Broad, non-specific definitions
- References outdated DOT regulations
- No test methods specified

The Definition is broad and lacks specificity. In discussing the reactivity characteristic in the 1980 final rule, EPA stated that "the definition was intended to identify wastes which, because of their extreme instability and tendency to react violently or explode, pose a problem at all stages of the waste management process."[14] EPA noted that the reactivity characteristic encompasses a diverse class of physical properties and effects and overlaps somewhat with the ignitability characteristic.

Some commenters argued that the definition was vague. They advocated using a quantitative definition accompanied by testing protocol(s). EPA responded that "the prose definition should provide generators with sufficient guidance to enable them to determine whether their wastes are reactive."[15] EPA argued that most generators whose wastes are dangerous because they are reactive are well aware of this property and such wastes usually are generated from reactive feedstocks and/or processes producing reactive products or intermediates. EPA further stated that problems posed by reactivity appeared to be confined to a fairly narrow category of wastes.

Theoretically, the reactivity characteristic could be clarified and made consistent with other programs (especially DOT) by developing more specific definitions of general terms such as "normally unstable," "violent change," "potentially explosive," "reacts violently with water," "readily capable of detonation," and so forth. Other programs include more specific definitions. For example, as shown in Exhibit 3-3, DOT has adopted definitions of *spontaneously combustible material* and *dangerous when wet material*, which could be used to clarify the RCRA characteristic. Specifically, DOT identifies an ignition time and violent reaction rate. Likewise, OSHA defines *pyrophoric, unstable reactive,* and *water reactive,* specifying reactive conditions such as shocks, pressure, and temperature which define the characteristic. The Basel Convention also defines similar terms.

References to DOT regulations are outdated. Forbidden explosive are no longer defined in 49 CFR 173.51. The current DOT regulations define forbidden explosives at 49 CFR 173.54. Other explosives are defined at 49 CFR 173.50. 49 CFR 173.88 no longer exists.

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[14] 45 *Federal Register* 33109.

[15] 45 *Federal Register* 33110.

Exhibit 3-3
Other Definitions of Reactivity

DOT (49 CFR 173.124)

Spontaneously combustible material is a pyrophoric material, that is a liquid or solid that, even in small quantities and without an external ignition source, can ignite within five minutes after coming in contact with air.

A *self-heating material* is a material that, when in contact with air and without an energy supply, is liable to self-heat.

A *dangerous when wet material* is a material that, by contact with water, is liable to become spontaneously flammable or to give off flammable or toxic gas at a rate greater than 1 liter per kilogram of the material, per hour.

OSHA (29 CFR 1910.1200)
A *pyrophoric chemical* is a chemical that will ignite spontaneously in air at a temperature of 130°C or below.

An *unstable reactive chemical* is a chemical that in the pure state, or as produced or transported, will vigorously polymerize, decompose, condense, or will become self-reactive under conditions of shocks, pressure or temperature.

A *water reactive chemical* is a chemical that reacts with water to release a gas that is either flammable or presents a health hazard.

Basel Convention Characteristic

An *explosive* is a solid or liquid capable by chemical reaction of producing gas at such a temperature and pressure and at such speed as to cause damage to the surroundings.

Substances or wastes liable to spontaneous combustion are liable to spontaneous heating under normal conditions encountered in transport, or to heating upon contact with air, and being then liable to catch on fire.

Substances or wastes which, in contact with water, emit flammable gases are substances or wastes, which by interaction with water, are liable to become spontaneously flammable or to give off flammable gases in dangerous quantities.

Substances or wastes that cause liberation of toxic gases in contact with air or water are substances or wastes that, by interaction with air or water, are liable to give off toxic gases in dangerous quantities.

Organic peroxides are organic substances or wastes which contain the bivalent O-O structure are thermally unstable substances which may undergo exothermic self-accelerating decomposition.

3.4.3 Potential Gaps Related to Reactivity Test Methods

Reactivity characteristic lacks test method(s). When the Agency promulgated the reactivity characteristic in 1980, no available tests were identified for use in defining the reactivity characteristic because:

- They were too restrictive and were confined to measuring how one specific aspect of reactivity correlates with a specific initiating condition or stress.
- Testing the reactivity of a sample does not necessarily reflect reactivity of the waste, because reactivity varies with properties including mass and surface area.
- Most available tests required subjective interpretation of results.
- Existing methods were not developed for testing wastes.

Although EPA has identified a test method (Method 9010) for reactive sulfide and/or cyanide bearing wastes, the Agency has not identified suitable test methods to fully define the reactivity characteristic.

3.5 Potential Gaps Associated with the Toxicity Characteristic

3.5.1 Definition of Toxicity Characteristic

The toxicity characteristic was designed by EPA to reduce risks to public health from chronic exposures to groundwater contamination caused by releases of toxic waste constituents. The Agency found “persuasive evidence that the contamination of groundwater through the leaching of waste contaminants from land disposed wastes is one of the most prevalent pathways by which toxic waste constituents migrate to the environment.”[16] The legislative history of RCRA and EPA’s case studies of damages from hazardous waste management were cited as support for focusing the toxicity characteristic exclusively on groundwater pathway risks.

EPA originally listed 14 contaminants as part of the toxicity characteristic. Subsequently, EPA added another 26 substances to the list, as shown in Exhibit 3-4. These 40 TC chemicals were selected because:

- The chemicals were included on the 40 CFR Part 261 Appendix VIII list of hazardous waste constituents that have been “shown to have toxic, carcinogenic, mutagenic, or teratogenic effects,” and
- Appropriate chronic toxicity information had been developed and adequate fate and transport data were available to allow the modeling of groundwater fate and transport for each constituent.[17]

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[16] 45 *Federal Register* 33110, May 19, 1980.

[17] 55 *Federal Register* 11801, March 29, 1990. In finalizing the revised toxicity characteristic, however, the Agency used a generic DAF of 100 in a subsurface fate and transport model to set the regulatory levels.

Exhibit 3-4
TC Constituents and Regulatory Levels (mg/l)

Arsenic	5.0	Hexachlorobenzene	0.013

Source: 40 CFR 261.24.

Thus, EPA found these chemicals to be among those posing the greatest risk to humans from chronic groundwater exposure.

The remainder of Section 3.5 evaluates the TC in five steps:

- Section 3.5.2 examines whether new data on the toxicity and persistence of TC analytes and updated groundwater transport modeling techniques would result in allowable TC leachate concentrations different from those established in 1990.

- Section 3.5.3 presents screening-level exposure and risk modeling methods and results that are used to evaluate whether the current TC chemicals could pose risks to human health and environmental receptors through the inhalation pathway.

- Sections 3.5.4 and 3.5.5 evaluate potential risks from TC chemicals to human health through surface water pathways and indirect pathways, respectively. These risks are evaluated by comparing toxicity and fate and transport values to defined risk-related criteria, both singly and in combination, and by reviewing the results of the Agency's multipathway risk modeling for the analytes that was performed as part of the proposed Hazardous Waste Identification Rule (HWIR-Waste) development.

- Sections 3.5.6 and 3.5.7 evaluate the potential for acute adverse health effects of exposures to TC analytes and potential risks to ecological receptors from TC analytes, respectively.

3.5.2 Changes in Groundwater Pathway Analysis

This section of the Scoping Study explores two issues related to the current TC regulatory levels: (1) whether new toxicity data indicate a potential need to revise the regulatory levels; and (2) whether, in light of recent developments in groundwater modeling techniques, the current dilution and attenuation factor (DAF) value of 100 still provides a reliable basis for assuring that human health is protected against risks from groundwater exposures to TC chemicals.

Revisions to MCLs and Toxicity Criteria

The toxicological bases for the establishment of TC analyte regulatory levels were chronic toxicological and health-based regulatory criteria that were current at the time of promulgation. These included Safe Drinking Water Act Maximum Contaminant Levels (MCLs), Reference Doses (RfDs), and Risk-Specific Doses (RSDs) based on ingestion pathway Cancer Slope Factors (CSFs). For almost all of the TC analytes, these values have not changed since 1990. The few changes have included:

- A reduction in the RfD for p-cresol by a factor of ten and the withdrawal of the MCL of 50 ug/l for lead and its replacement with an Action Level of 15 ug/l. For cresol and lead, the reductions in RfDs and promulgation of Action Levels indicate that the toxicological evaluation of these chemicals has changed such that the TC regulatory levels may be less protective than was originally intended. The changes for both of these analytes were an order of magnitude or less.

- The withdrawal of the MCL for silver, with its replacement by an SMCL at the same value. This change simply means that the critical toxic effect for silver (argyria, which is the collection of dark pigment in the skin and mucous membranes) has been downgraded from a health effect to a cosmetic effect.

- In addition, the RfD for pentachlorophenol has been reduced from 2 mg/l to $3x10^{-2}$ mg/l. More importantly, since the TC was revised, the Agency has promulgated a cancer slope factor for this compound, which is a suspect human carcinogen. Thus, the critical toxic endpoint has been changed from non-cancer to cancer induction. The promulgation of the Cancer Slope Factor implies that a much lower TC regulatory level (about 1000 times lower) would be needed to achieve the same level of protection against cancer risks as originally intended when the TC was promulgated.

Advances in Groundwater Modeling

To develop the existing TC regulatory levels, the Agency used the EPAMCL model to estimate the likely extent of dilution after the release of waste constituents from waste management units during their transport to the nearest drinking water wells.[18] These calculations were conducted for municipal solid waste landfills and Subtitle D surface impoundments, taking into account the geochemical properties of the constituents, the size and configuration of the units, the vadose zone and groundwater regimes beneath the units, and the distribution of distances in the downgradient direction to the nearest drinking water well. Groundwater regimes were defined using distributions of transport parameter values typical of conditions throughout the United States. Receptor wells were assumed to be in the groundwater plume at a distribution of distances derived from a Subtitle D facility survey. Simulation methods were used to derive estimates of dilution-attenuation factors (DAFs) for each constituent and each type of waste management unit. After reviewing the results, the Agency elected to calculate acceptable leachate concentrations (regulatory levels) for each TC analyte using a single DAF value of 100.[19] In other words, the threshold leachate concentration of each analyte above which wastes would be identified as TC hazardous was set equal to allowable drinking water concentration or other benchmark (10^{-5} cancer risk or Hazard Quotient (HQ) = 1.0) for the analytes multiplied by 100.

Since the TC was promulgated, the Agency has continued to use the same general approach to evaluate the groundwater transport of pollutants in developing RCRA regulations. The exact techniques used in this modeling, however, have changed significantly. In recent rulemakings, the Agency has used an updated version of the EPAMCL model, known as EPACMTP, to derive constituent-specific DAFs for a wide range of pollutant releases from hazardous and non-hazardous waste management units. This model employs many of the same basic transport algorithms as the EPAMCL, with several important differences, including the following:[20]

- The EPACMTP model uses a detailed metals speciation model (MINTEQA) to estimate leachate concentrations from wastes of defined ionic composition, whereas the EPAMCL model did not employ such a model;
- The EPACMTP, unlike EPAMCL, can model the adsorbtion to soil and transformation of organic waste constituents by hydrolysis into more toxic (or less toxic) transformation products;
- The EPACMTP directly simulates the interface between the saturated and vadose zones;
- The EPACMTP model can simulate groundwater mounding under management units, whereas the EPAMCL could not; and
- The EPACMTP model provides more flexibility in modeling finite, versus infinite, source terms.

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[18] A detailed discussion of the groundwater modeling approach used by EPA in support of the TC rule can be found at 55 *Federal Register* 11816, March 29, 1990.

[19] Ibid at 11827.

[20] A detailed discussion of the EPACMTP model can be found in U.S. Environmental Protection Agency, Office of Solid Waste, EPACMTP Background Document, 1995; and EPACMTP Background Document for Metals, Volume 1: Methodology, 1995.

Recent applications of the model also used somewhat different assumptions regarding waste and facility characteristics, hydrogeological regimes, climatology, and receptor locations than those used in the development of the TC. Therefore, it is not possible, except in a very general way, to simply compare the DAF value used in establishing the TC allowable leachate concentrations with the constituent-specific DAF values for the same constituents derived in the subsequent analyses. In addition, DAF values derived for metals using the EPACMTP vary with the initial concentration of the constituent in the waste, because the model incorporates saturable binding and transport phenomena. In contrast, the DAFs derived using the EPAMCL model are concentration-invariant under most conditions.

Recently, EPA has employed the EPACMTP model in two major regulatory development efforts.

- EPA applied the model in its development of proposed risk-based exit levels for the Proposed Hazardous Waste Identification Rule for Process Waste (HWIR-Waste).[21] In that analysis, EPACMTP was used to back-calculate concentrations of constituents in wastes and in waste leachate corresponding to specific risk levels through groundwater exposures. The Agency is currently revising the proposed HWIR-Waste exit level groundwater risk modeling methods in response to comments from the Science Advisory Board and from other technical reviewers. Thus, the results of this modeling presented in this Scoping Study should be regarded as preliminary.

- In the Phase IV LDR regulatory development effort for mineral processing wastes, the model was used to derive constituent-specific DAFs for mineral processing wastes disposed of in surface impoundments and waste piles.[22] The DAFs were then used to derive groundwater pathway risk estimates for exposure to waste constituents.

The results of these analyses have been used to evaluate the extent to which changes in modeling techniques may have affected the assessment of groundwater fate and transport relative to the assessment used to derive the TC regulatory concentrations. As noted previously, a simple comparison of DAF values and/or calculated risk levels from the different modeling efforts is not possible without further analysis since the more recent modeling employs different groundwater transport models and different assumptions regarding facility characteristics, groundwater regimes, and receptor locations. In the case of the mineral processing risk assessment, for example, DAF values were derived specifically for facility sizes representative of the mineral processing industry, rather than Subtitle D management units. In addition, groundwater modeling was performed using climatologic data primarily from drier regions where many mineral processing facilities are located. While Subtitle D facilities were used to calculate releases for the HWIR-Waste proposal, the receptor wells were assumed to be distributed uniformly in the downgradient direction, instead of being confined to the plume. More importantly, the proposed exit levels were derived using a carcinogenic risk target of 10^{-6}, rather than 10^{-5}, and the 90th percentile, rather than the 85th percentile, estimates of risk were used. Using the 90th instead of 85th percentile of the risk output results in estimating higher risks for a given receptor for a given constituent concentration and in more stringent (lower) exit levels. Thus, the proposed HWIR-Waste risk calculations, especially for carcinogens, are substantially more conservative in several important respects than those used to derive the TC regulatory levels.

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[21] U.S. Environmental Protection Agency, Office of Solid Waste, Technical Support Document for the Hazardous Waste Identification Rule: Risk Assessment for Human and Ecological Receptors, August 1995.

[22] U.S. Environmental Protection Agency, Office of Solid Waste, Regulatory Impact Analysis of the Supplemental Proposed Rule Applying to Phase IV Land Disposal Restrictions to Newly Identified Mineral Processing Wastes, December 1995.

In the mineral processing risk assessment, DAF values were derived for eight of the TC analyte metals. For waste piles, the DAF values for the majority of the TC metals were considerably higher than 100, the highest value being $1x10^{30}$ for lead. Barium, with a DAF value of 54, was the only metal for which the mineral processing waste pile DAF was less than the value of 100 used in the derivation of the TC regulatory concentrations. These results imply that the DAF value of 100 used in the TC derivation remains conservative for most metals when compared to values derived for this population of facilities.

The situation is different, however, if the DAF values derived for mineral processing surface impoundments are used as a basis for comparison. In this case, the majority of the DAF values for the TC metals were less than 100. This finding suggests that the DAF value of 100 used to derive the TC regulatory levels may not provide adequate protection against groundwater risks from surface impoundments, which are the most frequent management type employed for non-hazardous industrial wastes.

The large difference in DAF values for the two types of management units can be explained partly in terms of the comparative aridity of the locations for which DAFs were calculated. Where little moisture was available to drive transport from the waste piles through the vadose zone, DAF values tended to be high. In contrast, the surface impoundments provided a water supply that drove transport through the vadose zone into groundwater. The extent to which this effect would be seen in moister regions of the country is not clear.

The HWIR-Waste proposed groundwater exit level calculations for the TC analytes are summarized in Exhibit 3-5, and compared to the TC regulatory levels. The majority of the exit levels are considerably lower (more stringent) than the corresponding TC regulatory levels. In 4 cases, the TC levels are comparable to or less than the exit level.[23] For 9 analytes, the ratio of the TC regulatory level to the exit level is between 1 and 10. For 12 analytes, this ratio is between 10 and 100; for 5 analytes, the ratio is between 100 and 1,000; and for 6 analytes, the ratio is greater than 1,000.

This distribution confirms that, generally, the assumptions and modeling approaches used to derive the HWIR-Waste proposed exit levels lead to somewhat more conservative or more protective results than those used to derive the TC regulatory levels. This conclusion holds true, even taking into account that the cancer risk target is 10-fold lower for setting some of the proposed exit levels than was used for setting the TC levels. For all but a few of the carcinogens among the TC analytes, the proposed exit levels are far more than 10 times lower than the corresponding TC regulatory levels. Thus, some other factors account for a significant proportion of the conservatism in these calculations.

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[23] In one of these cases (for endrin), however, the limiting risk, is ecological, rather than human health.

Exhibit 3-5
Comparison of TC Regulatory Concentrations and HWIR-Waste Proposed Exit/Leach Levels

Analyte	Chronic Toxicity Reference Level, mg/l[a]	TC Regulatory Level, mg/l[a]	HWIR-Waste Groundwater Exit Level (mg/l)[b]	Ratio of Regulatory Level to Exit/Leach Level
Arsenic	0.05	5	0.000148	33784
Barium	1	100	15.5	6.5
Benzene	0.005	0.5	0.0054	92.6
Cadmium	0.01	1	0.11	9.1
Carbon tetrachloride	0.005	0.5	0.00161	311
Chlordane	0.0003	0.03	0.000163	184
Chlorobenzene	1	100	1.33	75.2
Chloroform	0.06	6	0.017	353
Chromium	0.05	5	0.476	10.5
Cresol, m-	2	200	3.2	62.5
Cresol, o-	2	200	3.2	62.5
Cresol, p-	2	200	0.32	625
Dichlorobenzene, 1,4-	0.075	7.5	0.0108	694
Dichloroethane, 1,2-	0.005	0.5	0.00006	8333
Dichloroethylene, 1,1-	0.007	0.7	0.00018	3889
2,4-D	0.1	10	0.6	16.7
Dinitrotoluene, 2,4-	0.0005	0.13	0.112	1.2
Endrin	0.0002	0.02	32	0.000625
Heptachlor	0.00008	0.008	No value	30
Heptachlor epoxide	0.00008	0.008	0.45	0.0178
Hexachloro-1,3-butadiene	0.005	0.5	0.00691	72.4
Hexachlorobenzene	0.0002	0.13	0.000113	1150
Lindane	0.004	0.4	0.693	0.577
Hexachloroethane	0.03	3	0.033	90.9
Lead	0.05	5	11.6	0.4

Exhibit 3-5 (continued)
Comparison of TC Regulatory Concentrations and HWIR-Waste Proposed Exit/Leach Levels

Analyte	MCL or HBL[a]	TC Regulatory Level, mg/l[a]	HWIR-Waste Lowest Exit Level (mg/l)[b]	Ratio of Regulatory Level to Exit/Leach Level
Mercury	0.002	0.2	0.138	1.4
Methoxychlor	0.1	10	No value	--
Methyl ethyl ketone	2	200	30	6.7
Nitrobenzene	0.02	2	0.032	62.5
Pentachlorophenol	1	100	0.00041	243902
Pyridine	0.04	5	0.06	83.3
Selenium	0.01	1	0.357	2.8
Silver	0.05	5	No value	--
Tetrachloroethylene	0.007	0.7	0.68	1.0
Toxaphene	0.005	0.5	0.11	4.5
Trichloroethylene	0.005	0.5	0.0128	39
Trichlorophenol, 2,4,5-	4	400	4.2	95.2
Trichlorophenol, 2,4,6-	0.02	2	0.0152	132
Silvex	0.01	1	0.48	2.1
Vinyl chloride	0.002	0.2	0.00006	3333

Notes:

[a] 55 *Federal Register* 11804, March 29, 1990.

[b] 60 Federal Register 66424-66432, December 21, 1995.

Some of this conservatism may be due to differences in modeling assumptions, rather than modifications in modeling techniques. For example:

- The HWIR-Waste proposed exit levels were derived to be protective of 90th percentile receptors, while the TC levels were set to be protective of 85th percentile receptors.
- As shown in Exhibit 3-5, some HWIR-Waste proposed exit levels were driven by exposure pathways other than groundwater.
- The proposed HWIR-Waste exit levels and the TC regulatory levels were designed for different purposes. The TC levels are designed to provide a method for identifying

wastes that would otherwise be non-hazardous, while the proposed HWIR-Waste exit levels would relieve wastes previously identified as hazardous from stringent regulatory control.

These issues are discussed in more detail in Sections 3.5.3 and 3.5.4. Other differences in modeling assumptions, such as the retention of constituents in waste management (loss terms) in TC modeling only and the differences in the assumed location of wells relative to the contamination source, influence the results in the other direction.

Summary. Based on the preceding analyses, only general conclusions can be drawn about whether there are any significant gaps in the TC associated with the specific regulatory levels set for individual constituents. The wide range in the mineral processing DAF values illustrates the high degree of variability associated with specific groundwater modeling assumptions, and does not necessarily indicate whether the DAFs should be considered less or more protective than when they were originally derived. The HWIR-Waste proposed exit level calculations, on the other hand, suggest that the application of more recent modeling techniques might result in more conservative transport calculations. Some, but not all, of this greater level of protectiveness reflects a policy decision by the Agency regarding what proportion of receptors should be protected to the target risk level. In addition, advances in modeling techniques and differences in specific input assumptions also affect the differences in the apparent levels of protectiveness.

3.5.3 Potential Inhalation Pathway Risks Associated with TC Analytes

This section investigates the general level of protectiveness of the allowable TC concentrations against direct inhalation, a risk that the TC was not specifically intended to protect against. EPA analyzed this issue by performing screening-level risk calculations for long-term air releases of the TC constituents from Subtitle D facilities. EPA used the CHEMDAT8 model using facility characteristic parameters for surface impoundments and land application units (LAUs). Release estimates for all of the organic TC analytes were developed for two scenarios.

- In the first scenario, releases were estimated from the same “high-end” surface impoundments and LAUs that were modeled in the proposed HWIR-Waste exit level modeling.
- The second scenario modeled releases from the "central tendency" impoundments and LAUs, which were considerable smaller and shallower than the high-end units.

In both release scenarios, the concentrations of the organic TC analytes were assumed to be at the TC regulatory level for liquid wastes in surface impoundments and at 20 times the TC levels for nonwastewaters in land application units. The latter assumption roughly estimates the maximum concentration of the TC analyte that could be present without the waste being hazardous, assuming efficient leaching using the TCLP. For analytes that do not leach well, this approach may underestimate exposure concentrations and risks associated with air releases from non-hazardous industrial wastes, since nonwastewaters with high concentrations of constituents would not be identified as hazardous by the TCLP. Average releases to air were calculated for an assumed 40-year facility life-span under both scenarios. The basic approach and input assumptions used in the modeling are summarized in Exhibit 3-6.

The organic TC analytes for which releases were modeled vary widely in molecular weight, vapor pressure, Henry’s Law constant, and other physical properties that affect releases to air. Thus, the extent of release of these chemicals to air from land disposal facilities might be expected to differ widely. This is true to some extent; but, as can be seen in Exhibit 3-7, the estimated release of these compounds from land application units and surface impoundments over the expected facility life-span varies only moderately. In the case of the high-end land application units, between approximately 7 percent and 100 percent of the chemicals entering the units are released to the air over the facility life. The average proportion of the analytes released from these units was 81.6 percent, and the calculated releases were greater than 95 percent for two-thirds of the organic TC analytes.

The results were similar for the central tendency LAU. Releases ranged from 27 to 100 percent of the analytes, and the average proportion released was 96.3 percent. The explanation for the predicted higher proportional releases from the central tendency LAU is not clear, but may be related to the shallower tilling depth assumed for the central tendency unit (0.2 compared to 0.3 meters).

The proportions of the TC analytes released from surface impoundments are shown in the final two columns of Exhibit 3-7. The releases ranged from 6 to 77 percent of the applied total per year for the high-end impoundment, with an average release of 55.5 percent per year.[24] Proportionate releases were again higher from the central tendency unit, ranging from 15 percent to 88 percent, with an average of 71.2 percent released annually. Similar to the situation for the LAUs, the higher proportional releases from the central tendency unit may be due to its considerably shallower depth (2 meters) compared to the high-end unit (7 meters).

The limited impact of a chemical's Henry's Law constant on air releases is somewhat surprising in light of the broad spectrum of solubility and vapor pressure reflected in the chemicals modeled. Perhaps it can best be understood as indicating that, in the long run (a year or more), a high proportion of any of these organic chemicals placed in uncovered land management units will be released to the air, provided other removal pathways are not important. In actual practice, some land application units are covered to some extent, and other removal processes, such as leaching, biological and chemical degradation, and binding to soil or sediment, compete to reduce air emissions significantly.

EPA calculated chronic risks from inhalation pathway exposures for all organic TC analytes. To calculate exposure concentrations, EPA multiplied release estimates by the long-term fenceline dispersion coefficients used in the proposed HWIR-Waste exit level calculations for the high-end and central tendency surface impoundments and LAU releases. The fenceline dispersion coefficients are used to represent the nearest credible residential exposure locations, in keeping with the proposed HWIR-Waste risk methodology. Exposure durations are assumed to be 30 years in the high-end exposure release and exposure scenario, and 9 years in the central tendency scenario.

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[24] Release from surface impoundments were estimated on an annual basis, rather than on a facility life-time basis because these units receive a constant and continuous flow of wastes throughout the facility life, with liquid flowing out of the unit after an assumed dwell time. In contrast, once a waste is added to an LAU, it is assumed to remain in the facility to volatilize throughout the facility life-span.

Exhibit 3-6
Summary of Inhalation Pathway Screening Methods, Input Data, and Models Used for Bounding Risk Analysis

Modeling Procedures

- Estimate release proportions at TC regulatory concentrations
- Estimate exposure concentrations using fenceline dispersion coefficients from HWIR-Waste model[a]
- Estimate risks using IRIS and HEAST toxicity values (RfCs and Unit Risk values)

Subtitle D Surface Impoundment from Proposed HWIR-Waste Risk Analysis

HIGH-END	CENTRAL TENDENCY
● 40,000 square meters	● 2,000 square meters
● 40-year lifespan	● 40-year lifespan
● Depth 7 meters	● Depth 2 meters

"Generic" Land Application Unit from Proposed HWIR-Waste Risk Analysis

HIGH-END	CENTRAL TENDENCY
● 900,000 square meters	● 61,000 square meters
● 40-year lifespan	● 40-year lifespan
● Tilling depth 0.3 meters	● Tilling depth 0.2 meters

Long-Term Release Values

- Estimated over facility life using CHEMDAT8 model
- Modeled at TC concentrations for surface impoundments
- Modeled at 20 times TC concentrations for land application units
- Assumed persistence in management units (except vinyl chloride)

Chronic Exposure Durations

- High-end exposure duration = 30 years
- Central tendency exposure duration = 9 years

Chemicals Modeled

- All organic TC analytes
- Differ by seven orders of magnitude in Henry's Law constant
- Have molecular weight from 30 to 410
- Are rapidly degrading to very persistent

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[a] Technical Support document for the Hazardous Waste Identification Rule: Risk Assessment for Human and Ecological Receptors, US. Environmental Protection Agency, Office of Solid Waste, August 1995.

Exhibit 3-7
Emission Fraction for Air Releases of Volatile TC Analytes

		Fraction Emitted From:			
		Land Application Unit		**Surface Impoundment**	
TC Analyte	**kH**	**Central Tendency**	**High-End**	**Central Tendency**	**High-End**
Benzene	$5.5x10^{-3}$	0.9984	0.9984	0.8661	0.7451
Carbon tetrachloride	$2.9x10^{-2}$	0.9984	0.9984	0.8578	0.7318
Chlordane	$6.7x10^{-5}$	0.9984	0.6301	0.6649	0.4413
Chlorobenzene	$4.4x10^{-3}$	0.9984	0.9984	0.8564	0.7294
Chloroform	$4.0x10^{-3}$	0.9984	0.9984	0.8676	0.7475
m-Cresol	$8.8x10^{-7}$	0.8228	0.2225	0.2093	0.0858
o-Cresol	$1.6x10^{-6}$	0.9749	0.3384	0.3651	0.1713
p-Cresol	$8.2x10^{-7}$	0.8249	0.2233	0.2105	0.0864
Cresol	--	0.9678	0.3256	0.3550	0.1648
2,4-D	$4.5x10^{-6}$	0.9984	0.6866	0.6970	0.4722
1,4 Dichlorobenzene	$2.8x10^{-3}$	0.9984	0.9984	0.8483	0.7163
1,2 Dichloroethane	$1.3x10^{-3}$	0.9984	0.9984	0.8659	0.7443
1,1 Dichloroethylene	$2.5x10^{-2}$	0.9984	0.9984	0.8769	0.7631
2,4 Dinitrotoluene	$1.5x10^{-7}$	0.9984	0.9417	0.7280	0.5151
Endrin	$1.2x10^{-6}$	0.2696	0.0674	0.1466	0.0575
Heptachlor	$5.9x10^{-4}$	0.9984	0.9984	0.8160	0.6662
Heptachlor epoxide	$8.3x10^{-6}$	0.9983	0.5730	0.6558	0.4287
Hexachlorobenzene	$7.5x10^{-4}$	0.9984	0.9984	0.8211	0.6744
Hexachloro-1,3-butadiene	$2.4x10^{-2}$	0.9984	0.9984	0.8261	0.6824
Hexachloroethane	$3.6x10^{-3}$	0.9984	0.9984	0.8335	0.6928
Lindane	$3.4x10^{-6}$	0.9984	0.9984	0.8246	0.6793
Methoxychlor	$6.3x10^{-6}$	0.9984	0.9979	0.7759	0.6038
Methyl ethyl ketone	$3.6x10^{-5}$	0.9984	0.9984	0.8526	0.7174
Nitrobenzene	$2.1x10^{-5}$	0.9984	0.9689	0.7851	0.5981
Pentachlorophenol	$1.4x10^{-5}$	0.9984	0.9983	0.8021	0.6379
Pyridine	$7.0x10^{-3}$	0.9984	0.9822	0.7827	0.5975
Tetrachloroethylene	$1.7x10^{-2}$	0.9984	0.9984	0.8519	0.7224
Toxaphene	$3.4x10^{-6}$	0.9984	0.9984	0.7891	0.6282
Trichloroethylene	$1.1x10^{-2}$	0.9984	0.9984	0.8604	0.7359
2,4,5 Trichlorophenol	$4.4x10^{-6}$	0.9979	0.4889	0.5733	0.3339
2,4,6 Trichlorophenol	$4.1x10^{-6}$	0.9984	0.7077	0.6830	0.4571
2,4,5-TP (Silvex)	$1.3x10^{-8}$	0.9984	0.9984	0.8203	0.6735
Vinyl chloride	$8.4x10^{-2}$	0.9984	0.9984	0.8829	0.7733

Exhibit 3-8 summarizes the results of the screening-level risk estimation for the TC analytes having inhalation pathway toxicity values in IRIS or HEAST (as discussed below). The first eight columns of the results indicate whether the estimated lifetime cancer risk associated with managing the analytes at the TC (or the TC multiplied by 20) concentrations in the various management units would be greater than 10^{-5} or if the inhalation pathway hazard quotient (HQ) would exceed 1.0. These risk threshold values are the same as those used in developing the TC analyte concentrations for groundwater exposures. For the 16 TC analytes with IRIS Unit Risk values, inhalation pathway cancer risks greater than 10^{-5} are not predicted for any of the TC analytes released from the central tendency surface impoundment. In contrast, cancer risks above 10^{-5} are predicted for 12 of these analytes released from the high-end impoundment.[25] None of these analytes released from the central tendency LAU would result in an inhalation pathway risk greater than 10^{-5}. Releases of four analytes (chloroform, 1,4-dichlorobenzene, 1,1-dichloroethylene, hexachlorobenzene, and toxaphene) from the high-end LAU would result in risks above this level.

Of the four TC organics with inhalation RfCs, hazard quotients greater than 1.0 were calculated for three analytes (chlorobenzene, methyl ethyl ketone, and nitrobenzene) released from the central tendency surface impoundment. When releases are modeled from high-end impoundments, the one additional chemical (1,4-dichlorobenzene) also has an HQ greater than 1.0. Exactly the same pattern is seen for LAUs.

These results indicate that, under assumptions of no degradation or release to other pathways, the cancer risks and non-cancer hazard indices associated with management of some of the organic TC analytes may be above levels of concern previously used in amending the TC.

These risks may be overestimated if significant amounts of pollutants in waste are released through other pathways or are degraded biologically or chemically. For this reason, EPA used the proposed HWIR-Waste database to identify the TC analytes that are persistent in soil or water. As shown in the last two columns of Exhibit 3-8, most of the organic analytes that exceed the air risk targets under the assumption of no degradation are, in fact, not very persistent in either soil or water. Using a cutoff value for degradation rate constants of 0.5 year^{-1}, which corresponds to a half-life in soil or water of about 17 months, only 3 of the organic TC analytes are expected to be very persistent. The relatively short half-lives in water or soil may reduce the potential concern for inhalation pathway risks associated with the other TC analytes to the same extent. These results illustrate the need for more detailed, site-specific modeling of all of the transport and degradation processes.

Risks were calculated in this analysis for only those TC analytes having inhalation pathway toxicity values (Reference Concentrations or Unit Risk values) in IRIS. If instead inhalation pathway toxicity values were derived for the rest of the TC analytes from ingestion pathway values and used in similar risk calculations, the number of chemicals for which cancer risks and particularly non-cancer risks would exceed levels of regulatory concern would be much higher. These results have not been included in Exhibit 3-8 because EPA considers the level of uncertainty associated with such procedures to be unacceptably high.

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[25] The risks are greater from the high-end surface impoundment than from the central tendency surface impoundment, despite the lower proportionate releases from the former units, because the total mass disposed in the high-end unit and the total mass released are much greater. This result also occurs for the LAUs.

Exhibit 3-8. Inhalation Pathway Risks for TC Analytes and Their Dependence on Fate and Transport Properties

	Cancer Risk Exceeds 10^{-5}				HQ Exceeds 1.0					
	Surface Impoundment		Landfill		Surface Impoundment		Landfill			
TC Analyte	Central Tendency	High-End	Central Tendency	High-End	Central Tendency	High-End	Central Tendency	High-End	Persistent in Water[a]	Persistent in Soil
Benzene	--	--	--	--	ND	ND	ND	ND	--	--
Carbon tetrachloride	--	1.50E-04	--	--	ND	ND	ND	ND	--	--
Chlordane	--	1.34E-04	--	--	ND	ND	ND	ND	X*	X*
Chlorobenzene	ND	ND	ND	ND	2.55E+03	9.99E+04	5.74E+02	2.06E+04	--	--
Chloroform	--	2.82E-03	--	5.69E-04	ND	ND	ND	ND	--	--
1,4 Dichlorobenzene	ND	ND	ND	ND	--	1.84E+02	--	3.87E+01	--	--
1,2 Dichloroethane	--	2.65E-04	--	ND	ND	ND	ND	ND	--	--
1,1 Dichloroethylene	--	7.31E-04	--	1.44E-04	ND	ND	ND	ND	--	--
Heptachlor	--	1.90E-04	--	--	ND	ND	ND	ND	--	--
Heptachlor epoxide	--	2.44E-04	--	--	ND	ND	ND	ND	X	X
Hexachlorobenzene	--	1.10E-03	--	2.47E-04	ND	ND	ND	ND	X	X
Hexachloro-1,3-butadiene	--	2.06E-04	--	--	ND	ND	ND	ND	--	--
Hexachloroethane	--	2.28E-04	--	--	ND	ND	ND	ND	--	--
Methyl ethyl ketone	ND	ND	ND	ND	1.02E+02	3.93E+03	2.30E+01	8.25E+02	--	--
Nitrobenzene	ND	ND	ND	ND	4.67E+02	1.64E+04	1.15E+02	4.00E+03	--	--
Tetrachloroethylene	--	--	--	--	ND	ND	ND	ND	--	--
Toxaphene	--	2.75E-03	--	6.60E-04	ND	ND	ND	ND	ND	ND
Trichloroethylene	--	--	--	--	ND	ND	ND	ND	--	--
2,4,6 Trichlorophenol	--	--	--	--	ND	ND	ND	ND	--	--
Vinyl chloride	--	3.56E-04	--	--	ND	ND	ND	ND	--	--

Notes: [a] Degradation rate constant for soil or water less than 0.5 yr^{-1}.
* For surface impoundments only; does not exceed at landfills.
X = Yes.
-- = Risk or hazard is below threshold.
ND = No Data.

Evaluation of the proposed HWIR-Waste exit level calculations for the TC analytes confirms the potential concern for nongroundwater pathways. For some of the TC analytes, the HWIR-Waste proposed exit level calculations indicated that non-groundwater pathways are significant. Findings include the following:

- For 9 of the TC analytes, pathways other than human groundwater exposure drove the establishment of proposed exit levels.
- For six of the analytes, ingestion of contaminated milk or vegetables was the highest-risk exposure pathways.
- For one of the pollutants, the driving non-groundwater exposure pathway was direct inhalation.
- For two analytes, ecological risks rather than health risks drove the derivation of proposed exit levels.

In all of these cases, the initial release was to air through volatilization. These indirect pathway risks will be discussed in more detail in the following sections.

3.5.4 Potential Risks from Surface Water Exposures

This section investigates the general level of protectiveness of the TC regulatory levels against surface water exposures, a risk that the TC was not specifically intended to address. Waste constituents could be released to surface water from land management units through several mechanisms:

- Discharge of groundwater contaminated by leachate from waste management units;
- Transport of waste constituents to surface water bodies by runoff and overland transport of wastes released from the management unit;
- Direct releases through overland runoff of liquid wastes from surface impoundments;[26] and
- Volatilization of constituents from land-based units, followed by deposition onto surface water or onto soil that eventually finds its way into surface water bodies.

The surface water exposure pathways of potential significance for humans include direct consumptive use (i.e., ingestion and dermal contact with domestic water) and dermal contact and incidental ingestion of the surface water associated with recreational exposures. If the contaminants are persistent in sediment, dermal contact and incidental ingestion of small amounts of sediment also are possible exposure pathways.

All of these release and exposure pathways have been analyzed in the development of hazardous waste management regulations and in other contexts. The experience gained in these exercises has led the Agency to a number of general conclusions regarding the importance of surface water exposures for human health risks:

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[26] Such releases are likely to be controlled by permit requirements for surface water discharges and through facility design regulations.

- For common waste management practices, surface water exposure cannot be automatically ruled out as insignificant in comparison to groundwater, inhalation, and other indirect pathways.

- The significance of surface water releases depends heavily on the management practices employed by a facility and the specific interactions between surface water and groundwater at the facility.

- Generally, groundwater discharge significantly affects surface water quality only where groundwater constitutes a significant proportion of the total surface water in a water body. This pathway may be important for very large management units that generate large amounts of leachate, but usually significant surface water quality impacts are limited to relatively small streams adjacent to management units and to on-site or adjacent ponds derived mainly from leachate.

- Exposure to volatile contaminants in surface water is generally limited because these contaminants are depleted rapidly from surface water through volatilization. Air releases from surface water may themselves be significant from a health standpoint. Usually, however, volatilization from the management unit itself dominates, unless the unit is covered.

- Incidental ingestion and dermal contact with contaminated sediment tend not to be significant exposure pathways for humans, because of their infrequency and the relatively small amounts of contaminated sediment contacted (but see below).

- Indirect pathway exposures may be of concern, however. The contaminants that persist in sediment and have a high capacity to bioaccumulate and bioconcentrate are often the most significant contributors to human health risks. This capacity may overcome the high dilution factors often associated with releases to surface water. These persistent pollutants most often reach human receptors through the consumption of contaminated fish or shellfish.

In evaluating the potential risks associated with proposed HWIR-Waste chemicals, EPA identified contaminants for which surface water pathways were of potential concern. Whether or not the surface water pathway was a concern depended on the waste treatment scenario. For wastewaters managed in surface impoundments, surface water was not a human health risk for any of the TC analytes. All of the proposed exit levels driving non-groundwater pathways for humans were associated with volatilization followed by deposition on soil and did not involve surface water. For nonwastewaters disposed in land application units and waste piles, however, more than 50 percent of the proposed exit levels for the HWIR-Waste constituents are driven by pathways involving surface water exposures.[27] The driving (highest-risk) pathways were approximately equally divided among the contaminants between overland runoff followed by fish uptake, and overland runoff followed by surface water ingestion. These results must be interpreted cautiously. The analysis of the proposed HWIR-Waste exit levels cited above gives only a comparative, not an absolute, indication of the importance of the surface water exposure pathways for waste piles and land application units. The proposed exit levels calculated for these types of units are generally higher than those associated with surface impoundments, for example, indicating that the magnitude of the risks

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[27] Preliminary Report on Factors Important to Identifying Risk-Based Entry Characteristics: Analysis of Hazardous Waste Identification Risk Models, Ogden Environmental and Engineering Services, August 1996.

from wastes piles and land application units are, in general, lower than those associated with surface impoundments.

Summary. The preceding analysis has explored the possibility that significant risks to health or the environment may be associated with exposures through surface water pathways. While a number of theoretical arguments suggest that such releases might be important under only a relatively narrow range of conditions, the proposed HWIR-waste modeling results indicate that these pathways may well be significant for some TC analytes disposed as non-hazardous industrial wastes. The possibility that the surface water releases and exposures represent a potential gap in the TC, especially for persistent and bioaccumulative chemicals, cannot be ruled out.

3.5.5 Potential Indirect Pathway Risks from TC Analytes

"Indirect" pathways are any pathways involving more than one environmental medium (e.g., groundwater, air, surface water, soil, sediment, and biota) between the release and the exposed receptor. The initial release may be to any medium. Indirect exposure pathways often, but not always, involve uptake of environmental contaminants by living organisms, which, in turn, are consumed by human or other receptors. Some of the pathways discussed in the previous sections, such as groundwater releases to surface water, are, strictly speaking, indirect. This section, however, emphasizes pathways involving potential long-range transport of persistent pollutants and pathways involving biota (crops, fish, or livestock) prior to human exposures.

Persistence, properties facilitating physical transport, and the potential to bioaccumulate in the environment are critical in the indirect pathways, and the physical/chemical and environmental fate properties of constituents significantly determine their movement through such pathways. Exhibit 3-9 summarizes some important physical, chemical, and environmental fate properties of the TC analytes relating to persistence, partitioning behavior between environmental media, and bioaccumulation. For each parameter, the exhibit compares each constituent's value to a criterion or cutoff value that roughly indicates whether the parameter will strongly influence the transport and partitioning of the chemical in the environment in a multipathway analysis. The derivation of these criteria are discussed in more detail in Section 4.3.2.

The first column identifies TC analytes with a high Koc (high Kd for metals),[28] generally indicating a propensity to bind to soils. A high value means that chemicals will leach only slowly to soil, but would bind to particulates if they were released through runoff or into the air. Essentially all of the chemicals with Koc values above 10,000 are pesticides. In addition, the majority of the TC metals would be expected to bind to some extent to particulates.

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[28] The Koc is the organic carbon binding coefficient; the Kd is the soil-water dissociation constant.

Exhibit 3-9
Major Fate and Transport Parameters for TC Analytes

TC Analyte	Koc/Kd > 10,000 ml/g	Henry's Law Constant>10^{-5} atm-m^3/mol	Half-life in Air > 0.15 yr.	Soil/Water Degradation Rate Constant < 0.5/yr.	Plant-Soil BFC for Forage Plants > 3.5 (ug/g)/(ug/g)	Beef Biotransfer Factor > $7.8x10^{-4}$ day/kg	Fish BCF/BAF> 1000 l/kg
1,1-Dichloroethene		✓					
1,2-Dichloroethane		✓	✓		✓		
1,4-Dichlorobenzene		✓					
2,4,5-TP (Silvex)					✓		
2,4,5-Trichlorophenol				✓	✓		
2,4,6-Trichlorophenol					✓		
2,4-D							
2,4-Dinitrotoluene							
Arsenic				✓		✓	
Barium				✓			✓
Benzene		✓					
Cadmium				✓			
Carbon tetrachloride		✓	✓				
Chlordane	✓	✓		✓		✓	✓
Chlorobenzene		✓					
Chloroform		✓	✓				
Chromium				✓		✓	
Cresol, m-							
Cresol, o-							
Cresol, p-							
Endrin	✓					✓	✓
Heptachlor	✓	✓				✓	✓
Heptachlor epoxide	✓			✓		✓	✓
Hexachloro-1,3-butadiene	✓	✓				✓	✓
Hexachlorobenzene	✓	✓		✓		✓	✓
Hexachloroethane		✓					
Lead	✓			✓			
Lindane							✓
Mercury	✓			✓			✓
Methoxychlor	✓					✓	✓
Methyl ethyl ketone		✓			✓		
Nitrobenzene		✓			✓		
Pentachlorophenol	✓	✓				✓	✓
Pyridine		✓			✓		
Selenium				✓		✓	
Silver				✓		✓	
Tetrachloroethylene		✓	✓				
Toxaphene	✓					✓	✓
Trichloroethylene		✓					
Vinyl chloride		✓			✓		

The next column on Exhibit 3-9 shows the Henry's Law constants (kH)[29] for the TC analytes, with values above 10^{-5} generally indicating a moderate to high capacity to volatilize from soil-water systems, which may be the first step in an indirect exposure pathway. About half (19) of the TC analytes have kH values above 10^{-5}. As discussed in Section 3.5.3, variations in Henry's Law constants did not strongly effect the predicted long-term release of the TC analytes from surface impoundments and waste piles. Short-term releases, however, may be much more dependent on this parameter.

The next two columns address the persistence of TC analytes in soils, water, and air. Data in these two columns summarize information from the proposed HWIR-Waste database on the estimated half-life of chemicals in air and the overall degradation rate constants in soils and surface water. Four of the TC analytes are identified as having long half-lives in air and 12 are persistent (have low degradation rate constants) in soil and/or surface water. The air half-life values must be interpreted cautiously, as the proposed HWIR-Waste database contains this information on only about 20 chemicals. Metals and many high-Koc organics would also be expected to have long half-lives in air if they were bound to particulates. As discussed earlier, the TC analytes with long half-lives in soil/water systems include primarily the metals and chlorinated pesticides.

The final three columns of Exhibit 3-9 consider the propensity of TC analytes to bioaccumulate in aquatic and terrestrial ecosystems. The plant-soil bioconcentration factor (BCF) is an estimate of the typical ratio of the concentration of a constituent in soil to the concentration in a particular kind of plant (in this case, forage plants consumed by beef and dairy cattle). Similarly, the beef biotransfer factor is an estimated typical ratio of the concentrations of pollutants in the diet of beef cattle to the resultant concentrations in edible tissue. Finally, the BCF and bioaccumulation factor (BAF) values for fish represent the typical ratios of pollutant concentrations in surface water to that in fish tissue, considering only water exposures or considering all pathways, respectively. (These value tend to be quite similar for most chemicals.) Although the exhibit indicates that several constituents may bioaccumulate from soil to forage plants, in reality, only 2,4,5-trichloropropionic acid (Silvex) has a very high bioconcentration potential. The value of the forage biotransfer factor for this pesticide is five orders of magnitude greater than for any other chemical (greater than 10^{6}). Generally the same chemicals have high beef biotransfer factors, fish BCFs, and BAFs, with barium, mercury, and lindane bioconcentrating only in aquatic systems, and arsenic, chromium, selenium, and silver being significant for the beef exposure pathways alone.

Summary. These single comparisons indicate the significant potential for many TC analytes to be transported through multiple media to reach the ultimate receptors. The data in Exhibits 3-8 and 3-9 show that the chlorinated pesticides (i.e., chlordane, endrin, heptachlor, heptachlor epoxide, hexachlorobenzene, methoxychlor, pentachlorophenol, and toxaphene), chloroform, and hexachloro-1,3-butadiene have the potential to participate in indirect exposure pathways and have non-groundwater pathways as their driving pathways. In addition, several high-toxicity and persistent metals, such as mercury, arsenic, and lead, also are of potential concern.

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[29] As noted previously, kH is the ratio of a chemical's vapor pressure to its water solubility.

3.5.6 Potential for Acute Adverse Effects of Exposures to TC Analytes

The TC was originally established based on the need to protect individuals from adverse health effects due to chronic exposures to the TC constituents consumed in groundwater. This approach to protecting against groundwater exposure risks is conservative because the relatively long time scale involved in groundwater transport to receptors, under most reasonable assumptions, means that limiting concentrations in any time period to the low chronic risk-based levels also will protect against short-term adverse effects. Short transient exposures to high levels of groundwater contaminants are extremely uncommon. Before the concentration of a pollutant reaches the relatively high level required to cause acute effects, it generally will have exceeded the allowable chronic exposure level for a long period of time.

This relationship may not apply to exposure through pathways not involving slow releases to groundwater. For example, the rapid evaporation of volatile chemicals from a ruptured container, the catastrophic release due to overtopping of a surface impoundment, or runoff erosion from an extreme storm event have the potential to result in short-term acute exposures to humans and environmental receptors. For this reason, EPA has evaluated the potential level of protectiveness of the TC against acute exposures. EPA evaluated the potential for adverse effects associated with acute volatilization of chemicals from land management units. The approach was analogous to the screening-level risk modeling for chronic exposure, except that the short-term releases were calculated and exposure concentrations were compared to short-term exposure standards. This analysis indicates that the short-term concentrations of all of the volatile TC analytes calculated at the fenceline were far below applicable short-term exposure standards (in this case, occupational exposure standards).

This simple modeling does not unconditionally eliminate the possibility of adverse effects from acute exposures to the TC analytes. Unusual release events, such as fires, or explosions, could result in higher exposures than calculated assuming simple volatilization. In addition, high winds or other events could result in high concentrations of particle-bound metals and other non-volatile analytes. The potential for these kinds of release events strongly depends on specific waste characteristics, site conditions, and management practices.

3.5.7 Potential Risks to Ecological Receptors from TC Analytes

Risks to non-human receptors are the final category of risks evaluated by EPA. Like the inhalation, surface water, and indirect pathway risks, they were not expressly factored into the derivation of the regulatory levels for the TC analytes. While a substantial number of the TC chemicals are toxic to ecological receptors, the protection of ecological receptors was not a specific concern in the rulemaking. This section discusses potential gaps in the TC characteristic associated with harm to ecological receptors.

Many of the same factors that contribute to potential risks for human receptors also contribute to potential risks for ecological receptors. Generally, harm to environmental receptors requires release of chemicals from containment and transport to sensitive receptors without extensive degradation or extreme dilution, just as in the case of human health risks. Thus, the physical properties of chemicals that contribute to persistence and transport in the environment, as shown in Exhibit 3-9, are indicators of potentially significant risks for ecological receptors. The fact that most of the persistent chemicals with high bioconcentration potentials are also pesticides, which are toxic to certain plants, insects, or other animals, adds to the potential risks.

The degree of protection of ecological receptors afforded by the TC leachate concentrations does not appear very high for many of the most toxic pesticides. Exhibit 3-10 compares the TC regulatory levels to two basic measures of potential aquatic toxicity, the acute and chronic Ambient Water Quality Criteria (AWQC) for the protection of aquatic life. It shows that, for many analytes, the allowable leachate concentrations are many orders of magnitude above the corresponding AWQC.

The shaded boxes in the table identify TC analytes with regulatory levels greater than 1,000 times the AWQC. The chemicals falling into this category again include the chlorinated pesticides, chlorobenzene, lead, mercury, silver, and 2,4,5-trichlorophenol. This ratio indicates that if the TC analytes were released from wastes to groundwater and from there discharged to surface water, a dilution of at least 1,000-fold would be required to reduce the concentration to levels not harmful to aquatic biota. Such a scenario may be unlikely, however, because, as noted above, these chemicals tend to bind strongly to soil and do not move readily in groundwater. (As is discussed in more detail in Chapter 2, however, some of these chemicals were found in groundwater at concentrations above health-based levels in the descriptions of environmental releases from non-hazardous industrial waste management units.)

In a more likely scenario, the high ecotoxicity of these chemicals means that runoff transport of particulate wastes at concentrations not considered hazardous under the TC could cause adverse effects in water bodies near management units. As noted above, the concern for runoff exposures is borne out to some extent by the proposed HWIR-Waste modeling, where proposed exit levels are driven by this pathway for disposal in waste piles and land application units. In the case of silver and endrin (two of the chemicals in shaded boxes in Exhibit 3-10), the proposed exit levels were driven by runoff releases to surface water.

<u>Summary</u>. Based on these findings, it appears that the level of protectiveness of the TC is not very high for some non-human receptors. At a minimum, the ecotoxicity parameters suggest a potential concern associated with the aquatic toxicity of chlorinated pesticides, as well as a few other chemicals. The severity of these potential gaps is addressed in more detail in later chapters.

3.6 Potential Gaps Associated with TCLP

This section reviews the technical basis for the Toxicity Characteristic Leaching Procedure (TCLP) and discusses potential problems associated with its use based on a brief review of available literature and data. Specifically, this section focuses on whether the TCLP fails to accurately predict releases from identified classes of wastes into groundwater and non-groundwater pathways.

3.6.1 TCLP Background

In 1980, prior to development of the TCLP, the Agency adopted the Extraction Procedure (EP) to identify wastes likely to leach hazardous concentrations of particular toxic constituents into the groundwater under conditions of improper management.[30] In 1986, the Agency proposed a modified leaching procedure, the TCLP, to replace the EP.[31] The Agency promulgated the final rule on the

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[30] 45 *Federal Register* 33110, May 19, 1980.

[31] 51 *Federal Register* 21648, June 13, 1986.

Exhibit 3-10
Ratios of TC Leachate Regulatory Levels to Ambient Water Quality Criteria for Aquatic Life[a]

Chemical	Freshwater AWQC Concentration (ug/l)		TC RegulatoryLevel (mg/l)	TC Leachate Concentration (ug/l)	Ratio of TC Regulatory Level to AWQC
	Acute	Chronic			
Arsenic	850	190	5	5000	26
Barium	--	--	100	100000	NA
Benzene	5300	--	0.5	500	0.09[b]
Cadmium	3.9	1.1	1	1000	909
Carbon tetrachloride	35200	--	0.5	500	0.01
Chlordane	2.4	0.0043	0.03	30	6.98E+04
Chlorobenzene	250	50	100	100000	2.00E+04
1,4 Dichlorobenzene	250	50	7.5	7500	150
Chloroform	28900	1240	6	6000	4.8
Chromium	1700	210	5	5000	24
Chromium VI	16	11	---	5000	455
o-Cresol	--	--	200	200000	NA
m-Cresol	--	--	200	200000	NA
p-Cresol	--	--	200	200000	NA
Cresol	--	--	200	200000	NA
2,4-D	--	--	10	10000	NA
1,2-Dichloroethane	118000	20000	0.5	500	0.025
1,1 Dichloroethylene	--	--	0.7	700	NA
2,4-Dinitrotoluene	330	230	0.13	130	0.57
Endrin	0.18	0.0023	0.02	20	8.70E+04
Heptachlor	0.52	0.0038	0.008	8	2.11E+04
Heptachlor epoxide	0.52	0.0038	0.008	8	2.11E+04
Hexachlorobenzene	6	3.68	0.13	130	35

Exhibit 3-10 (continued)
Ratios of TC Leachate Regulatory Levels to Ambient Water Quality Criteria for Aquatic Life

Chemical	Freshwater AWQC Concentration (ug/l)		TC RegulatoryLevel (mg/l)	TC Leachate Concentration (ug/l)	Ratio of TC Regulatory Level to AWQC
	Acute	Chronic			
Hexachloro-1,3-butadiene	90	9.3	0.5	500	54
Hexachloroethane	980	540	3	3000	5.6
Lead	82	3.2	5	5000	1.56E+04
Lindane	2	0.08	0.4	400	5.00E+04
Mercury	2.4	0.012	0.2	200	1.67E+05
Methoxychlor	--	0.03	10	10000	3.33E+06
Methyl ethyl ketone	--	--	200	200000	NA
Nitrobenzene	27000	--	2	2000	0.07[a]
Pentachlorophenol	20	13	100	100000	7.69E+04
Pyridine	--	--	5	5000	NA
Selenium	20	5	1	1000	200
Silver	4.1	0.12	5	5000	4.17E+05
2,4,5-TP (Silvex)	--	--	1	1000	NA
Tetrachloroethylene	5280	840	0.7	700	0.83
Toxaphene	0.73	0.0002	0.5	500	2.50E+07
Trichloroethylene	45000	21900	0.5	500	0.02
2,4,5-Trichlorophenol	100	63	400	400000	6.35E+04
2,4,6-Trichlorophenol	--	970	2	2000	2.1
Vinyl chloride	--	--	0.2	200	NA

Notes:

[a] Shaded rows indicate that the ratio of the TC regulatory level to the AWQC for the analyte exceeds 1,000.
[b] Indicates ratio is to acute AWQC.

application of the TCLP in 1990.[32] In finalizing the TCLP, the Agency intended to improve the leachate test procedure and eliminate some of the analytical difficulties involved in the EP.

The TCLP is used to quantify the extractability of certain hazardous constituents from solid waste under a defined set of laboratory conditions. This test is used to evaluate the leaching of TC metals, volatile and semivolatile organic compounds, and pesticides from wastes. In principle, this procedure simulates the leaching of constituents into groundwater under conditions found in a municipal solid waste (MSW) landfill. The TCLP, however, does not simulate the release of contaminants to non-groundwater pathways. The TCLP is most commonly used by EPA and state agencies to evaluate the leaching potential of wastes, and for determining toxicity. The TCLP is promulgated in Appendix II of 40 CFR Part 261.24(a) and has been designated as EPA Method 1311 in "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods - SW-846."

In the TCLP, liquid wastes (those containing less than 0.5 percent dry solid material) are "extracted" by filtering the wastes through a 0.6 to 0.8 µ glass fiber filter. Non-liquid samples (those containing greater than or equal to 0.5 percent dry solid material) are:

- Reduced to a particle size of less than 9.5 mm (liquid, if any, is separated from the solid phase) and extracted with an acetate buffer solution with either a pH of 5 or an acetic acid solution with a pH of 3, depending on the alkalinity of the waste (wastes with a pH of 5 and above are extracted with the acetic acid solution);

- A liquid-to-solid ratio of 20:1 is used for an extraction period of 18 hours; and

- The leachate is filtered and combined with the liquid portion of the wastes, if necessary.

Contaminant analyses then are conducted on the extracts of the liquids and non-liquids.

3.6.2 Limitations of the TCLP

The Agency reviewed TC constituent and concentration data collected on releases from the non-hazardous industrial waste management units discussed in Chapter 2 (see Exhibit 2-5). These data show that, of the 15 TC constituents detected in at least three case studies, eight are present in groundwater at levels much higher than their TC levels.[33] If the wastes passed the TCLP before being placed in the management units, this could indicate that the TCLP underestimated the long-term releases for certain classes of wastes. One of the major limitations of these data, however, is that they may not reflect current waste analysis or management practices. For example, some data represent releases from waste disposal that occurred prior to implementation of the TCLP, and thus some of the releases that exceed TC levels could be due to problems with other extraction procedures or to the lack of any testing procedure. Nevertheless, some site data (not reported in Chapter 2) exists that may represent problems with the TCLP. For example, the kiln residues from the treatment of spent aluminum potliners at one facility are disposed in a monofill as non-hazardous wastes.[34] EPA approved a delisting petition for the kiln

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[32] 55 *Federal Register* 11827, March 29, 1990.

[33] Note that the majority of these data were collected from on-site groundwater monitoring wells and not from drinking water wells, and therefore actual risks likely are lower than would be indicated by these data.

[34] Lester Sotsky, Arnold & Porter, "Reynolds Metal Company's Gum Springs Facility," Memorandum to Steven Silverman, U.S. EPA, September 26, 1996.

residue waste based on TCLP data that showed the target constituents in the TCLP extract to be below treatment standards (which, for the TC constituents, are lower than the TC regulatory levels). When the leachate from the monofill was analyzed, however, levels of arsenic were found to be higher than its TC level. Other hazardous constituents, including cyanide and fluoride, were also found at levels higher than those predicted by the TCLP.

Several technical and practical issues have been raised by the regulated community and others regarding the applicability of the TCLP for identifying hazardous waste. A number of comments were submitted to the Agency in response to the June 13, 1986 proposal to replace the EP with the TCLP. The Agency responded to the comments in the final rule, but also decided to continue to address commenters concerns and further evaluate modifications to the TCLP. The Agency stated that further improvements in the TCLP will be proposed as they are developed. Subsequent to that rulemaking, additional concerns have been raised by commenters during later rulemakings (e.g., rules addressing newly listed or identified wastes).

Some of the key issues regarding the TCLP identified from these comments on various rulemakings and from other sources are outlined below.[35]

TCLP underestimates leachate from some high alkaline wastes or environments. The high alkalinity of some wastes may make the TCLP an inappropriate predictor of leachate composition. For example, the addition of acid during the TCLP might not reduce the pH of high alkaline waste to the same level as would occur over time in the environment. Thus, long-term leachate concentrations of constituents that are insoluble at higher pH ranges may be underestimated in the TCLP leachate compared to the actual leachate from the industrial landfills where a long-term acid environment (e.g., from acidic rain water) is present.

Some toxic metal constituents are more mobile at both the higher and the lower pH ranges. For example, studies show that leaching of metals such as cadmium, chromium, and lead typically is limited when the pH is in the range of about 8 or 9, but can increase significantly when the pH either increases or decreases.[36] Thus, if a waste is highly alkaline (e.g., pH >11) and the TCLP acidic leaching medium lowers the pH to only about 8 or 9, then the concentrations of these metals in the TCLP leachate could be significantly lower than would occur from either a highly alkaline or a highly acidic environment (depending on a number of factors, such as characteristics of any co-disposed wastes, type of treatment, and characteristics of the soil and rain water).

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[35] Note, however, that this list of issues is not meant to be comprehensive. Other issues, such as the potential overestimation of the dilution simulated by the TCLP, may need further study.

[36] van der Sloot, H.A., G.J. de Groot, and J. Wijkstra, "Leaching Characteristics of Construction Materials and Stabilization Products Containing Waste Materials," in P.L. Cote and T.M. Gilliam, eds., Environmental Aspects of Stabilization and Solidification of Hazardous and Radioactive Wastes, ASTM STP 1033, American Society for Testing and Materials, Philadelphia, Pennsylvania, 1989; and Willis, et al., "When the TCLP Is Not Enough: Leaching Tests for Solidification/Stabilization Technologies," Hazardous Materials Controls/Superfund 1991, Proceedings of the 12th National Conference, Hazardous Materials Control Research Institute, pp. 385-388, December 3-5, 1991.

Several commenters to the June 13, 1986 TCLP proposal expressed concern regarding the application of the TCLP to alkaline wastes. They noted that no high alkaline wastes were included in the development of the TCLP and, therefore, no conclusions could be made concerning the actual behavior of these wastes. The MEP, described in the text box, is one test that the Agency and others use that may better simulate the long-term leaching behavior of such wastes.

Multiple Extraction Procedure (MEP)

The MEP involves an initial extraction with acetic acid and at least eight subsequent extractions with a synthetic acid rain solution (sulfuric/nitric acid adjusted to pH 3). The MEP is intended to simulate 1,000 years of freeze and thaw cycles and prolonged exposure to a leaching medium. One advantage of the MEP over the TCLP is that the MEP gradually removes excess alkalinity in the waste. Thus, the leaching behavior of metal contaminants can be evaluated as a function of decreasing pH, where the solubility of most metals increases. Currently, the MEP is used in the Agency's de-listing program.

TCLP underestimates the leachate concentrations from oily wastes and some paint wastes. Several reports indicate that oily and some paint wastes tend to clog the filters used to separate the extract from the solids prior to analysis, resulting in under-reporting of the extractable constituent concentrations.[37] Several commenters on the June 13, 1986 TCLP proposal noted that, in the development of the TCLP, the Agency tested only 11 wastes.[38] These commenters argued that increasing the variety of wastes (to include oily wastes, organic chemical wastes, and municipal wastes) and the number of extractions performed could refine the TCLP and enhance its accuracy.

TCLP may not accurately mimic conditions commonly found in non-hazardous industrial waste disposal. A discussed in the 1980 final EP rule, several commenters responding to the proposed use of the EP for evaluating the leaching of hazardous constituents argued that the co-disposal assumption is not applicable to wastes that are never co-disposed with municipal solid wastes and thus do not leach at the aggressive rates characteristic of co-disposal situations. Thus, the commenters stated, the leachate procedure does not simulate the conditions found in industrial waste monofills. In response, the Agency stated that most wastes, even those that are unlikely to be disposed in a municipal landfill, are likely to come into contact with some form of acidic leaching medium during their management histories or could otherwise encounter environments that could cause the wastes to leach comparable levels of toxic constituents.

This same debate occurred during development of the TCLP, and it continues today. For example, the Lead Industries Association Inc., commenting on the Phase IV supplemental proposed rule,[39] cited an EPA study[40] that

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[37] "Preliminary Proposal to Require the TCLP in Lieu of the Waste Extraction Test," Memorandum to James Carlisle, Department of Toxics Substances Control, California EPA, from Jon Marshack, California Regional Water Quality Control Board, December 18, 1995; and U.S. Environmental Protection Agency, Technical Background Document and Response to Comments - Identification and Listing of Hazardous Waste - Method 1311 - TCLP, F-90-TCF-S0004, April 1989.

[38] *Ibid*.

[39] 61 *Federal Register* 2338, January 25, 1996.

[40] U.S. Environmental Protection Agency, "Performance Testing of Method 1312 QA Support for RCRA Testing," p. III, June 1989

stated that acetic acid leaching fluid could selectively solubilize toxicants (specifically lead) and incorrectly classify the material as hazardous when, in fact, no mobilization (leaching) would be expected to occur in the landfill environment. Kennecott Corporation and National Mining Association, also in response to the Phase IV supplemental proposed rule, stated similar concerns. The SPLP (see text box at right) is one test that has been considered for addressing this issue.

TCLP may underestimate the chelation-facilitated mobility of some waste constituents. A recent analysis of the TCLP and Cal WET (see text box at right) indicates that the low chelation[41] activity of the acetate buffer used in the TCLP may underestimate the ability of leachate containing chelating agents to mobilize waste constituents.[42] Cal WET uses a citrate buffer that approximates the chelation ability of many other compounds of landfill leachate and, thus, overcomes the constraints of the TCLP test.

TCLP does not account for the oxidation/reduction reactions occurring in landfills. A recent study noted that the addition of iron filings to stabilize foundry sand

Synthetic Acid Precipitation Leach Test (SPLP)

The SPLP is similar to the TCLP, but the initial liquid-solid separation step has been eliminated and the acetate buffer extraction fluid has been replaced by a dilute nitric acid/sulfuric acid mixture. The TCLP addresses co-management of industrial and non-industrial wastes in an organic acid environment, a scenario that does not match the disposal setting of many treated wastes, while the SPLP simulates disposal in an acid rain environment. The SPLP is currently used by several state agencies to evaluate the leaching of TC hazardous constituents from wastes.

California Waste Extraction Test (Cal WET)

Cal WET was developed by the State of California to classify hazardous wastes. This test uses sodium citrate buffer as the leachate, a 10:1 liquid-to-solids ratio, and a testing period of 48 hours. Cal WET applies a soluble threshold limit concentration (STLC) as the regulatory standard. STLC standards for metal concentrations in the leachate are similar to those for the TCLP. Cal WET also develops a Total Threshold Limit Concentration (TTLC), which is equivalent to the Total Waste Analysis (TWA) procedure. Cal WET is a more aggressive test when compared to the TCLP. That is, Cal WET almost always extracts higher levels of contaminants, and the citrate buffer used in this test has greater chelation effect than the acetate buffer used in the TCLP.

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[41] The chelation property of a reagent (such as acetate and citrate) refers to the ability of the reagent to bind with and solubilize metal contaminants. The low chelation ability of acetate buffer might result in fewer metal constituents being leached into the extract.

[42] "Preliminary Proposal to Require the TCLP in Lieu of the Waste Extraction Test," *supra* footnote 37.

wastes[43] seems to mask the potential leachability of lead by interfering with the TCLP.[44] If metallic iron (iron filings) are added to the waste, the lead concentration in the TCLP extract may be decreased by an oxidation/ reduction reaction to levels below the lead TC level. If, however, the waste is placed in a landfill or surface impoundment, the iron oxidizes over time and loses its ability to further reduce the lead ions. This results in the leaching of lead to the environment.

Another recent study reviewed the practice of using iron as an additive in stabilizing paint waste.[45] The study notes that the iron reduces the lead ions in paint waste to the less soluble metallic lead, which is subsequently removed by filtration from the leachate being analyzed. This use of iron allows the lead-containing waste to pass the TCLP. The study notes, however, that repeated leaching of the same waste sample increases the leaching rate to a point where lead is sufficiently solubilized to exceed the TC regulatory level.

Finally, another study showed that oxidation/reduction potential has a significant effect on leaching of metals from stabilized waste materials.[46] This study showed that the leaching of chromium increases significantly under highly oxidizing conditions, and the leaching of arsenic, vanadium, lead, and iron increase significantly under reducing conditions.

***TCLP may not predict long-term mobility of organic contaminants in some treated*[47] *wastes*.** A fairly recent Superfund Innovative Technology Evaluation (SITE) field evaluation examined the long-term performance of stabilization treatment of lead and other metals, oil and grease, and mixed volatile and semivolatile organic compounds.[48] Portland cement and a proprietary additive were used as stabilizing agents. Durability was tested with weathering tests by wet-dry and freeze-thaw cycling and by sampling stabilized treated waste after 9 and 18 months of burial. The results showed that organic contaminants were not effectively immobilized (although the testing also showed that lead and other metals remained highly immobilized, the physical properties of the stabilized treated waste deteriorated only slightly, and the porosity decreased).

Another study conducted on the long-term leaching performance of commercially stabilized waste demonstrated a highly waste-dependent effect of time on the TCLP results.[49] In this study, TCLP extraction was

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[43] Stabilized waste is a concern for the Scoping Study because some non-hazardous industrial waste either is treated (e.g., using stabilization) to reduce the release of hazardous constituents or is derived from characteristically hazardous waste that has been "decharacterized" via treatment.

[44] Douglas Kendall, "Impermanence of Iron Treatment of Lead-Contaminated Foundry Sand--NIBCO, Inc. Nacogdoches, Texas," National Enforcement Investigations Center--Project PA9, April 18, 1996.

[45] Northwestern University, "Chapter 4 - Evaluation of Procedures for Analysis and Disposal of Lead-Based Paint-Removal Debris," Issues Impacting Bridge Painting: An Overview, Infrastructure Technology Institute, FHWA/RD/94/098, August 1995.

[46] Dusing, D.C., Bishop, P.L., and Keener, T.C., "Effect of Redox Potential on Leaching from Stabilized/Solidified Waste Materials," Journal of Air and Waste Management Association, Vol. 42, N1, p. 56(7), January 1992.

[47] See footnote 36.

[48] U.S. Environmental Protection Agency, Office of Research and Development, Technical Resource Document - Solidification/Stabilization and Its Application to Waste Materials, June 1993.

[49] Perry, K.J, Prange, N.E., and Garvey, W.F., "Long-Term Leaching Performance for Commercially Stabilized Waste," Stabilization and Solidification of Hazardous, Radioactive, and Mixed Wastes, Vol. 2, ASTM STP 1123, T.M. Gilliam and C.C. Wiles, Eds, American Society for Testing and Materials, Philadelphia, pp. 242-251, 1992.

performed on both the raw waste and the treated waste. The treated waste consisted of samples at 28, 90, 200, 470, and 650 days after treatment. The results showed that leachate values for some metallic wastes increased over time.

TCLP may not be appropriate for some contaminated soil. The Michigan Department of Natural Resources (MDNR) believes that the TCLP is not appropriate for soils contaminated with cyanides, sulfides, and hexavalent chromium.[50] Furthermore, MDNR reports that the SPLP (see previous text box) more accurately simulates the conditions of contaminated soil and therefore is an appropriate alternative test for soil contaminated with cyanides, sulfides, and hexavalent chromium.

TCLP does not predict releases to non-groundwater pathways. As discussed in Section 3.4, the TCLP was designed to simulate the leaching of waste constituents to groundwater and not for releases to non-groundwater pathways. The TCLP does not simulate the release of volatile organic contaminants into air either directly or through entrained dust, nor does it simulate releases through surface runoff.[51]

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[50] Alternate Soil Leaching Procedures, Interoffice Memorandum to the Environmental Response Division Staff from Alan J. Howard, Environmental Response Division, Michigan Department of Natural Resources, January 5, 1995.

[51] The TCLP does account for the loss of volatile contaminants that occur during the liquid/solid separation and extraction process; however, this is only for correcting the leachate concentration, not for simulating releases to air.

CHAPTER 3. POTENTIAL GAPS ASSOCIATED WITH HAZARDOUS WASTE CHARACTERISTICS DEFINITIONS

CHAPTER 4. POTENTIAL GAPS ASSOCIATED WITH NON-TC CHEMICALS

This chapter identifies potential gaps in the hazardous waste characteristics associated with chemicals not on the toxicity characteristic list. Chemicals and chemical classes are identified as potential gaps based on their hazardous properties such as toxicity to humans and ecological receptors, their fate and transport properties such as persistence and bioconcentration potential, and their potential for occurrence in non-hazardous industrial wastes. This approach to identifying gaps is complemented by the approach discussed in Chapter 5, which identifies gaps in terms of the important environmental risks and their potential association with waste management, rather than focusing on specific chemicals.

4.1 Overview of Methodology

EPA identified potential gaps in the characteristics associated with non-TC chemicals through a six-step process, as shown in Exhibit 4-1. Each of these steps is described below.

Step 1: Identify and Classify Known Non-Hazardous Industrial Waste Constituents

An essential task in this analysis is identifying a universe of chemicals that are either known or likely to be present in non-hazardous industrial wastes, excluding TC analytes (which are addressed in Chapter 3). In the analysis that follows, these two classes of chemicals are referred to as **<u>known</u> non-hazardous industrial waste constituents** and **<u>possible</u> non-hazardous industrial waste constituents**, respectively. As described in Section 4.2, the identification of the "known" non-hazardous constituents is relatively straightforward, although reliable data on the composition of non-hazardous industrial waste are limited. The data sources used to identify these constituents are shown in the top panels of Exhibit 4-1. They are the non-hazardous industrial waste release descriptions (discussed in Chapter 2), the Industrial Studies Data Base (ISDB), Effluent Guidelines Development Documents, and Listing Documents from recent rulemakings for dyes and pigments and solvent wastes. As discussed in Section 4.2, the distinguishing characteristic that makes a chemical a “known” non-hazardous industrial waste constituent is that it has been documented through direct chemical analysis to occur either in non-hazardous industrial waste or in environmental media contaminated by releases from non-hazardous industrial waste management units.

Step 2: Identify and Screen Possible Non-Hazardous Industrial Waste Constituents

In addition to the chemicals that are known to be present in non-hazardous industrial wastes, EPA identified other chemicals that have a high likelihood of being present in such wastes and could pose significant risks to human health or the environment. Unlike the known non-hazardous industrial waste constituents, however, the possible waste constituents have not been confirmed as non-hazardous industrial waste constituents through direct chemical analysis in any of the data sources used by the Agency. To identify non-hazardous industrial waste constituents that could pose risks to human health or ecological receptors, the Agency reviewed 36 lists of chemicals created for regulatory and advisory purposes by EPA, other federal agencies, states, other countries, and advisory and scientific bodies. These lists were originally created based on criteria such as toxicity, fate and transport characteristics, production volume, widespread use, and detection in environmental media.

Insert **Exhibit 4-1** **Flow Chart of Procedures Used to Identify Non-TC Chemicals Posing Potential Gaps in the TC Characteristics**

In graphics

Rather than include all the chemicals on these lists as possible non-hazardous industrial waste constituents, EPA narrowed the list of chemicals to those most likely to pose significant risks to human health and the environment. The screening was performed in two steps, as shown in the upper right-hand panels of Exhibit 4-1. First, chemicals were screened with regard to individual toxicity and fate and transport properties. Then, the resulting high-hazard chemicals were screened against 1994 national Toxic Release Inventory (TRI) release data, serving as a proxy for potential occurrence in waste. Section 4.3 describes the process of compiling and screening possible non-hazardous industrial waste constituents.

Step 3: Apply Hazard-Based Screening Criteria

In this step, which is described in detail in Section 4.4, EPA compared the lists of known and possible non-hazardous industrial waste constituents and screened them against single and multiple hazard-based screening criteria. In Step 2, individual chemicals that are possible non-hazardous industrial waste constituents were screened on the basis of single indicators of hazard (e.g., a low reference dose or a high bioconcentration factor). This step refines this analysis by examining both the known and possible non-hazardous industrial waste constituents against single and multiple indicators of toxicity, fate, transport, and occurrence in waste, and by reviewing the implications of this screening for classes of chemicals.

Step 4: Review Relevant Multipathway Risk Modeling Results

Section 4.5 reviews the results of the multipathway risk modeling conducted as part of the proposed HWIR-Waste (Hazardous Waste Identification Rule for Process Wastes) determination of exit levels, where available for chemicals on the combined list of known or possible non-hazardous industrial waste constituents. The proposed exit levels and risk-driving pathways provide information on the relative risks posed by the various constituents and on the most important exposure pathways.

Step 5: Identify Potential Acute Hazards

In the prior steps, the evaluation of potential hazards associated with the possible and known non-hazardous industrial waste constituents has focused on chronic toxic effects. In Section 4.6, the possible and known constituents are compared to acutely hazardous chemical lists developed by EPA and other regulatory agencies. This analysis thus addresses risks from acute exposures and from physical hazards associated with reactivity, flammability, and corrosivity.

Step 6: Summarize Findings

Chapter 4 concludes by identifying non-TC chemicals and groups of chemicals that constitute potential gaps in the hazardous waste characteristics. Section 4.7 presents a table identifying these potential gaps, the rationale for their identification, and the major issues and data gaps remaining to be resolved to judge the severity of these potential gaps.

4.2 Identify and Classify Known Constituents of Non-Hazardous Industrial Wastes

Chemicals present in non-hazardous wastes that have been released from non-hazardous industrial waste management units into the environment may constitute potential gaps in the hazardous waste characteristics. This section reviews the available evidence concerning such chemicals. Reliable data concerning the chemical composition of non-hazardous industrial wastes, however, are quite limited for two major reasons. First, such wastes may be generated by virtually any industrial facility or operation and are inherently heterogeneous. Second, state requirements to analyze non-hazardous industrial wastes and to report analytical results are quite limited.

In the course of this Scoping Study, the Agency identified four sources of information regarding the composition of non-hazardous industrial wastes:

- The descriptions of environmental releases from non-hazardous industrial waste management facilities, compiled as part of this Scoping Study, which were summarized in Chapter 2;

- The Industrial Studies Data Base (ISDB), which includes information on point of generation constituent concentrations on various industries;

- Chemicals identified as being present in liquid non-hazardous wastes by EPA Effluent Guideline Development Documents, as summarized in the Capacity Analysis for the Phase III Land Disposal Restrictions (LDR) Rule; and

- Chemicals identified as being present in non-hazardous industrial waste that were not listed as hazardous wastes in background documents for recent Agency listing/no-listing proposals for pigments and dyes industries and for solvents.

The first source provides information on chemicals detected in environmental media (primarily groundwater) that were released from non-hazardous industrial waste management facilities, while the other three sources provide information on the composition of non-hazardous industrial wastes. Although not reflected in this Study, in future investigations the Agency will consider examining the constituents present in remediation waste from non-hazardous industrial waste management units.

The descriptions of environmental releases in Chapter 2 identify the constituents found in environmental media near non-hazardous industrial waste management units, their maximum detected concentrations, the types of units from which the releases occurred, and the industries responsible for the releases. The release descriptions provide direct evidence of potential environmental exposure to non-hazardous industrial waste constituents and damage to human health and the environment. They, however, do not encompass all instances where non-hazardous industrial waste management has resulted in releases to the environment or other potential risks. As noted in Chapter 2, the release descriptions come from only a small proportion of the states. However, they do represent a large proportion of the readily identifiable releases from facilities regulated by state non-hazardous industrial waste programs.

In addition, some types of occurrences (e.g., fires and explosions) and units (e.g., waste piles) are generally not regulated by these state programs, and would not show up in the records EPA examined. The quantitative data from these descriptions generally were limited to groundwater monitoring results. Few releases to other media were identified. In addition, the chemicals identified tend to be those whose monitoring is required under existing regulatory programs. The potential for identifying chemicals not already recognized as hazardous is therefore limited. Finally, the data sources evaluated did not provide useful information on various types of uses constituting disposal, such as cement additives, soil amendments, or aggregate.

The ISDB was the second source of data used to identify known waste constituents. EPA has maintained this data set since 1982. It contains information on point-of-generation constituent concentrations for 16 industries. The sources of information include RCRA Section 3007 questionnaires, plant visit reports, sampling and analysis reports, and engineering analysis. Its major limitations include data that are sometimes more than 15 years old and the coverage of only selected industries.

The third data source was information gathered by EPA's Office of Water in preparing Effluent Guidelines Development Documents. These data are summarized in OSW's Capacity Analysis Background Document for the Phase I LDR.[1] The data describe the composition of non-hazardous industrial wastewaters generated by major industry groups. These wastewater data are of varying age, and therefore their continued representativeness is unclear. Also, the number of analytes in the database is quite limited. As seen below, a very high proportion of the waste constituents identified in this source also are identified in one or both of the two data sources described above. Thus, the effluent guidelines data serve mainly to confirm data from the other sources.

The Agency also reviewed two recent proposed listing decisions for hazardous wastes, those for solvent wastes and for wastes from the dyes and pigments industries. Several additional chemicals were identified as being constituents of unlisted (non-hazardous) solvent waste streams that were not found in any of the other data sources: 2-methoxyethanol, 2-ethoxyethanol acetate, cyclohexanol, isophorone, and diethylamine.[2] No non-hazardous industrial waste constituents from the dyes and pigments industry were identified, because all of the data concerning the compositions and generation rates of these wastes were held as confidential by the industries that submitted data.[3]

Excluding TC analytes, which are addressed in Chapter 3, a total of 146 chemicals were identified in the release descriptions, 183 in the ISDB, and 19 in the effluent guidelines data. An additional five unique constituents were found in the listings background document. Overall, a total of 250 unique chemicals were identified.

The chemicals and waste constituents identified in the three data sources are sorted into major chemical classes and shown in Exhibit 4-2. These constituents span a wide range of chemical classes. Even with a number of possibly redundant entries, the most common category of chemicals was metals and inorganics, with 48 chemicals. Other prominent families of chemicals included volatile chlorinated organics (38), other semivolatile organics (46), other volatile organics (45), and pesticides and related compounds (29). Included among the chlorinated organics are several trihalomethanes and two chlorofluorocarbons. The “other semivolatile” category contains a wide range of compounds, many of which are found only in the ISDB data. The pesticides category contains mostly chlorinated organic pesticides and intermediates, but also contains some nonchlorinated compounds.

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[1] U.S. Environmental Protection Agency, Office of Solid Waste, Background Document for Capacity Analysis for Land Disposal Restrictions Phase III - Decharacterized Wastewaters, Carbamate Wastes, and Spent Potliners (Final Rule), Volume 1, February 1996.

[2] U.S. Environmental Protection Agency, Office of Solid Waste, Assessment of Risks from the Management of Used Solvents (Draft), May 3, 1996.

[3] U.S. Environmental Protection Agency, Office of Solid Waste, Listing Background Document: Final Hazardous Waste Listing Determination for the Dyes and Pigments Industries, November 30, 1994, non-confidential business information version.

Exhibit 4-2. Known Non-Hazardous Industrial Waste Constituents Found in Case Studies, ISDB, Listings Documents, and Effluent Guidelines by Chemical Class

Less prominent categories of chemicals include the PAHs (18 compounds), volatile hydrocarbons (12), phenolic compounds (8), and phthalate esters (6). The PAHs range from low-molecular weight, noncarcinogenic compounds (such as naphthalene) to the higher molecular weight carcinogens and mutagens (such as benzo(a)pyrene). All but one of the volatile hydrocarbons (styrene) are commonly found as constituents in kerosene, gasoline, and related fuels. Styrene is a monomer used in plastics production. The phenolic compounds include creosote components (cresols) and two nitrophenols. Most of the phthalate esters are found in all the first three data sources, including the suspect carcinogen bis-(2-ethylhexyl)-phthalate. Polychlorinated biphenyls (PCBs) and chlorinated dioxins (represented by 2,3,7,8-TCDD) were found in the ISDB.

The number of compounds in the various categories does not necessarily reflect the relative potential importance of the chemicals or categories. As noted above, some chemicals occur only in one database, while others occur in two, three, or all four. In addition, some chemicals occur in more than one release description, that is, at more than one facility, or are identified as waste constituents from more than one industry group. Except for the chemicals in the release descriptions, there is no indication of the relative concentrations of the chemicals in wastes.

Given the wide range of chemical classes represented in the lists, and the relatively small total number of non-TC chemicals in the four datasets (250), the Agency found no convincing reason to eliminate any candidate chemicals from inclusion in the gaps analysis. Given that toxicological and fate and transport data are available for most of these chemicals, all the chemicals were carried forward for further analysis.

4.3 Identify Possible Non-Hazardous Industrial Waste Constituents of Potential Concern

This section describes the approach to identifying additional chemicals that might constitute potential gaps in the hazardous waste characteristics. Unlike the previous analysis, which began with four relatively narrow and specific data sources, this analysis begins with a wide range of data sources, in order to avoid excluding chemicals of potential concern. Subsequently, a substantial proportion of the large universe of chemicals are screened out on the basis of toxicity, fate and transport characteristics, and potential for occurrence in waste. A large portion also could not be evaluated because of a lack of data. The result is a focused list of possible non-hazardous industrial waste constituents that could pose significant risks to human health or the environment. The list of possible non-hazardous industrial waste constituents supplements the list of known non-hazardous industrial waste constituents developed in the previous section.

4.3.1 Approach to Identifying Potentially Hazardous Chemicals

Excluding TC analytes, EPA identified over 2,300 distinct chemicals from 36 regulatory and advisory lists originally created by EPA, other federal agencies, state and national regulatory agencies, and special environmental task forces and advisory bodies. Exhibit 4-3 identifies these lists. The RCRA regulatory lists included are the 40 CFR 261 Appendix VII and VIII lists of hazardous waste constituents, the proposed HWIR-Waste Chemicals, and the HWIR-Media “Bright Line” chemicals. Other major federal regulatory lists include the Clean Water Act Section 307 Toxic Pollutants and Section 311(b)(2) Hazardous Substances, the CERCLA list of hazardous substances with reportable quantities, the Emergency Planning and Community Right-to-Know (EPCRA) Toxic Chemicals and Extremely Hazardous Substances lists, the Clean Air Act Amendments Section 112(b) Hazardous Air Pollutants and Section 112(r) Regulated Toxic Substances, and chemicals for which OSHA has published Permissible Exposure Limits (PELs). The U.S. Department of Transportation (DOT)

Exhibit 4-3. Lists Used to Identify Possible Non-Hazardous Industrial Waste Constituents

RCRA Section 3001 Hazardous Waste, 40 CFR Part 261, Appendix VII
RCRA Section 3001 Hazardous Waste, 40 CFR Part 261, Appendix VIII
CWA Section 307 Toxic Pollutants
CWA Section 311(b)(2)(A) List of Hazardous Substances
CERCLA Hazardous Substances Reportable Quantity List
CAA Section 112(b) Hazardous Air Pollutants
CAA Section 112(r) Regulated Toxic Substances
HWIR-Media (Bright-Line) Chemicals
HWIR-Waste Chemicals
HWIR-Waste Ecotoxicity Chemicals
OSHA Permissible Exposure Limits for Chemicals
EPCRA Section 302 Extremely Hazardous Substances
EPCRA Section 313 Toxic Chemicals List
Industrial Studies Data Base
Canada's Toxic Substances Management Policy
Canadian ARET Toxics Scoring Protocol (A1-A2 LISTS)
Canadian ARET Toxics Scoring Protocol (B1 LIST)
Canadian ARET Toxics Scoring Protocol (B2 LIST)
Canadian ARET Toxics Scoring Protocol (B3 LIST)
Chemicals on Five or More Lists for Short-Term Exposure
Criteria to Identify Chemicals for Sunsetting in Great Lakes Basin
Deferred Toxicity Characteristic Chemicals
Effluent Guidelines Chemicals
Potential Endocrine Disruptors
EPA Hazardous Substance Task Force (Levels 1 and 2)
FIFRA Active Ingredients
Focus Chemicals for the Great Waters Study (USEPA 1991)
Great Lakes Water Quality Agreement Standard Methods Chemicals
Highly Flammable Chemicals (Based on Several Lists)
Highly Reactive Chemicals (Based on Several Lists)
Michigan Critical Materials Register
Persistent Bioaccumulative Chemicals Screening
Proposed Water Quality Guidance, Great Lake Systems (1994)
UN ECE Task Force on Persistent Organic Pollutants (1993)
University of Tennessee Chemical Ranking System (1994)
DOT Hazardous Materials Transportation Act, Hazardous Materials Regulations[a]

Notes:

[a] Data base searched manually.

Hazardous Materials Transportation Act (HMTA) Hazardous Materials Registry (HMR) also was used to identify potential gap chemicals, but could not be directly included in the database in time because of format differences in the available machine-readable forms of the list.

Some of the advisory lists that were included are the 1992 EPA Hazardous Substance Task Force's[4] Level 1 and Level 2 hazardous chemicals that were identified as not being controlled under RCRA or DOT regulations, the Focus Chemicals for the Great Waters Study,[5] chemicals identified by Environment Canada under the ARET Toxics Scoring Protocols, chemicals identified by the University of Tennessee Chemical Ranking System, and the Michigan Critical Materials Register. Some lists address specific types of hazards, such as potential endocrine disruptors, acutely toxic chemicals, highly flammable chemicals, and highly reactive chemicals. Brief descriptions of the lists and the selection criteria that were applied to derive them are provided in "Background Document: Identification of Chemicals from Regulatory and Advisory Lists Representing Potential Gaps in the Hazardous Waste Characteristics."[6]

Naturally, there is a high degree of overlap among the chemical lists. Some lists are subsets of, combinations of, or otherwise derived from other lists. Nonetheless, the chemicals identified represent a very broad spectrum of potential hazards. High-volume and highly toxic chemicals appear on many lists, as do acutely toxic, flammable, and reactive chemicals. Several lists specifically seek to include carcinogens, mutagens, and teratogens. Some lists are derived based on considerations of ecotoxicity, persistence, and bioaccumulation potential, or based on specific environmental media or geographical concerns. The overall goal in the Scoping Study was to identify the broadest possible set of chemicals of potential concern, and then to screen them down to the chemicals with the highest potential to pose risks to human health or the environment.

4.3.2 Screening Approach

EPA performed the hazard-based screening of potentially hazardous constituents in two steps. First, the entire list of chemicals was screened against criteria related to toxicity to humans and aquatic organisms and separately against various fate and transport criteria. Chemicals for which data were not available for at least one of these criteria were not included in further analysis. In the second step, EPA took all of the chemicals identified as either highly toxic, mobile, persistent, or bioaccumulative and first screened them against the proxy for occurrence in waste, namely the TRI release data. Any chemical passing this screen has a high potential for occurrence in waste and was identified as a possible non-hazardous industrial waste constituent. Chemicals were also retained in the analysis if they were not on the TRI list. Only the chemicals confirmed as having low releases through the TRI data were eliminated from being possible constituents.

The criteria considered for use in screening (both the possible constituents described in this section and the combined lists discussed in Section 4.4) are summarized in Exhibit 4-4. These criteria were derived using professional judgment to provide a reasonable level of discrimination between

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[4] U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response, <u>Report of the EPA Hazardous Substance Task Force</u>, April 1992.

[5] U.S. Environmental Protection Agency, Office of Air Quality, Planning and Standards, <u>Deposition of Air Pollutants to the Great Waters, First Report to Congress</u>, Publication EPA-453/R-93-055, May 1994.

[6] U.S. Environmental Protection Agency, Office of Solid Waste, November 15, 1996.

Exhibit 4-4
Criteria Considered for Screening Non-Hazardous Industrial Waste Constituents[a]

Parameter	Cutoff Value		Rationale
I. Toxicity Values			
Oral RfD	$<1.3\times10^{-2}$	mg/kg-day	50th percentile
Oral CSF	Any Value $>2.9\times10^{-1}$	 $(\text{mg/kg-day})^{-1}$	All Suspect Carcinogens 50th percentile
Inhalation RfC	$<1\times10^{-2}$	ug/m^3	50th percentile
Inhalation UR	Any Value $>3.3\times10^{-4}$	 $(\text{ug/m}^3)^{-1}$	All Suspect Carcinogens 50th percentile
Primary MCL	$<5\times10^{-2}$	mg/l	50th percentile
Acute AWQC	<130	mg/l	50th percentile
Chronic AWQC	<5.2	mg/l	50th percentile
II. Fate and Transport Parameters			
Fish BCF	>1,000	l/kg	About 85th percentile, lists range from 500-100,000
Fish BAF	>1,000	l/kg	About 50th percentile, lists range from 500-15,000
Kow	>100,000	(unitless)	About 75th percentile, lists range from 10,000-1,000,000
Beef Biotransfer	$>7.8\times10^{-3}$	day/kg	75th percentile
Vegetable Root CF	>15	(ug/gm)/(ug/gm)	75th percentile
Forage BCF	>3.5	(ug/gm)/(ug/gm)	75th percentile
Henry's Law Constant (kH)	$>1\times10^{-5}$	$\text{atm-M}^3\text{/mole}$	50th percentile, moderately volatile
Vapor Pressure	$>1.3\times10^{-2}$	atm	About 70th percentile = 1 mm Hg
Air-Leafy Plant Factor	$>5.3\times10^{-4}$	(ug/gm)/(ug/gm)	75th percentile
Air Half Life	>0.15	years	75th percentile
Soil Deg. Constant	<0.5	year^{-1}	About 75th percentile, DAF risk reduction = 100x
Water Deg. Constant	<0.5	year^{-1}	About 75th percentile, DAF risk reduction = 100x
III. Indicators of Possible Occurrence in Waste			
1994 TRI Release Data	$>10^6$	lbs.	Includes 99 percent of all releases to air, water, and land (including underground injection)
1994 Production Data (TSCA Inventory Update)	$>10^6$	lbs.	Indicates potential for widespread use, occurrence in waste and release potential

[a] All of these criteria were considered for use in the screening of both the possible non-hazardous industrial waste constituents and the combined lists discussed in Section 4.4. As discussed in the text, only a subset of these criteria ultimately were used.

chemicals with relatively high-hazard potential and those with lower potential. For most toxicity parameters, which were available only for a relatively small number of more toxic chemicals, the cutoff values were set at the 50th percentile of the entire range of values. For many fate and transport parameters, the criteria were set at or around the 75th percentile (or 25th percentile, if a low value implied high hazard potential) of the entire range of the parameter values for all of the chemicals for which the parameter was available. In some cases, the screening criteria were set at levels generally recognized as indicative of hazard potential.

In the course of the Scoping Study, many different criteria for and approaches to the screening process were evaluated; the background document to this Study provides further detail.[7] The criteria and approach described in this section is a relatively simple one that evolved from those previous efforts. One of the major lessons learned in that work was that screening is inherently imprecise, and no single screen will catch or exclude all the chemicals desired. Another lesson learned is that screening large lists against complex criteria can quickly become very complicated, and the return on the complexity, in terms of useful information, can be quite low. Therefore, EPA has focused on a relatively small number of criteria that are important in determining risk potential and has critically interpreted the results of the screening.

In the case of carcinogens, two sets of criteria were used. The first set indicates whether a cancer slope factor (CSF) had been promulgated for the chemical. The second indicates whether an inhalation unit risk (UR) had been developed. These criteria identified the bulk of human carcinogens. For noncarcinogenic effects, two sets of criteria again were used. The first indicates whether an ingestion reference dose (RfD) had been developed at a sufficiently toxic level for the purposes of this analysis (i.e., below the 50th percentile). The second indicates whether an inhalation Reference Concentration (RfC) had been developed below the 50th percentile. For aquatic effects, the 50th percentile of the Chronic Ambient Water Quality Criteria (AWQC) was used.

EPA used several criteria to screen fate and transport properties. The screening criteria for the fish bioconcentration factor (BCF) and bioaccumulation factor (BAF) were both set at 1,000 l/kg, the beef biotransfer factor was set at 7.8×10^{-3} day/kg, and the octanol-water partition coefficient (Kow) was set at 10^5. These four values indicate the potential for the chemicals to be taken up and/or accumulated by organisms. The vapor pressure criterion, used as a proxy for volatilization release, was set at 1 mm Hg. A Henry's Law constant (kH) value of 10^{-5} atm-m^3/mole was also used to identify chemicals with high volatilization potential. The criterion used to identify persistent chemicals in soil or water (degradation rate constant less than 0.5/year) was selected based on an analysis of the EPACMTP findings for organic pollutant transport in groundwater, which indicated that, at rate constants above this value, the calculated DAF values begin to differ substantially from those for non-degrading pollutants with similar properties.[8]

As noted in Section 3.5, the screening-level risk analysis also was used to identify screening criteria and their importance. For example, Henry’s Law constants were found not to be a good indicator of the potential for long-term volatilization releases, so that the parameter is not used as a primary screening factor (although it is examined briefly in the next section). Instead, vapor pressure is used to screen chemicals for volatilization release. Even this screen must be interpreted cautiously, however, since chemicals with low vapor pressures can still volatilize from treatment units if no other processes are occurring to limit the releases.

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[7] Background Document: Identification of Chemicals from Regulatory and Advisory Lists Representing Potential Gaps in the Hazardous Waste Characteristics, *supra* footnote 6.

[8] U.S. Environmental Protection Agency, Office of Solid Waste, EPACMTP Background Document for Finite Source Methodology Chemical with Transformation Products, Chapter 6, 1995.

The primary data source that is used as a proxy for occurrence of hazardous chemicals in non-hazardous industrial wastes is the release data, reported under the Emergency Planning and Community Right-to-Know Act (EPCRA) Toxic Release Inventory (TRI) requirements. For purposes of the screening conducted for this study, EPA considered those chemicals with releases to air, land, water, and underground injection exceeding one million pounds in 1994. Under EPCRA Section 313, facilities with more than 10 full-time employees that are classified in SIC codes 20 through 39 (i.e., manufacturing) must submit reports if they manufacture or process more than 25,000 pounds of a TRI chemical or otherwise use more than 10,000 pounds of a TRI chemical in a given calendar year. There were a total of 73 unique chemicals and 10 classes of chemicals in this category, out of the 345 individual chemicals for which reports are required. These chemicals account for greater than 99.8 percent of the total TRI releases of all chemicals. As discussed in Section 4.4.2, the combined list of known and possible non-hazardous industrial waste constituents were also screened against non-CBI 1994 production data from the TSCA Inventory.

A major limitation of this screening approach is that quantitative toxicity and fate and transport parameter values were available for only a fraction of the over 2,300 non-TC chemicals identified. Human toxicity parameters were available for just over 430 chemicals, ambient water quality data for 105 chemicals, and complete fate and transport data for 194 chemicals. For this reason, the screening approaches were supplemented by searching lists that identify chemicals presenting specific types of hazards, even if no quantitative parameter value was available, and by applying professional judgment to identify where potential risk findings for individual chemicals may be generalized to broader classes of chemicals. The results of this screening are described in a background report (see footnote 6).

4.3.3 Toxicity, Fate, and Transport Screening for Possible Non-Hazardous Industrial Waste Constituents

Exhibit 4-5 summarizes the results of the screening for possible non-hazardous industrial waste chemicals against the toxicity criteria. The first two columns indicate the chemicals that are suspect or known human carcinogens having ingestion CSFs or inhalation URs. The last three columns identify the chemicals with oral RfDs, inhalation RfCs, and AWQCs below the 50th percentile of these parameter values (a low value indicates high toxicity) for all chemicals for which these values have been developed. Note that this table does not include TC analytes or chemicals previously identified as known non-hazardous industrial waste constituents.

As noted previously, the number of chemicals identified on all 37 lists of chemicals is much greater than the numbers of chemicals for which toxicity parameters have been developed. Furthermore, the list of chemicals, which includes practically all of the known chemicals from Section 4.2 and all of the TC analytes, includes almost all chemicals for which these toxicity values have been derived. Thus, the toxicological screen has the potential[9] to screen out most of the possible non-hazardous industrial waste constituents simply because most of the constituents do not have toxicity values, and therefore the effectiveness of the individual toxicity screening criterion is substantially

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[9] Toxicological criteria only have a potential to screen out chemicals because, as discussed below, chemicals may be considered high hazard (for the purposes of this analysis) because of fate and transport characteristics.

Exhibit 4-5. Toxicity Screening Results for Possible Non-Hazardous Industrial Waste Constituents

Chemicals with CSFs	Chemicals with Unit Risks	Chemicals with Low RfDs (50th percentile)
2,4,6-Trinitrotoluene	1,3-Butadiene	
3,3'-Dichlorobenzidine	Aramite	1,1,2 Trichloropropane
4,4'-Methylenebis(N,N-dimethyl)benzenamine	Asbestos (friable)	1,2,4 Tribromobenzene
Acephate	Azobenzene	1,3,5-Trinitrobenzene
Aramite	Benzidine	1,3 Phenylenediamine
Azobenzene	Bis(chloromethyl) ether	1,4 Dibromobenzene
Benzidine	Hexachlorocyclohexane	1,4 Dithiane
Bis(2-ethylhexyl) adipate	HxCDD	2-Chlorophenol
Bis(chloromethyl) ether	N-Nitrosodi-n-butylamine	2-Cyclohexyl-4,6-dinitrophenol
Cyclotrimethylene trinitramine	N-Nitrosodiethylamine	2,3 Dichloropropanol
Dichlorvos	N-Nitrosopyrrolidine	2,4,5-T acid
Folpet	Nickel subsulfide	2,4,6-Trinitrotoluene
Fomesafen	Propylene oxide	2,4-DB
Furmecyclox		2,6-Dimethylphenol
Hexachlorocyclohexane		3,4 Dimethylphenol
Hexachlorodibenzo p dioxin, mixture (HxCDD)		Acephate
N-Nitrosodi-n-butylamine		Acetataldehyde, trichloro-
N-Nitrosodi-n-propylamine		Acifluoren, sodium salt
N-Nitrosodiethanolamine		Alachlor
N-Nitrosodiethylamine		Aldicarb sulfone
N-Nitrosomethylethylamine		Aluminum phosphate
N-Nitrosopyrrolidine		Ametryn
Prochloraz		Amitraz
Propylene oxide		Avermectin B1
Trifluralin		Bentazon
		Benzidine
		Bis(tributyltin) oxide
		Captafal
		Carbamothioic acid, dipropyl-S-propyl ester
		Carbosulfan
		Chlorpyrifos
		Cyclotrimethylene trinitramine
		Cyhalothrin
		Decabromodiphenyl oxide
		Demeton
		Dichlorvos
		Dicrotophos
		Dinitrobutyl phenol
		Diquat
		Diuron
		Dodine
		EPN
		Ethion
		Ethylene thiourea
		Fenamiphos
		Flometuron
		Fluvalinate
		Fonofos
		Glufosinate ammonium
		Glycidylaldehyde
		Haloxyfop methyl

Exhibit 4-5. Toxicity Screening Results for Possible Non-Hazardous Industrial Waste Constituents (continued)

Low RfDs (continued) (<50th percentile)	**Low RfCs (50th Percentile)**	**Low AWQCs (50th percentile)**
Hexabromobenzene	2-Chloroacetophenone	Azinphos-methyl
Hexachlorophene	Antimony trioxide	Chlorpyrifos
Hydramethylnon	Arsine	Demeton
Imazalil	Chlorine dioxide	Malathion
Lactofen	Dichlorvos	Mirex
Linuron	Hexamethylene-1,6-diisocyanate	
Maneb	Methylenebis(phenylisocyanate)	
Mecoprop	Toluenediisocyanate (mixed isomers)	
Mercuric chloride	Triethylamine	
Merphos	Vinyl bromide	
Methacrylonitrile		
Methamidophos		
Methidathion		
Methoxone		
Methyl mercury		
Mirex		
N,N-Dimethylaniline		
Naled		
NuStar		
Octabromodiphenyl ether		
Oxydiazon		
Oxyfluorfen		
Parquat dichloride		
Pentabromodiphenyl ether		
Phenylmercuric acetate		
Primiphos methyl		
Prochloraz		
Prometryn		
Propachlor		
Propanil		
Propargyl alcohol		
Propiconazole		
Propoxur		
Quinalphos		
Quintozene		
Quizalofop-ethyl		
Rotenone, commercial		
S,S,S-Tributyltrithiophosphate		
Selenious acid		
Simazine		
Sodium azide		
Sodium fluoroacetate		
Strychnine		
Terbacil		
Terbutryn		
Tetraethyl lead		
Thallium chloride TlCl		
Thallium(I) acetate		
Thallium(I) carbonate		
Thallium(I) nitrate		
Thallium(I) sulfate		
Thiobencarb		
Triallate		
Tribenuron methyl		
Trifluralin		
Warfarin		
Zinc phosphide		

Exhibit 4-5. Toxicity Screening Results for Possible Non-Hazardous Industrial Waste Constituents (continued)

limited for a large proportion of the chemicals identified on the 37 lists. Nevertheless, because all chemicals with cancer toxicity values are considered high hazard for this portion of the analysis, no chemicals would be screened out on the basis of carcinogenicity.

The toxicity screening reduced the number of chemicals dramatically from the original universe of over 2300. As noted above, this reduction is primarily a function of the relatively small number of chemicals (about 400) for which human or ecotoxicity data are available. The screened list contains about one-third (25/74) of the chemicals for which CSFs were available, and about one-quarter (13/52) of those for which inhalation unit risks are available. The chemicals with low (<50th percentile) RfDs comprise by far the largest (107) set of all the chemicals identified by the toxicity screening, representing about one-third of the total number of chemicals for which RfDs have been derived. A large proportion of these chemicals are pesticides. Relatively few chemicals were identified having low inhalation RfCs and AWQCs for aquatic life.

Exhibit 4-6 summarizes the results of the screening of chemicals with regard to fate and transport properties. The first two columns address the potential to volatilize for soil and water, as indicated by the vapor pressure and Henry's Law constant. Since these parameters are directly related, the chemicals in these two columns overlap substantially. The next column lists chemicals with soil or water column degradation constants less than 0.5/year. Since the values for these two media are close for most of the chemicals, separate columns are not provided for each medium. The final three columns identify the chemicals with relatively high aquatic BCFs, beef biotransfer factors, or Kows. Since all three of these values are related to partitioning between lipid and water phases, the chemicals in these three columns also overlap substantially.

As was the case for the toxicity screens, consistently-derived fate and transport parameters are not available to screen the majority of the chemicals. Thus, the menu of chemicals that are identified by the screening criteria related to each individual parameter again is determined primarily by the availability of data. In the case of the fate and transport screening, fewer chemicals are identified as being potentially hazardous. In addition, the fate and transport screening identifies a smaller proportion of the chemicals for which data are available. In all cases, the chemicals exceeding the screening criteria represent less than 10 percent of the chemicals for which data are available.

4.3.4 Release Volume Screening of Possible Non-Hazardous Industrial Waste Constituents

Chemicals not screened out by the toxicity or fate and transport criteria were screened against the 1994 TRI data (used as a proxy for occurrence in wastes). The results of this final screening are presented in Exhibit 4-7. Of the 151 unique chemicals or classes of chemicals that were identified in the toxicity or fate and transport screening, TRI release data were available for 24 of them. Five of these chemicals (Freon 113, 1,3-butadiene, chlorine dioxide, chloroprene, and propylene dioxide) had TRI releases above one million pounds in 1994. Nineteen of the chemicals had TRI releases less than a million pounds. This latter group of chemicals were eliminated from further analysis. As noted previously, the remaining 132 chemicals for which no TRI data were available were retained in the analysis.

Exhibit 4-6. Persistence and Bioconcentration/Bioaccumulation Screening Results for Possible Non-Hazardous Industrial Waste Constituents

Vapor Pressure > 1.3×10^{-3} atm	Henry's Law Constant > 10^{-5} atm-m^3/mole	Soil/Water Degradation Rate Constant < 0.5 $years^{-1}$
2-Chlorophenol	2-Chlorophenol	3-Methylcholanthrene
Chloroprene	Bis(2-chloroisopropyl) ether	Kepone
cis-1,3-Dichloropropene	Chloroprene	Quintozene
Ethyl methacrylate	cis-1,3-Dichloropropene	
Freon 113	Dinitrobutyl phenol	
Methacrylonitrile	Ethyl methacrylate	
N-Nitrosodi-n-propylamine	Freon 113	
N-Nitrosodiethylamine	Methacrylonitrile	
N-Nitrosomethylethylamine	N-Nitrosodi-n-butylamine	
	N-Nitrosodi-n-propylamine	
	Quintozene	
	Safrole	
	Tris(2,3-dibromopropyl) phosphate	

Fish BCF > 1,000 l/kg	Beef Biotransfer Factor > 7.8×10^{-4}	Kow > 10^5
3-Methylcholanthrene	3-Methylcholanthrene	3-Methylcholanthrene
Chlorobenzilate	Diethylstilbestrol	Diethylstilbestrol
Diallate	Hexachlorophene	Hexachlorophene
Diethylstilbestrol	Kepone	Kepone
Kepone	Quintozene	

Exhibit 4-7
Screening of High-Toxicity, Persistent, Bioaccumulative/Bioconcentrating Possible Non-Hazardous Industrial Waste Constituents Against TRI Release Volumes

Exhibit 4-7 (continued)
Screening of High-Toxicity, Persistent, Bioaccumulative/Bioconcentrating Possible Non-Hazardous Industrial Waste Constituents Against TRI Release Volumes

Exhibit 4-7 (continued)
Screening of High-Toxicity, Persistent, Bioaccumulative/Bioconcentrating Possible Non-Hazardous Industrial Waste Constituents Against TRI Release Volumes

4.3.5 Summary of Possible Non-Hazardous Industrial Waste Constituents

Exhibit 4-8 summarizes the results of the TRI screening process. It places the possible non-hazardous waste constituents into the same chemical categories as were used to characterize the known non-hazardous industrial waste constituents in Exhibit 4-2. The largest number of possible waste constituents (74) are pesticides and related compounds. As discussed in Section 4.3.2, these chemicals are identified as being potentially hazardous primarily by virtue of low RfDs, although there are also some potent ecotoxins, as well as persistent and bioaccumulative chemicals, among this group.

The next most numerous category among the possible constituents are the other semivolatile organic chemicals. This diverse group includes chemicals recognized both for their toxicity and their fate and transport properties. Twelve metals/inorganic elements or groups are identified including five different thallium salts. Similarly, the other volatile organics group includes 5 nitrosamines among a total of 13 compounds. Also included in this group are two very toxic organometallic compounds, methyl mercury and tetraethyllead. Among the seven chlorinated organics are two of the five chemicals with TRI releases greater than one million pounds (Freon 113 and chloroprene). No other chemical category is represented by more than five chemicals.

4.4 Combine and Screen Known and Possible Non-Hazardous Industrial Waste Constituents

In this section, the known (from Section 4.2) and possible (from Section 4.3) non-hazardous industrial waste constituents are combined and screened against toxicity, fate, and transport criteria. Unlike the prior section, screening is oriented more toward groups of chemicals rather than toward individual chemicals, and toward comparing the properties of known versus possible non-hazardous industrial waste constituents. There is, in addition, another screening step related to potential for occurrence in wastes, namely, comparison to 1994 non-confidential TSCA production volume data.

4.4.1 Combine the Lists

The lists of known and possible non-hazardous industrial waste constituents are shown in Exhibits 4-2 and 4-8. Exhibit 4-9 summarizes the screening of the known non-hazardous industrial waste constituents in the same way that Exhibit 4-7 provides these data for the possible constituents. As seen in these exhibits, the distribution of chemicals within chemical classes is somewhat different between the known and possible non-hazardous industrial waste constituents. These differences, however, are exaggerated by the removal of the known constituents from consideration as possible constituents. (Logically, a chemical cannot be both a “known” and “possible” waste constituent.) The known non-hazardous industrial waste constituents are distinguished by a relatively high proportion of metals and inorganics, chlorinated volatile organics, other volatile organics, and polycyclic aromatic hydrocarbons, compared to the possible non-hazardous waste constituents. In contrast, pesticides and related compounds constitute a much higher proportion of the possible non-hazardous industrial waste constituents than the known constituents.

The pattern of differences in chemical category can be partially explained by the differences in the data sources. The relatively high prominence of volatile organics among the possible constituents probably reflects the difficulties in controlling fugitive releases of these high-volume chemicals during storage and processing. Such chemicals are somewhat less likely to turn up in groundwater samples (in the release descriptions or in aqueous effluents) because of their high volatility. The prominence of the less volatile organics in the known non-hazardous industrial waste constituents again reflects the greater stability of these chemicals in solid and liquid wastes.

Exhibit 4-8

Possible Non-Hazardous Industrial Waste Constituents by Chemical Class

Exhibit 4-9
Screening of Known Non-Hazardous Industrial Waste Constituents Against TRI Release Volumes

Exhibit 4-9 (continued)
Screening of Known Non-Hazardous Industrial Waste Constituents Against TRI Release Volumes

Exhibit 4-9 (continued)
Screening of Known Non-Hazardous Industrial Waste Constituents Against TRI Release Volumes

Exhibit 4-9 also shows that the known waste constituents include a much higher number of chemicals with TRI release values greater than one million pounds (45)[10] than is found among the possible constituents (5). This is primarily due to the fact that the known waste constituents were identified first. Many of the high TRI release chemicals also would have been identified as possible non-hazardous industrial waste constituents if they had not been identified as known constituents. The implications of these findings for the potential severity of gaps in the hazardous characteristics are discussed in more detail in Chapter 10.

In the analysis that follows, the known and possible non-hazardous industrial waste constituent lists are combined, and screened against single and multiple parameters related to toxicity, fate and transport, and release potential.

4.4.2 Screen Combined List Against Single Criteria

Quantitative Human Toxicity Indicators. Exhibit 4-10 summarizes the toxicological properties of the combined known and possible non-hazardous industrial waste constituents. The chemicals are screened using the same criteria as described for the possible constituents alone in Section 4.3, with the exception that additional criteria related to carcinogenic potency are added (oral CSF and inhalation UR > 50th percentile). The list of suspect carcinogens (i.e., the first and third columns in Exhibit 4-10) contains a large proportion of all chemicals for which EPA has developed CSFs and URs. The proportion of the chemicals with high CSFs or URs (i.e., the second and fourth columns) is likewise very near to one-half of the total suspect carcinogens. This finding indicates that, as expected, the large universe of chemicals initially screened contains almost all of the chemicals that EPA has evaluated as potential human carcinogens. Many classes of chemicals (inorganics, volatile chlorinated organics, pesticides, other volatile chemicals) are represented among the suspect carcinogens.

Ecotoxicity. As shown in the last column of Exhibit 4-10, 18 of the combined known and possible constituents have low AWQCs (below 50th percentile), indicating the potential for adverse effects on aquatic organisms. Many of these chemicals are pesticides, and most of the pesticides are persistent chlorinated pesticides. Although most of these chemicals are no longer produced, their presence among the known non-hazardous industrial waste constituents may give rise for some concern. Also included in this group are selenium, silver, and hydrogen sulfide.

Potential Endocrine Disruptors. Because of the rapidly-evolving state of knowledge regarding chemicals that may act as endocrine disruptors, estrogen inhibitors, or have other hormone-like effects, it is difficult to estimate precisely how many of the combined known and possible non-hazardous industrial waste constituents fall into this category. Based on the rather broad list of potential endocrine disruptors,[11] 23 of the combined constituents are implicated as being potential endocrine disruptors (Exhibit 4-11). (Nine of the TC analytes are also potential endocrine disruptors.) Because of the lack of knowledge concerning dose-response relationships for exposures to single and multiple

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[10] This number includes both unique compounds (e.g., ethylbenzene) and categories of compounds (e.g., antimony compounds).

[11] The list of endocrine disrupting chemicals was developed based on information from Colborn, T., F.S. Saal, and A.M. Soto, 1993, "Developmental Effects of Endocrine-Disrupting Chemicals in Wildlife and Humans," Environmental Health Perspectives, 101:378-384, October 1993; and Warhurst, M., 1996, Introduction to Hormone Disrupting Chemicals, on the World Wide Web at http://www.ed.ac.uk/~amw/oestrogenic.html.

Exhibit 4-10 Toxicity Summary of Known and Possible Non-Hazardous Industrial Waste Constituents

Exhibit 4-11
Potential Endocrine Disruptors

Known and Possible Constituents	TC Analytes
2,3,7,8-tetrachlorodibenzodioxin (2378-TCDD)	cadmium
2,4,5-trichlorophenoxyacetic acid (2,4,5-T)	heptachlor and heptachlor expoxide
alachlor	lead
aldicarb	lindane
b-hexachlorocyclohexane (b-BHC)	mercury
butylbenzylphthalate (BBP)	methoxychlor
DDD	pentachlorophenol (PCP)
DDE	toxaphene
DDT	
dibromochloropropane (DBCP)	
dibutyl phthalate (DBP)	
dieldrin	
diethylhexyl phthalate (DEHP)	
dimethyl phthalate (DMP)	
dioctyl phthalate (DOP)	
endosulfan	
mirex	
parathion	
polychlorinated biphenyls (PCBs)	
polychlorinated dibenzodioxins (PCDDs)	
styrene	

endocrine disruptors, it is difficult to predict if these chemicals would present risk to humans and non-human receptors. Nevertheless, the fact that so many of these chemicals are present among the constituents may cause concern.

Potential for Frequent Occurrence in Wastes. The combined list of known and possible non-hazardous industrial waste constituents were also searched to identify those chemicals with high potential for occurrence in wastes, as indicated by TRI releases and/or non-confidential TSCA Inventory production data. The results of this analysis are summarized in Exhibit 4-12. Constituents are included in the table only if either TRI release data or non-CBI TSCA inventory data are available for them.

Volatility and Persistence. As discussed in Section 3.5, volatility and persistence appear to be key indicators of potential risks for the TC analytes. In the first four columns of Exhibit 4-13, the known and possible non-hazardous industrial waste constituents are screened against these properties. Vapor pressure of $1.3x10^{-3}$ atmosphere (which is approximately equivalent to 1 mm Hg) is used to identify volatile chemicals. This measure approximates the potential to volatilize; many chemicals with lower vapor pressure could volatilize readily under certain waste management conditions. Even so, 70 known or possible non-hazardous industrial waste constituents fall into this category. This

Exhibit 4-12 TRI Releases and Non-Confidential TSCA Production Volume Data for the Known and Possible N Hazardous Industrial Waste Constituents

Exhibit 4-13 Volatility, Persistence, and Bioaccumulation/Bioconcentration Summary Potential of Known and Possible Non-Hazardous Industrial Was Constituents

finding suggests that, as for the volatile TC analytes, volatilization releases and inhalation exposures (and possibly indirect exposures) may be a concern for some of these chemicals.

Two chemicals, both chlorinated organics, are identified as having long half-lives (greater than 0.15 year) in air. This finding does not mean that all of the other constituents are too short-lived to be of concern through air exposures. Half-lives on the order of a few hours or days also may be of concern in terms of direct inhalation exposures. This criterion is more indicative of the potential for long-range (e.g., regional or global-scale) transport of these chemicals in the vapor phase. Also, as noted in Section 3.5, the air half-lives of many of the inorganic waste constituents (especially the metals) bound to particulates would also be limited only by how long the particles remained suspended in the atmosphere.

The third column of Exhibit 4-13 identifies the non-hazardous industrial waste constituents that are relatively persistent either in soils or in the water column. The metals all fall into this category, along with the PAHs, many chlorinated pesticides, and 2,3,7,8-TCDD. The only volatile organic chemical in this category is 1,2-dichloropropane. Appearance in this category arouses concern for potential inhalation and indirect pathway exposure risks, as discussed in Section 3.5.

A high Kow, as indicated in the fourth column, indicates a high potential to bind to soil organic matter. It is highly correlated with the tendency to bioaccumulate. Thirty-one of the known and possible waste constituents including many persistent pesticides and PAHs, are in this category.

Bioaccumulation Potential. The last three columns of Exhibit 4-13 indicate the potential for bioaccumulation by the known and possible non-hazardous industrial waste constituents in aquatic and terrestrial food chains. The constituents with aquatic BCFs or BAFs greater than 1,000 are limited to the chlorinated pesticides, several phthalate esters, and diethylstilbestial (DES). This finding does not imply that no other constituents present significant risks through indirect pathways; nevertheless, the identified chemicals are all clearly recognized as being problematic from the point of view of bioconcentration. If these chemicals were released in significant amounts from non-hazardous waste industrial management activities, they could present substantial risks through food-chain exposures.

The last column of the table lists chemicals that are taken up from feed by beef cattle with above-average (greater than 75th percentile) efficiency. This list includes most chemicals that also are of potential concern for aquatic ecosystems. Also, several additional classes of chemicals are identified, including the metals and PAHs. Although the beef biotransfer factor is only one of many parameters determining the potential for risks to humans from beef consumption, it is a reasonable indicator of potential concern for this pathway and is a useful indicator of exposure potential in other terrestrial food chains.

LNAPL and DNAPL Formation. The potential to form nonaqueous phase liquids (NAPLs) is of great concern from the point of view of waste management risks. Historically, NAPLs have been serious problems in the remediation of hazardous waste, because of their high potential risks and high remediation costs. Any chemical that is relatively insoluble in water and is a liquid at ambient temperature can be the principal component of a NAPL. If the chemical or chemical mixture is denser than water, then a dense nonaqueous phase liquid (DNAPL) is formed. If the liquid is less dense than water, a light nonaqueous phase liquid (LNAPL) may be formed.

DNAPLs are of particular concern because, when they escape to groundwater, they will sink through the unsaturated zone or aquifer until they encounter bedrock or another barrier. They can remain at the bottom of the aquifer (for example, in bedrock fractures) where they are hard, or in some cases nearly impossible, to remediate. Most DNAPLs undergo only limited degradation in the subsurface, and persist for long periods while slowly releasing soluble organic constituents to groundwater. Even with a moderate DNAPL release, dissolution may continue for hundreds of years or longer under natural conditions before all the DNAPLs are dissipated and concentrations of soluble organics in groundwater return to background levels. When released into surface water, DNAPLs tend to sink to the bottom and contaminate sediments. LNAPLs, in contrast, will tend to float on the surface of an aquifer, where they are easier to remedy; yet, they also can contaminate large volumes of groundwater through slow dissolution. Both LNAPLs and DNAPLs also can facilitate the transport of toxic waste constituents by solubilizing chemicals that would otherwise be immobile in waste or soil matrices.

It is difficult to predict the circumstances under which LNAPL and DNAPL formation will occur and pose a risk to human health or the environment. Whether significant amounts of NAPLs will form depends on the composition of the wastes and the management practices employed. Reports of nonaqueous phase liquids were not found among the release descriptions for non-hazardous industrial waste management summarized in Chapter 2, possibly due to limitations in monitoring requirements. EPA has recently conducted a study of the potential for DNAPL formation at hazardous waste (NPL) sites, and identified several industries where NAPL formation is particularly likely to occur.[12] These industries include wood treating sites, general manufacturing, organic chemical production, and "industrial waste landfills". A wide variety of chemicals have been found in NAPLs, and it appears that if a chemical is to be the major constituent of a NAPL, the most important requirements are relative insolubility in water and liquidity at ambient temperatures.

Exhibit 4-14 identifies a number of the known and possible non-hazardous industrial waste constituents with the requisite physical properties. Since there is no clear dividing line between chemicals likely and not likely to form NAPLs, this list was developed using a combination of professional judgment and information about the physical properties of the waste constituents. All of the chemicals listed are organics, have relatively low water solubilities, and are liquid at room temperature (melting points greater than 7ºC, boiling point greater than 30ºC). Those indicated as being potential DNAPL formers have bulk liquid densities greater than 1 gm/cc, while those with densities less than water are indicated as potential LNAPL formers. The distinction is not clear-cut however, as a mixture of light and heavy constituents at different relative concentrations might have widely varying densities.

Exhibit 4-14 identifies more potential DNAPL formers than LNAPL formers found among the known and possible waste constituents. Based on density considerations, the LNAPL formers tend to be primarily the non-halogenated hydrocarbons, including "BTEX"[13] and compounds with similar properties, whereas the DNAPL formers tend to be primarily chlorinated and brominated chemicals. Not included in the NAPL list are pesticides that also fulfill the physical criteria, but which are no longer produced (see Chapter 9) and thus are less likely to be present in significant amounts in pure form in non-hazardous industrial wastes. These findings suggest that, on physical bases alone, many

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[12] U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response, Evaluation of the Likelihood of DNAPL Presence at NPL Sites, EPA 540-R-93-073, September 1993.

[13] BTEX refers to benzene, toluene, ethylbenzene, and xylene, which are common constituents of gasoline.

Exhibit 4-14
LNAPL/DNAPL Formation Potential of Known and Possible Non-Hazardous Industrial Waste Constituents

Chemical Name	NAPL Type[a]	Chemical Name	NAPL Type[a]
1,1,1,2-Tetrachloroethane	D	Chloropropene	D
1,1,1-Trichloroethane	D	cis-1,2-Dichloroethylene	D
1,1,2-Trichloropropane	D	cis-1,3-Dichloropropene	D
1,1,2,2-Tetrachloroethane	D	Cumene	L
1,1,2-Trichloroethane	D	Di(2-ethylhexyl) phthalate	L
1,2,3-Trichloropropane	D	Dibutyl phthalate	D
1,2-Dibromo-3-chloropropane	D	Dichlorobromomethane	D
1,2-Dibromoethane	D	Diethyl phthalate	D
1,2-Dichlorobenzene	D	Dimethyl phthalate	D
1,2-Dichloroethylene, trans	D	Ethylbenzene	L
1,2-Dichloropropane	D	Ethylidene Dichloride	D
1,3-Dichloropropylene	D	Freon 113	D
2,3-Dichloropropanol	D	Hexachlorocyclopentadiene	D
2,3,4,6-Tetrachlorophenol	D	n-Dioctylphthalate	L
2,4-Dichlorophenol	D	N-Nitrosodi-n-propylamine	L
2-Chloroacetophenone	L	p-Chloroaniline	D
Acetophenone	L	Propylene oxide	L
Allyl chloride	L	Safrole	L
Benzyl chloride	D	Styrene	L
Bromoform	D	Toluene	L
Butyl benzyl phthalate	D	trans-1,3-Dichloropropene	D
Carbon disulfide	D	Trichlorofluoromethane	D
Chlorodibromomethane	D	Xylene (mixed isomers)	L

Notes:

[a] D = DNAPL (density of pure compound > 1.0 gm/cc)
L = LNAPL (density of pure compound < 1.0 gm/cc)

of the known and possible non-hazardous industrial waste constituents could form LNAPLs or DNAPLs. As noted above, however, when this actually occurs depends to a large degree on the specific characteristics of the wastes and waste management practices.

EPA's analysis of DNAPL formation at NPL sites found that the contaminants most directly associated with DNAPL presence include creosote compounds, coal tar compounds, polychlorinated biphenyls (PCBs), chlorinated solvents, and mixed solvents.[14]

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[14] U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response, Evaluation of the Likelihood of DNAPL Presence at NPL Sites, EPA 540-R-93-073.

4.4.3 Screen Combined List Against Multiple Parameters

This section discusses the results of one last round of screening conducted on the entire combined list of known and possible non-hazardous industrial waste constituents. This analysis combines toxicity, persistence, volatility, and bioaccumulation screens in various combinations in order to identify the chemicals most likely to pose risks by various exposure pathways. Only constituents in the intersections of the screens remain (e.g., only constituents that are persistent and highly toxic). For human toxicity, the criteria have been applied in the following order:

- Persistent and Highly Toxic to Humans. This combination is intended to identify highly toxic chemicals that could pose risks through any pathways involving long-term release and transport of contaminants, such as groundwater and indirect pathways involving air, surface water, or groundwater releases.

- Persistent, Highly Toxic to Humans and Bioaccumulative. This screen narrows the above waste constituents to those with potential for adverse effects through indirect food chain exposure.

- Persistent, Highly Toxic to Humans, Bioaccumulative, and Volatile. This combination further narrows the above chemicals to those with potential to cause indirect pathway risks through air releases.

A fourth screen applied persistent, ecotoxic, and bioaccumulative criteria to the combined list of constituents. This combination of screening criteria is intended to identify chemicals for which potential harm to ecological receptors is a potential concern.

The individual criteria used in combination are described in Section 4.3. The persistence screen consisted of a determination of whether the chemicals had soil or water column degradation rate constants of less than 0.5/year. "Highly toxic" indicates any chemical having a CSF or Unit Risk above the 50th percentile of all chemicals, or a chronic RfD below the 50th percentile. Volatility was screened against Henry's Law constant of 10^{-5} atm-m^3/mole, and bioaccumulation potential determined by an aquatic BCF or BAF value of greater than 1,000 L/Kg.

The results of the combined screening of known and possible non-hazardous industrial waste constituents are summarized in Exhibit 4-15. To a substantial degree, these results parallel the screening-level modeling results for the TC analytes discussed in Section 3.5. Four of the nine persistent and highly toxic chemicals are chlorinated pesticides or degradation products, along with three metals (antimony, beryllium, and molybdenum), benzo(a)pyrene, and 2,3,7,8-TCDD. The appearance of benzo(a)pyrene suggests that other high molecular weight PAHs (some of which are also carcinogens) might also pass this screen if CSF values were available for these compounds. In addition, several other chlorinated pesticides have properties that just miss the toxicity or persistence cutoff values.

When bioaccumulation potential is added to the screening conditions (second column of Exhibit 4-15), no chemicals drop out. This finding shows the high correlation between persistence and bioaccumulative potential: if a chemical was not persistent, it would lack the opportunity to accumulate in environmental media or tissue.

Exhibit 4-15
Multiple Screening Criteria Applied to Known and Possible Non-Hazardous Industrial Waste Constituents

Persistent and Highly Toxic	Persistent, Highly Toxic, and Bioaccumulative	Volatile, Persistent, Highly Toxic, and Bioaccumulative	Persistent, Ecotoxic, and Bioaccumulative
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	2,3,7,8-TCDD	Aldrin[a]	2,3,7,8-TCDD
Aldrin[a]	Aldrin[a]	DDE	DDT[a]
Antimony	Antimony	DDT[a]	Dieldrin
Benzo[a]pyrene	Benzo[a]pyrene		
Beryllium	Beryllium		
DDE	DDE		
DDT[a]	DDT[a]		
Dieldrin	Dieldrin		
Molybdenum	Molybdenum		

Notes:

[a] Use has been cancelled under FIFRA.

When the criterion of volatility is added to the preceding screens, three chemicals, all persistent pesticides remain. This result again parallels the results seen for the TC analytes in Section 3.5. If vapor pressure cutoff (1 mm Hg), rather than Henry's Law constant (10^{-5} atm.-M^3/mole) is used to characterize the potential to volatilize, none of the chemicals qualify in this category.

The last column of Exhibit 4-15 identifies persistent, bioaccumulative, and ecotoxic chemicals. As might be expected from the previous screening results, these chemicals include chlorinated pesticides and 2,3,7,8-TCDD. Because the AWQC screen is based only on harmful concentrations, it does not include any screening for the concentrations normally encountered in the environment. Thus, if a much less toxic chemical (for example zinc or copper) were released into the environment in much larger amounts than the pesticides, the exposure concentrations might be much greater and adverse effects on ecological receptors might occur.

4.5 Driving Risk Pathways for the Known and Possible Non-Hazardous Industrial Waste Constituents

EPA has previously evaluated the potential risks associated with the management of many known and possible non-hazardous industrial waste constituents in the context of deriving proposed risk-based exit levels for the proposed HWIR-Waste rulemaking. As discussed in Section 3.5, these proposed exit levels were derived by back-calculating concentrations in wastewaters and nonwastewaters corresponding to acceptable risk levels. The magnitude of the modeled exit levels is inversely proportional to the magnitude of risk posed by the chemical when placed in the specified management units. Proposed exit levels are calculated for groundwater exposures and other pathways. Thus, the proposed exit levels also indicate the relative importance of the exposure pathways for each chemical.

Exhibit 4-16 tabulates the exit levels for 128 of the known or possible non-hazardous industrial waste constituents (i.e., the entire combined list prior to any screens that were also addressed in the HWIR-waste proposed rulemaking), and the exposure pathways that were risk drivers for setting the exit levels. As in the case of the similar analysis for the TC analytes in Section 3.5, many of the known or possible non-hazardous industrial waste constituents have proposed exit levels that are quite low (68 are below 0.1 mg/l). Therefore, the Agency has determined that the presence of these constituents in wastes at even relatively low concentrations may pose significant risks to human health. Again it should be noted that the target cancer risk level used to derive the exit levels was 10^{-6}, rather than the 10^{-5} level used in the derivation of TC regulatory levels. Even so, these levels indicate potential cause for concern for many of these chemicals at even low concentrations in wastes.[15]

As was also the case for the TC analytes, non-groundwater pathway risks drive the establishment of exit levels for about one-quarter of the known or possible non-hazardous industrial waste constituents. The driving pathways include direct inhalation and vegetable and milk ingestion. Pesticides make up a large proportion of the chemicals for which non-groundwater pathways drive the risks, but many volatile chlorinated and nonchlorinated organics also fall into this category. Ecological, rather than human health risks, drive the setting of proposed exit levels for two chemicals (copper and parathion). These findings confirm the indications from the toxicity and fate and transport screening presented in the previous sections that inhalation and indirect pathways could be of concern for many of the known or possible non-hazardous industrial waste constituents.

4.6 Potential Acute Hazards Associated With Known and Possible Non-Hazardous Industrial Waste Constituents

To this point, the evaluation of the potential hazards associated with the possible and known non-hazardous industrial waste constituents has focused on chronic toxic effects. As discussed in Chapter 3, waste constituents may also pose risks from acute exposures, as well as from physical hazards associated with reactivity, flammability, or corrosivity. To investigate the possibility of acute adverse effects, the Agency has compared list of the known and possible waste constituents to lists developed by the EPA and other regulatory agencies that identify such hazardous properties. The results of this comparison are summarized in Exhibit 4-17.

As shown in the exhibit, 38 of the known and possible non-hazardous industrial waste constituents have been identified in one or more regulatory contexts as being acutely toxic.[16] Although most of these chemicals are volatile organics, several acid gases and other inorganic compounds also are included. Appearance on these lists does not automatically indicate that acute

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[15] The Agency is currently revising the proposed HWIR-Waste exit level risk modeling methods in response to comments from the Science Advisory Board and other reviewers. Thus, the proposed exit levels shown in Exhibit 4-15 should be regarded as preliminary.

[16] Edelstein, Maravene, "Memorandum to Paul Tobin on the Subject of a Database of Chemicals of Interest for Short Term Inhalation Exposure," September 1993. Sources of data for the database include the Emergency Planning and Community Right-to-Know Act (EPCRA) (40 CFR Part 355), Section 112(r) of the Clean Air Act (CAA) (40 CFR Part 68), and the Occupational Safety an Health Administration (OSHA) Process Safety Management (PSM) Standard (29 CFR Part 1910).

Exhibit 4-16
Lowest Proposed HWIR-Waste Exit Levels for Known and Possible Non-Hazardous Industrial Waste Constituents

Exhibit 4-16 (continued)
Lowest Proposed HWIR-Waste Exit Levels for
Known and Possible Non-Hazardous Industrial Waste Constituents

Exhibit 4-16 (continued)
Lowest Proposed HWIR-Waste Exit Levels for
Known and Possible Non-Hazardous Industrial Waste Constituents

Exhibit 4-17
Potential Acute Hazards Associated with Known and Possible Non-Hazardous Industrial Waste Constituents

Acutely Toxic Chemicals		Highly Flammable Chemicals	Highly Reactive Chemicals
1,1,1-Trichloroethane	Furan	1,3-Butadiene	1,3,5-Trinitrobenzene
1,3-Butadiene	Hydrazine	Acetaldehyde	2,4,6-Trinitrotoluene
Acetaldehyde	Hydrogen cyanide	Chloroethane	
Acrolein	Hydrogen fluoride	Chloromethane	
Acrylonitrile	Hydrogen sulfide	Dimethylamine	
Allyl alcohol	Methacrylonitrile	Ethane, 1,1'-oxybis-	
Allyl chloride	Methanol	Ethylene oxide	
Ammonia	Methyl iodide	Formaldehyde	
Arsine	Methyl isocyanate	Furan	
Bis(chloromethyl) ether	Methyl mercaptan	Hydrogen cyanide	
Bromomethane	Nickel carbonyl	Hydrogen sulfide	
Carbon disulfide	Nitric oxide	Methyl mercaptan	
Chlorine	Nitrogen dioxide	Phosphine	
Chlorine dioxide	Phosgene	Propylene oxide	
Chloromethane	Phosphine	Vinylidene chloride	
Epichlorohydrin	Propylene oxide		
Ethylene oxide	Toluene		
Fluorine	Vinyl acetate		
Formaldehyde	Xylene (mixed isomers)		

Notes:

[a] See text for categorization criteria.

adverse effects will occur, only that such effects could potentially be associated with management of wastes containing these chemicals.

Fifteen of the waste constituents are also identified as being highly flammable.[17] These are mostly volatile organics, along with a few inorganic gases and liquids. They substantially overlap with the previous list. Only two of the known or possible non-hazardous industrial waste constituents are identified as being highly reactive.

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[17] ICF Incorporated, Draft Physical/Chemical Properties Criteria Database, October 1987. Sources of data for the database include the Department of Transportation (DOT) Hazardous Materials Table (49 CFR 172.101) and the National Fire Protection Association (NFPA) publication 325M, Fire Hazard Properties of Flammable Liquids, Gases, and Volatile Solids.

4.7 Identify Individual Chemicals and Classes of Chemicals Constituting Potential Gaps

The analyses in the previous sections help to clarify the nature of potential gaps in the hazardous waste characteristics associated with specific chemicals and chemical classes related to chronic human health risks and ecological risks. The analyses identified groups of chemicals most likely to be present in non-hazardous industrial waste, and screened them in terms of their toxicity, fate, and transport properties. The results of the proposed HWIR-waste modeling were reviewed, where available, to confirm and expand the findings of the screening results. Finally, the known and possible non-hazardous industrial waste constituents were reviewed with regard to their potential to cause acute adverse effects. As a result of these efforts, a number of potential gaps have been identified, as summarized in Exhibit 4-18.

This listing of potential gaps for non-TC analytes should not be taken as being either exhaustive or definitive. These gaps are potential, not actual gaps. They have been identified for purposes of targeting further analysis, not for purposes of choosing what constituent or wastes to regulate. Other potential gaps related to natural resource damages and regional or global environmental problems are discussed in Chapter 5. Also, Chapter 6 describes how several states have expanded the TC, implicitly identifying gaps in the TC. In Chapter 10, some of the unresolved issues identified in Exhibit 4-18 are discussed and the available information about the potential significance of these impacts is reviewed in detail.

EPA recognizes the limitations of this analysis. As noted previously, the data concerning the composition of non-hazardous industrial wastes are quite limited and generally quite old. This lack of data in large part explains the need for the elaborate screening procedures employed in this chapter. Few data are available on the current patterns of non-hazardous industrial waste generation, management, and disposal. In addition, the chemical-specific screening is further complicated by the lack of toxicity and fate and transport parameter data for a large proportion of the universe of possible waste constituents, which necessitated extensive use of professional judgment to supplement the screening process.

Exhibit 4-18
Potential Gaps in the Hazardous Waste Characteristics Identified Based on the Hazardous Properties of Known and Possible Non-Hazardous Industrial Waste Constituents

Potential Gap	Basis for Identification	Important Unresolved Issues, Data Gaps
Groundwater exposure to toxic metals	Potential variability in groundwater transport; finding of metals in groundwater above HBLs in release descriptions; proposed HWIR-waste risk results	Amounts and concentrations disposed; management practices; leaching characteristics
Groundwater and inhalation pathway exposures to volatile chlorinated organic compounds	Findings above HBLs in release descriptions; large number of volatiles among non-hazardous industrial waste constituents; screening-level risk results; proposed HWIR-waste risk results	Amounts and concentrations disposed; management practices
Inhalation pathway exposure to persistent organic pesticides	Screening level risk modeling; screening based on toxicity, fate and transport parameters	Whether these pesticides are still being managed in substantial amounts as non-hazardous wastes
Exposure to persistent organic pesticides and some metals through aquatic indirect pathways	Screening risk results; screening of waste constituents for persistence, bioaccumulation, toxicity, proposed HWIR-Waste risk results indicating non-groundwater pathways drive risks	Whether these pesticides are still being managed in substantial amounts as non-hazardous wastes
Risks to aquatic ecosystems from persistent pesticides	Ecotoxicity, persistence, bioaccumulation screening; analogy to screening risk modeling	Whether these pesticides are still being managed in substantial amounts as non-hazardous wastes
Risks to humans, ecological receptors from chlorinated dioxins, PCBs	Toxicity, fate and transport screening; analogy to screening risk results; proposed HWIR-Waste risk results	Amounts and concentrations managed (not high-volume chemicals)
Endocrine disruption (humans and ecological receptors) from exposure to chlorinated pesticides, phthalate esters	Findings in release descriptions; toxicological properties; fate and transport screening	Dose-responses relationships for individual and multiple agents; combined exposures are largely unknown
Adverse effects to humans from exposure to “BTEX” hydrocarbons[a]	Occurrence in release descriptions above HBLs; fate and transport screening	Amounts and concentrations disposed
Groundwater exposures to phenolic compounds	Occurrence in release descriptions above HBLs	Relatively low toxicity compounds; amounts and concentrations in non-hazardous wastes

Exhibit 4-18 (continued)
Potential Gaps in the Hazardous Waste Characteristics Identified Based on the Hazardous Properties of Known and Possible Non-Hazardous Industrial Waste Constituents

Potential Gap	Basis for Identification	Important Unresolved Issues, Data Gaps
Potential for LNAPL and DNAPL formation, primarily for halogenated solvents	Large number of waste constituents have physical properties consistent with NAPL formation (mostly DNAPLs)	NAPL formation is highly dependent on waste characteristics and specific management practices; few data are available
Exposure to PAHs	Occurrence in Subtitle D data; persistence; toxicity screening	Amounts and concentrations disposed
Acute effects; toxicity and other injuries	Many constituents are acutely toxic, highly flammable, or highly reactive	Acute risks are highly dependent upon nature and composition of wastes and management practices

Notes:

[a] Toluene, ethylbenzene, xylenes; these compounds are all commonly found in gasoline, kerosene, and related petroleum products.

Exhibit 4-1 Flow Chart of Procedures Used to Identify Non-TC Chemicals Posing Potential Gaps in the TC Characteristics

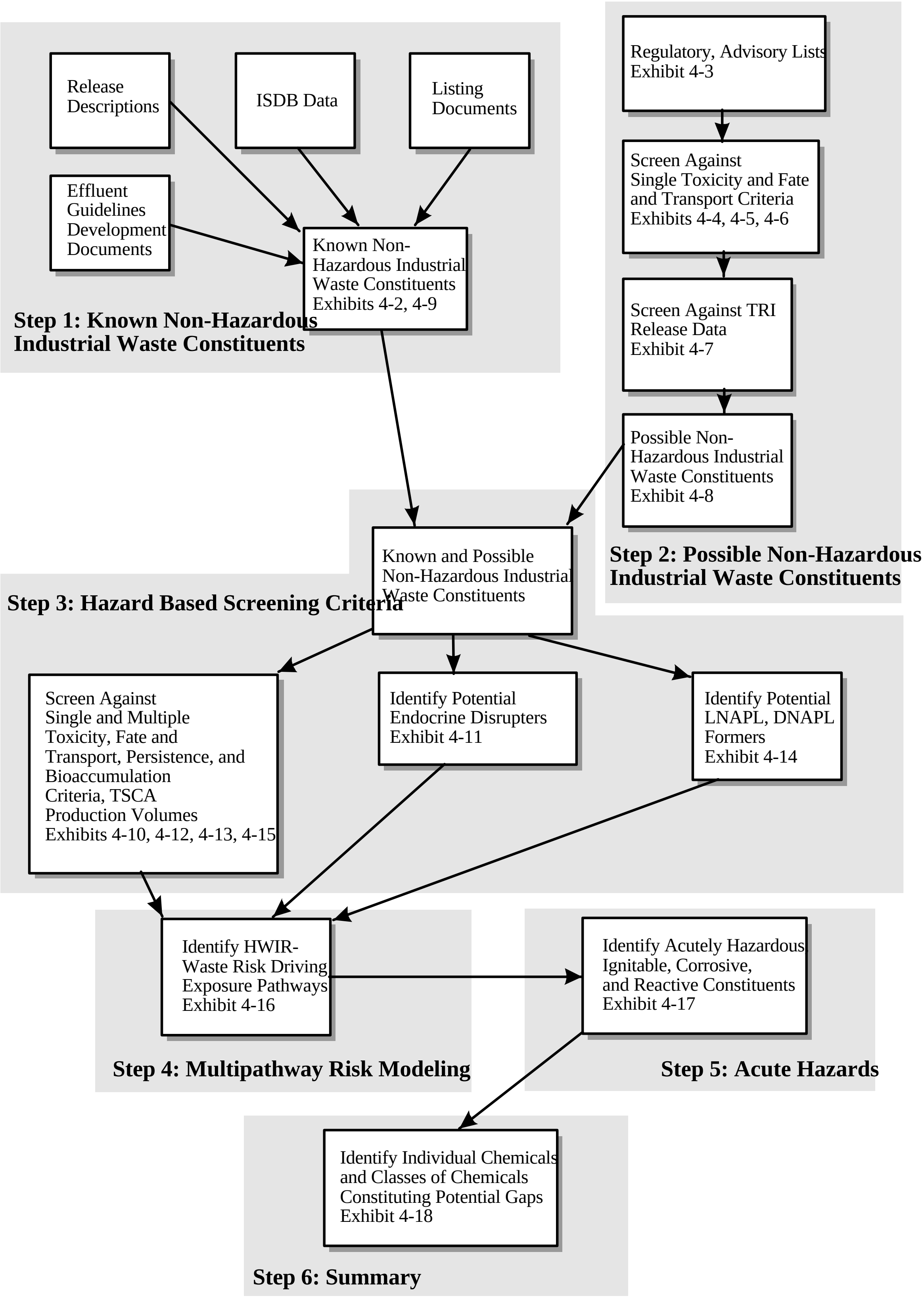

EXHIBIT 4-2 KNOWN NON-HAZARDOUS INDUSTRIAL WASTE CONSTITUENTS FOUND IN CASE STUDIES, ISDB, LISTINGS DOCUMENTS, AND EFFLUENT GUIDELINES BY CHEMICAL CLASS

Metals/ Inorganics	Volatile Chlorinated Organics	Volatile Hydrocarbons	Other Volatile Organics	Pesticides/ Intermediates/ Degradation Products	Phthalate Esters	Phenolic Compounds	Polycyclic Aromatic Hydrocarbons	Other Semivolatile Organics
Aluminum (fume or dust)	1,1,1,2-Tetrachloroethane	1,2,4-Trimethylbenzene	1,2-Dibromoethane	2,3,4,6-Tetrachlorophenol	Butyl benzyl phthalate	2,4-Dimethylphenol	2-Methylnaphthalene	1,2-Diphenylhydrazine
Ammonia	1,1,1-Trichloroethane	Cumene	1,4-Dioxane	Aldicarb	Di(2-ethylhexyl) phthalate	2,4-Dinitrophenol	7,12-Dimethylbenz[a]anthracene	2,3,7,8-TCDD
Antimony	1,1,2,2-Tetrachloroethane	Ethylbenzene	2-Ethoxyethanol	Aldrin	Dibutyl Phthalate	2-Nitrophenol	Acenaphthene	2,4-Diaminotoluene
Beryllium	1,1,2-Trichloroethane	m-Xylene	2-Ethoxyethanol acetate	alpha-Endosulfan	Diethyl Phthalate	4,6-Dinitro-o-cresol	Acenaphthylene	2,4-Dichlorophenol
Boron and compounds	1,2,3-Trichloropropane	n-Butylbenzene	2-Hexanone	alpha-Hexachlorocyclohexane	Dimethyl Phthalate	4-Nitrophenol	Anthracene	2,6-Dinitrotoluene
Calcium	1,2,4,5-Tetrachlorobenzene	n-Propyl benzene	2-Methoxyethanol	Atrazine	n-Dioctyl phthalate	p-Chloro-m-cresol	Benz[a]anthracene	3,3'-Dimethoxybenzidine
Calcium Carbonate	1,2,4-Trichlorobenzene	o-Xylene	2-Methyllactonitrile	beta-BHC		Phenol	Benzo(a)phenanthrene	4-Aminobiphenyl
Carbon dioxide	1,2-Dibromo-3-chloropropane	p-Xylene	2-Methylpyridine	beta-Endosulfan		Phenolics	Benzo(a)pyrene	4-Aminopyridine
Chloride	1,2-Dichlorobenzene	sec-Butylbenzene	2-Nitropropane	Carbofuran			Benzo(k)fluoranthene	5-Nitro-o-toluidine
Chlorine	1,2-Dichloroethylene	Styrene	Acetaldehyde	DDE			Benzo[b]fluoranthene	Acetophenone
Cobalt	1,2-Dichloropropane	Toluene	Acetone	DDT/DDD			Benzo[ghi]perylene	Acrylamide
Copper	1,3-Dichlorobenzene	Xylenes	Acetonitrile	Diazinon			Dibenz[a,h]anthracene	Acrylic acid
Copper cyanide	1,3-Dichloropropylene		Acrolein	Dieldrin			Fluoranthene	Adipic acid
Cyanides (sol. salts/complexes)	Allyl chloride		Acrylonitrile	Dimethoate			Fluorene	Aniline
Cyanogen chloride	Benzoic trichloride		Allyl alcohol	Disulfoton			Indeno(1,2,3-cd)pyrene	Benzal chloride
Fluoride/fluorine/hydrogen fluoride	Bis(2-chloroethyl) ether		Benzenethiol	Endosulfan			Isophorone	Benzoic acid
Fluorine	Chlorobromomethane		Benzyl alcohol	Endosulfan sulfate			Methapyrilene	Benzyl chloride
Hydrogen cyanide	Chlorodibromomethane		Bromoform	Endothall			Pyrene	Biphenyl
Hydrogen fluoride	Chloroethane		Bromomethane	Endrin aldehyde				Coal tars
Hydrogen sulfide	Chloromethane		Carbon disulfide	Endrin ketone				Creosote
Iron	cis-1,2-Dichloroethylene		Crotonaldehyde	Fampur				Dibenzofuran
Magnesium	Dichloro-2-propanol, 1,3-		Cyclohexanol	Mesitylene				Dichlorobenzene (mixed isomers)
Manganese	Dichlorobromomethane		Cyclohexanone	Methyl iodide				Diphenyl ether
Molybdenum	Dichlorodifluoromethane		Dimethylamine	Methyl parathion				Diphenylamine
Nickel	Dichloroethylene, N.O.S.		Dimethyl sulfate	Molinate				Ethyl dipropylthiocarbamate
Nickel carbonyl	Dichloromethane		Dimethylamine	O,O-Diethyl O-pyrazinyl phosphorothioate				Formic acid
Nitrates/nitrites	Dichloropropane		Ethane, 1,1'-oxybis-	Parathion				m-Dinitrobenzene
Nitric oxide	Epichlorohydrin		Ethyl acetate	Phorate				Maleic anhydride
Nitrite	Ethyl chloride		Ethylene glycol	Sulfotep				Maleic hydrazide
Nitrogen	Ethylidene Dichloride		Ethylene oxide					N-Nitroso-dimethyl amine
Nitrogen dioxide	Hexachlorocyclopentadiene		Formaldehyde					N-Nitrosodiphenyl amine
Phosgene	Pentachloroethane		Furan					Naphthalene
Phosphine	Tetrachloroethane, N.O.S.		Furfural					Nitrosamine, N.O.S.
Phosphorus	trans-1,2-Dichloroethylene		Hydrazine					O-Chlorotoluene
Potassium	trans-1,3-Dichloropropene		Isobutyl alcohol					Ortho(2-)Nitroaniline
Silica	Trichloroethane		Malononitrile					p-Chloroaniline
Silicon	Trichlorofluoromethane		Methanol					p-Chlorotoluene
Sodium	Trichloromethanethiol		Methyl isobutyl ketone					p-Nitroaniline
Sodium cyanide			Methyl isocyanate					Pentachlorobenzene
Strontium			Methyl mercaptan					Phenanthrene
Sulfide			Methyl methacrylate					Phthalic acid
Sulfite			Methylene bromide					Phthalic anhydride
Thallium			n-Butyl alcohol					Polychlorinated biphenyls
Tin (total)			Urethane					Resorcinol
Titanium			Vinyl acetate					Thioacetamide
Vanadium (fume or dust)								Thiram
Vanadium pentoxide								
Zinc								
Total: 48	38	12	45	29	6	8	18	46

EXHIBIT 4-7 SCREENING OF HIGH-TOXICITY, PERSISTENT, BIOACCUMULATIVE/BIOCONCENTRATING POSSIBLE NON-HAZARDOUS WASTE CONSTITUENTS AGAINST TRI RELEASE VOLUMES

Chemical CAS	Chemical Name	Release Volume	Oral CSF	Inhalation Unit Risk	Oral RfD < 50th	RfC < 50th	AWQC (Chronic) < 50th	Degradation Rate for Water Column	Fish BCF	Henry's Law Constant	Kow	Soil Degradation Rate	Vapor Pressure > 1_3e-3	Beef Biotransfer Factor >7_8e-4
0000076-13-1	Freon 113	5,077,542								✔			✔	
0000106-99-0	1,3-Butadiene	2,711,287		✔										
0010049-04-4	Chlorine dioxide	1,501,041				✔								
0000126-99-8	Chloroprene	1,157,755								✔			✔	
0000075-56-9	Propylene oxide	1,076,879	✔	✔										
0000101-68-8	Methylenebis(phenylisocyanate)	846,938				✔								
0000103-23-1	Bis(2-ethylhexyl) adipate	844,594	✔											
0001163-19-5	Decabromodiphenyl oxide	469,811			✔									
0001332-21-4	Asbestos (friable)	294,368		✔										
0000126-98-7	Methacrylonitrile	80,802			✔					✔			✔	
0026471-62-5	Toluenediisocyanate (mixed isomers)	50,695				✔								
0000092-87-5	Benzidine	31,606	✔	✔	✔									
0000121-69-7	N,N-Dimethylaniline	22,676			✔									
0001582-09-8	Trifluralin	15,304	✔		✔									
0000593-60-2	Vinyl bromide	2,620				✔								
0000082-68-8	Quintozene	2,558			✔			✔		✔		✔		✔
0000062-73-7	Dichlorvos	1,286	✔		✔	✔								
0002164-17-2	Fluometuron	832			✔									
0000096-45-7	Ethylene thiourea	529			✔									
0012427-38-2	Maneb	272			✔									
0000542-88-1	Bis(chloromethyl) ether	255	✔	✔										
0000091-94-1	3,3'-Dichlorobenzidine	10	✔											
0000114-26-1	Propoxur	4			✔									
0000070-30-4	Hexachlorophene				✔						✔			✔
0000133-07-3	Folpet		✔											
0000126-72-7	Tris(2,3-dibromopropyl) phosphate									✔				
0000122-34-9	Simazine				✔									
0000121-82-4	Cyclotrimethylene trinitramine		✔		✔									
0000140-57-8	Aramite		✔	✔										
0000141-66-2	Dicrotophos				✔									
0000143-50-0	Kepone							✔	✔		✔	✔		✔
0000131-89-5	2-Cyclohexyl-4,6-dinitrophenol				✔									
0000576-26-1	2,6-Dimethylphenol				✔									
0000709-98-8	Propanil				✔									
0000621-64-7	N-Nitrosodi-n-propylamine		✔							✔			✔	
0000616-23-9	2,3 Dichloropropanol				✔									
0000615-54-3	1,2,4 Tribromobenzene				✔									
0000330-55-2	Linuron				✔									
0000598-77-6	1,1,2 Trichloropropane				✔									
0000150-50-5	Merphos				✔									
0000563-68-8	Thallium(I) acetate				✔									
0000563-12-2	Ethion				✔									
0000532-27-4	2-Chloroacetophenone					✔								
0000510-15-6	Chlorobenzilate								✔					
0000505-29-3	1,4 Dithiane				✔									
0000330-54-1	Diuron				✔									
0000300-76-5	Naled				✔									
0000608-73-1	Hexachlorocyclohexane		✔	✔										
0000078-00-2	Tetraethyl lead				✔									
0000088-85-7	Dinitrobutyl phenol				✔					✔				

EXHIBIT 4-7 (CONTINUED)
SCREENING OF HIGH-TOXICITY, PERSISTENT, BIOACCUMULATIVE/BIOCONCENTRATING POSSIBLE NON-HAZARDOUS WASTE CONSTITUENTS AGAINST TRI RELEASE VOLUMES

Chemical CAS	Chemical Name	Release Volume	Oral CSF	Inhalation Unit Risk	Oral RfD < 50th	RfC < 50th	AWQC (Chronic) < 50th	Degradation Rate for Water Column	Fish BCF	Henry's Law Constant	Kow	Soil Degradation Rate	Vapor Pressure > 1_3e-3	Beef Biotransfer Factor >7_8e-4
0000108-45-2	1,3-Phenylenediamine				✔									
0000086-50-0	Azinphos-methyl						✔							
0000085-00-7	Diquat				✔									
0000083-79-4	Rotenone, Commercial				✔									
0000121-75-5	Malathion						✔							
0000078-48-8	S,S,S-Tributyltrithiophosphate				✔									
0000093-65-2	Mecoprop				✔									
0000075-87-6	Acetaldehyde, trichloro-				✔									
0000062-74-8	Sodium fluoroacetate				✔									
0000062-38-4	Phenylmercuric acetate				✔									
0000057-24-9	Strychnine				✔									
0000056-53-1	Diethylstilbestrol								✔		✔			✔
0000056-49-5	3-Methylcholanthrene							✔	✔		✔	✔		✔
0000056-35-9	Bis(tributyltin) oxide				✔									
0000081-81-2	Warfarin				✔									
0000101-61-1	4,4'-Methylenebis(N,N-dimethyl)benzenamine		✔											
0000121-44-8	Triethylamine					✔								
0000118-96-7	2,4,6-Trinitrotoluene		✔		✔									
0000765-34-4	Glycidylaldehyde				✔									
0000107-19-7	Propargyl alcohol				✔									
0000924-16-3	N-Nitrosodi-n-butylamine		✔	✔						✔				
0000087-82-1	Hexabromobenzene				✔									
0000103-33-3	Azobenzene		✔	✔										
0000093-76-5	2,4,5-T acid				✔									
0000099-35-4	1,3,5-Trinitrobenzene				✔									
0000097-63-2	Ethyl methacrylate									✔			✔	
0000095-65-8	3,4 Dimethylphenol				✔									
0000095-57-8	2-Chlorophenol				✔					✔			✔	
0000094-82-6	2,4-DB				✔									
0000094-74-6	Methoxone				✔									
0000094-59-7	Safrole									✔				
0000106-37-6	1,4 Dibromobenzene				✔									
0022967-92-6	Methyl mercury				✔									
0033089-61-1	Amitraz				✔									
0000822-06-0	Hexamethylene-1,6-diisocyanate					✔								
0032534-81-9	Pentabromodiphenyl ether				✔									
0030560-19-1	Acephate		✔		✔									
0029232-93-7	Pirimiphos methyl				✔									
0028249-77-6	Thiobencarb				✔									
0012035-72-2	Nickel subsulfide			✔										
0025057-89-0	Bentazon				✔									
0035554-44-0	Imazalil				✔									
0022224-92-6	Fenamiphos				✔									
0020859-73-8	Aluminum phosphide				✔									
0019666-30-9	Oxydiazon				✔									
0019408-74-3	Hexachlorodibenzo p dioxin, mixture (HxCDD)		✔	✔										
0015972-60-8	Alachlor				✔									
0013593-03-8	Quinalphos				✔									
0000834-12-8	Ametryn				✔									
0026628-22-8	Sodium azide (Na(N3))				✔									

EXHIBIT 4-7 (CONTINUED)
SCREENING OF HIGH-TOXICITY, PERSISTENT, BIOACCUMULATIVE/BIOCONCENTRATING POSSIBLE NON-HAZARDOUS WASTE CONSTITUENTS AGAINST TRI RELEASE VOLUMES

Chemical CAS	Chemical Name	Release Volume	Oral CSF	Inhalation Unit Risk	Oral RfD < 50th	RfC < 50th	AWQC (Chronic) < 50th	Degradation Rate for Water Column	Fish BCF	Henry's Law Constant	Kow	Soil Degradation Rate	Vapor Pressure > 1_3e-3	Beef Biotransfer Factor >7_8e-4
0067747-09-5	Prochloraz		✔		✔									
0085509-19-9	NuStar				✔									
0077501-63-4	Lactofen				✔									
0077182-82-2	Glufosinate ammonium				✔									
0076578-14-8	Quizalofop-ethyl				✔									
0072178-02-0	Fomesafen		✔											
0069806-40-2	Haloxyfop methyl				✔									
0032536-52-0	Octabromodiphenyl ether				✔									
0068085-85-8	Cyhalothrin				✔									
0039638-32-9	Bis(2-chloroisopropyl) ether									✔				
0067485-29-4	Hydramethylnon				✔									
0065195-55-3	Avermectin B1				✔									
0062476-59-9	Acifluorfen, sodium salt				✔									
0060568-05-0	Furmecyclox		✔											
0060207-90-1	Propiconazole				✔									
0055285-14-8	Carbosulfan				✔									
0042874-03-3	Oxyfluorfen				✔									
0069409-94-5	Fluvalinate				✔									
0001314-84-7	Zinc phosphide				✔									
0002385-85-5	Mirex				✔		✔							
0002303-16-4	Diallate								✔					
0002104-64-5	EPN				✔									
0001929-77-7	Carbamothioic acid, dipropyl-, S-propyl ester				✔									
0001918-16-7	Propachlor				✔									
0001646-88-4	Aldicarb sulfone				✔									
0002425-06-1	Captafol				✔									
0001309-64-4	Antimony trioxide					✔								
0001116-54-7	N-Nitrosodiethanolamine		✔											
0000950-37-8	Methidathion				✔									
0000944-22-9	Fonofos				✔									
0000930-55-2	N-Nitrosopyrrolidine		✔	✔										
0101200-48-0	Tribenuron methyl				✔									
0000886-50-0	Terbutryn				✔									
0000055-18-5	N-Nitrosodiethylamine		✔	✔									✔	
0001910-42-5	Paraquat dichloride				✔									
0007791-12-0	Thallium chloride TlCl				✔									
0010595-95-6	N-Nitrosomethylethylamine		✔										✔	
0010265-92-6	Methamidophos				✔									
0010102-45-1	Thallium(I) nitrate				✔									
0002303-17-5	Triallate				✔									
0008065-48-3	Demeton				✔		✔							
0002439-10-3	Dodine				✔									
0007784-42-1	Arsine					✔								
0007783-00-8	Selenious acid				✔									
0007487-94-7	Mercuric chloride				✔									
0007446-18-6	Thallium(I) sulfate				✔									
0007287-19-6	Prometryn				✔									
0006533-73-9	Thallium(I) carbonate				✔									
0005902-51-2	Terbacil				✔									
0002921-88-2	Chlorpyrifos				✔		✔							
0010061-01-5	cis-1,3-Dichloropropene									✔			✔	

EXHIBIT 4-8 POSSIBLE NON-HAZARDOUS INDUSTRIAL WASTE CONSTITUENTS BY CHEMICAL CLASS

Metals / Inorganics	Volatile Chlorinated Organics	Volatile Hydrocarbons	Other Volatile Organics	Pesticides/Intermediates/Degradation Products		Phenolic Compounds	Polycyclic Aromatic Hydrocarbons	Other Semivolatile Organics
Antimony trioxide	1,1,2 Trichloropropane	1,3-Butadiene	1,4 Dithiane	2,4,5-T acid	Imazalil	2,6-Dimethylphenol	3-Methylcholanthrene	1,2,4 Tribromobenzene
Arsine	2,3 Dichloropropanol		Azobenzene	2,4-DB	Kepone	2-Chlorophenol		1,3,5-Trinitrobenzene
Chlorine dioxide	Acetaldehyde, trichloro-		Glycol Ethers	Acephate	Lactofen	2-Cyclohexyl-4,6-dinitrophenol		1,3-Phenylenediamine
Copper	Bis(2-chloroisopropyl) ether		Methyl mercury	Acifluorfen, sodium salt	Linuron	3,4 Dimethylphenol		1,4 Dibromobenzene
Cyanide	Chloroprene		N-Nitrosodi-n-butylamine	Alachlor	Malathion	Dinitrobutyl phenol		2,4,6-Trinitrotoluene
Manganese	cis-1,3-Dichloropropene		N-Nitrosodi-n-propylamine	Aldicarb sulfone	Mecoprop			2-Chloroacetophenone
Mercuric chloride	Freon 113		N-Nitrosodiethanolamine	Aluminum phosphide	Merphos			4,4'-Methylenebis(N,N-dimethyl)benzenamine
Nickel subsulfide			N-Nitrosodiethylamine	Ametryn	Methamidophos			Avermectin B1
Selenious acid			N-Nitrosomethylethylamine	Amitraz	Methidathion			Cyclotrimethylene trinitramine
Sodium azide (Na(N3))			Propargyl alcohol	Aramite	Methoxone			Diethylstilbestrol
Thallium(I) chloride			Propylene oxide	Azinphos-methyl	Mirex			Ethyl methacrylate
Thallium(I) acetate			Tetraethyl lead	Bentazon	N-Nitrosopyrrolidine			Glycidylaldehyde
Thallium(I) carbonate			Triethylamine	Bis(tributyltin) oxide	Naled			Hexabromobenzene
Thallium(I) nitrate				Captafol	NuStar			Hexachlorodibenzo p dioxin, mixture
Thallium(I) sulfate				Carbamothioic acid, dipropyl-, S-propyl ester	Oxydiazon			Hexamethylene-1,6-diisocyanate
Zinc				Carbosulfan	Oxyfluorfen			Octabromodiphenyl ether
				Chlorobenzilate	Paraquat dichloride			Pentabromodiphenyl ether
				Chlorpyrifos	Phenylmercuric acetate			Propiconazole
				Cyhalothrin	Pirimiphos methyl			Safrole
				Demeton	Prochloraz			Tris(2,3-dibromopropyl) phosphate
				Diallate	Prometryn			
				Dicrotophos	Propachlor			
				Diquat	Propanil			
				Diuron	Quinalphos			
				Dodine	Quizalofop-ethyl			
				EPN	Rotenone, Commercial			
				Ethion	S,S,S-Tributyltrithiophosphate			
				Fenamiphos	Simazine			
				Fluvalinate	Sodium fluoroacetate			
				Folpet	Strychnine			
				Fomesafen	Terbacil			
				Fonofos	Terbutryn			
				Furmecyclox	Thiobencarb			
				Glufosinate ammonium	Triallate			
				Haloxyfop methyl	Tribenuron methyl			
				Hexachlorocyclohexane	Warfarin			
				Hexachlorophene	Zinc phosphide			
				Hydramethylnon				
12[1]	7	1	13	75		5	1	20

Notes:
1. All thallium salts are counted as one entry.

EXHIBIT 4-9 SCREENING OF KNOWN NON-HAZARDOUS WASTE CONSTITUENTS AGAINST TRI RELEASE VOLUMES

Chemical CAS	Chemical Name	Release Volume	Oral CSF	Inhalation Unit Risk	Oral RfD < 50th	RfC < 50th	Beef Biotransfer Factor >7_8e-4	AWQC (Chronic) < 50th	Degradation Rate for Water Column	Fish BAF	Fish BCF	Henry's Law Constant	Kow	Soil Degradation Rate	Vapor Pressure > 1_3e-3
0000067-56-1	Methanol	255,766,934										✔			✔
0000108-88-3	Toluene	168,958,681										✔			✔
0001330-20-7	Xylene (mixed isomers)	108,936,037										✔			✔
0000075-15-0	Carbon disulfide	83,384,729										✔			✔
----	Zinc compounds	81,764,720							✔					✔	
0000075-09-2	Dichloromethane	63,774,566	✔	✔								✔			✔
----	Glycol Ethers	48,991,927													
----	Copper compounds	47,115,338						✔	✔					✔	
----	Manganese compounds	41,504,786							✔					✔	
0000100-42-5	Styrene	40,156,848										✔			✔
0000071-55-6	1,1,1-Trichloroethane	38,056,891										✔			✔
0000071-36-3	n-Butyl alcohol	30,081,146													✔
0000108-10-1	Methyl isobutyl ketone	25,501,571										✔			✔
0000050-00-0	Formaldehyde	19,755,899		✔								✔			✔
0000075-05-8	Acetonitrile	18,264,054			✔							✔			✔
0000075-07-0	Acetaldehyde	13,052,168		✔		✔									
0000100-41-4	Ethylbenzene	12,802,139										✔			✔
0000064-18-6	Formic acid	11,267,572													✔
0007440-66-6	Zinc	10,155,449							✔					✔	
0007439-96-5	Manganese	9,354,553				✔									
0000079-10-7	Acrylic acid	6,915,166				✔									
0000107-13-1	Acrylonitrile	6,379,861	✔	✔		✔						✔			✔
0000079-06-1	Acrylamide	5,217,625	✔	✔	✔										
0000074-87-3	Chloromethane	5,174,937										✔			✔
0000075-71-8	Dichlorodifluoromethane	4,872,594										✔			✔
----	Cyanide compounds	4,382,509						✔							
0000091-20-3	Naphthalene	3,230,142										✔			
0000074-90-8	Hydrogen cyanide	3,143,253				✔									
0000075-69-4	Trichlorofluoromethane	2,994,474										✔			✔
0000074-83-9	Bromomethane	2,669,788			✔	✔						✔			✔
0000080-62-6	Methyl methacrylate	2,583,587										✔			✔
0007440-50-8	Copper	2,204,032					✔		✔					✔	
0000098-82-8	Cumene	2,057,269										✔			✔
0000062-53-3	Aniline	1,976,326	✔			✔									
----	Nickel compounds	1,665,815		✔					✔					✔	
----	Antimony compounds	1,445,522			✔			✔	✔					✔	

EXHIBIT 4-9 (CONTINUED)
SCREENING OF KNOWN NON-HAZARDOUS WASTE CONSTITUENTS AGAINST TRI RELEASE VOLUMES

Chemical CAS	Chemical Name	Release Volume	Oral CSF	Inhalation Unit Risk	Oral RfD < 50th	RfC < 50th	Beef Biotransfer Factor >7_8e-4	AWQC (Chronic) < 50th	Degradation Rate for Water Column	Fish BAF	Fish BCF	Henry's Law Constant	Kow	Soil Degradation Rate	Vapor Pressure > 1_3e-3
0000107-02-8	Acrolein	170,087				✔						✔			✔
0007440-36-0	Antimony	128,663			✔		✔		✔					✔	
0000099-65-0	m-Dinitrobenzene	100,719			✔										
0000074-95-3	Methylene bromide	77,545										✔			✔
0007723-14-0	Phosphorus	50,768			✔										
0007440-62-2	Vanadium (fume or dust)	41,023					✔		✔					✔	
0000079-46-9	2-Nitropropane	40,523										✔			✔
0000051-28-5	2,4-Dinitrophenol	39,344			✔										
0000542-75-6	1,3-Dichloropropylene	24,756			✔							✔			✔
0007440-41-7	Beryllium	23,795	✔	✔	✔		✔		✔					✔	
0000075-34-3	Ethylidene Dichloride	23,492										✔			✔
0000100-44-7	Benzyl chloride	23,331	✔									✔			✔
0000106-93-4	1,2-Dibromoethane	18,537	✔	✔								✔			✔
0000302-01-2	Hydrazine	16,956	✔	✔											
0000120-83-2	2,4-Dichlorophenol	14,760			✔										
0000079-34-5	1,1,2,2-Tetrachloroethane	14,027	✔	✔								✔			✔
0000630-20-6	1,1,1,2-Tetrachloroethane	11,746	✔	✔								✔			✔
0000077-47-4	Hexachlorocyclopentadiene	9,174			✔		✔	✔			✔	✔	✔		
0000111-44-4	Bis(2-chloroethyl) ether	3,237	✔	✔								✔			✔
0000137-26-8	Thiram	3,184			✔										
0000098-07-7	Benzoic trichloride	2,868	✔												
0000056-38-2	Parathion	1,147						✔							
0007440-28-0	Thallium	1,010					✔		✔					✔	
0000075-27-4	Dichlorobromomethane	0	✔									✔			✔
0000086-30-6	N-Nitrosodiphenylamine	0	✔									✔			
0001336-36-3	Polychlorinated biphenyls	0	✔				✔	✔				✔	✔		
0000096-18-4	1,2,3-Trichloropropane				✔							✔			✔
0000095-94-3	1,2,4,5-Tetrachlorobenzene				✔		✔			✔		✔			
0000096-12-8	1,2-Dibromo-3-chloropropane					✔						✔			
0000156-60-5	1,2-Dichloroethylene, trans											✔			✔
0000122-66-7	1,2-Diphenylhydrazine		✔	✔											
0000058-90-2	2,3,4,6-Tetrachlorophenol										✔	✔			
0001746-01-6	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)		✔				✔	✔	✔				✔	✔	
0000057-97-6	7,12-Dimethylbenz[a]anthracene						✔						✔		
0000083-32-9	Acenaphthene											✔			
0000067-64-1	Acetone											✔			✔
0000116-06-3	Aldicarb				✔										
0000309-00-2	Aldrin		✔	✔	✔		✔		✔		✔	✔	✔	✔	
0000959-98-8	alpha - Endosulfan							✔							
0000319-84-6	alpha-Hexachlorocyclohexane		✔	✔						✔					
0000056-55-3	Benz[a]anthracene						✔		✔				✔	✔	
0000218-01-9	Benzo(a)phenanthrene						✔		✔				✔	✔	
0000050-32-8	Benzo[a]pyrene		✔				✔		✔				✔	✔	
0000205-99-2	Benzo[b]fluoranthene						✔		✔			✔	✔	✔	
0033213-65-9	beta - Endosulfan							✔							

EXHIBIT 4-9 (CONTINUED)
SCREENING OF KNOWN NON-HAZARDOUS WASTE CONSTITUENTS AGAINST TRI RELEASE VOLUMES

Chemical CAS	Chemical Name	Release Volume	Oral CSF	Inhalation Unit Risk	Oral RfD < 50th	RfC < 50th	Beef Biotransfer Factor >7_8e-4	AWQC (Chronic) < 50th	Degradation Rate for Water Column	Fish BAF	Fish BCF	Henry's Law Constant	Kow	Soil Degradation Rate	Vapor Pressure > 1_3e-3
0000319-85-7	beta-BHC		✔	✔						✔					
0000075-25-2	Bromoform		✔	✔								✔			✔
0000085-68-7	Butyl benzyl phthalate						✔				✔				
0001563-66-2	Carbofuran				✔										
0000124-48-1	Chlorodibromomethane		✔									✔			✔
0018540-29-9	Chromium(VI)			✔	✔										
0000156-59-2	cis-1,2-Dichloroethylene											✔			✔
0008007-45-2	Coal tars			✔											
0000544-92-3	Copper cyanide				✔										
0000057-12-5	Cyanides (soluble salts and complexes)							✔							
0000072-54-8	DDD		✔				✔		✔		✔		✔	✔	
0000072-55-9	DDE		✔				✔		✔	✔		✔	✔	✔	
0000050-29-3	DDT		✔	✔	✔		✔	✔	✔	✔		✔	✔	✔	
0000053-70-3	Dibenz[a,h]anthracene						✔		✔				✔	✔	
0000060-57-1	Dieldrin		✔	✔	✔		✔	✔	✔		✔		✔	✔	
0000060-51-5	Dimethoate				✔										
0000298-04-4	Disulfoton				✔										
0000115-29-7	Endosulfan				✔			✔				✔			
0000060-29-7	Ethane, 1,1'-oxybis-											✔			✔
0000141-78-6	Ethyl acetate											✔			✔
0000206-44-0	Fluoranthene						✔						✔		
0000086-73-7	Fluorene											✔			
0000110-00-9	Furan				✔							✔			✔
0000098-01-1	Furfural				✔										
0007783-06-4	Hydrogen sulfide				✔	✔		✔							
0000193-39-5	Indeno(1,2,3-cd)pyrene						✔		✔				✔	✔	
0000078-83-1	Isobutyl alcohol											✔			✔
0000078-59-1	Isophorone		✔												
0000298-00-0	Methyl parathion				✔										
0002212-67-1	Molinate				✔										
0007439-98-7	Molybdenum				✔		✔		✔					✔	
0000117-84-0	n-Dioctylphthalate						✔					✔	✔		
0000062-75-9	N-Nitrosodimethylamine		✔	✔											✔
0000106-47-8	p-Chloroaniline				✔							✔			✔
0000608-93-5	Pentachlorobenzene				✔		✔				✔	✔	✔		
0000298-02-2	Phorate											✔			
0007803-51-2	Phosphine				✔	✔									
0000129-00-0	Pyrene						✔		✔				✔	✔	
0003689-24-5	Sulfotep				✔										
0010061-02-6	trans-1,3-Dichloropropene											✔			✔
0001314-62-1	Vanadium pentoxide				✔										

EXHIBIT 4-10 TOXICITY SUMMARY OF KNOWN AND POSSIBLE NON-HAZARDOUS INDUSTRIAL WASTE CONSTITUENTS

Inhalation Unit Risk (All)	Inhalation Unit Risk > 50th Percentile	Oral CSF (All)	Oral CSF > 50th Percentile	Oral RfD < 50th Percentile	Oral RfD < 50th Percentile (Continued)	AWQC (Chronic Freshwater) < 50th Percentile
1,1,1,2-Tetrachloroethane	Acrylamide	1,1,1,2-Tetrachloroethane	1,2-Dibromoethane	1,1,2 Trichloropropane	Glycidylaldehyde	2,3,7,8-TCDD
1,1,2,2-Tetrachloroethane	Aldrin	1,1,2,2-Tetrachloroethane	1,2-Diphenylhydrazine	1,1,2-Trichloroethane	Haloxyfop methyl	alpha - Endosulfan
1,1,2-Trichloroethane	alpha-Hexachlorocyclohexane	1,1,2-Trichloroethane	2,3,7,8-TCDD	1,2,3-Trichloropropane	Hexabromobenzene	Antimony
1,2-Dibromoethane	Benzidine	1,2-Dibromoethane	Acrylamide	1,2,4 Tribromobenzene	Hexachlorocyclopentadiene	Azinphos-methyl
1,2-Diphenylhydrazine	Beryllium	1,2-Diphenylhydrazine	Acrylonitrile	1,2,4,5-Tetrachlorobenzene	Hexachloroethane	beta - Endosulfan
1,3-Butadiene	beta-BHC	1,4-Dioxane	Aldrin	1,2,4-Trichlorobenzene	Hydramethylnon	Chlorpyrifos
Acetaldehyde	Bis(2-chloroethyl) ether	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	alpha-Hexachlorocyclohexane	1,3,5-Trinitrobenzene	Hydrogen sulfide	Copper
Acrylamide	Coal tars	2,4,6-Trinitrotoluene	Benzo[a]pyrene	1,3-Dichloropropylene	Imazalil	Cyanides (soluble salts and complexes)
Acrylonitrile	Dieldrin	4,4'-Methylenebis(N,N-dimethyl)benzenamine	Benzoic trichloride	1,3-Phenylenediamine	Lactofen	DDT
Aldrin	Hexachlorocyclohexane	Acephate	Beryllium	1,4 Dibromobenzene	Linuron	Demeton
alpha-Hexachlorocyclohexane	HxCDD, mixture	Acrylamide	beta-BHC	1,4 Dithiane	m-Dinitrobenzene	Dieldrin
Aramite	Hydrazine	Acrylonitrile	Bis(2-chloroethyl) ether	2,3 Dichloropropanol	Mecoprop	Endosulfan
Azobenzene	N-Nitrosodi-n-butylamine	Aldrin	DDE	2,4,5-T acid	Mercuric chloride	Hexachlorocyclopentadiene
Beryllium	N-Nitrosodiethylamine	alpha-Hexachlorocyclohexane	DDT	2,4,6-Trinitrotoluene	Merphos	Hydrogen sulfide
beta-BHC	N-Nitrosodimethylamine	Aniline	Dieldrin	2,4-DB	Methamidophos	Malathion
Bis(2-chloroethyl) ether	N-Nitrosopyrrolidine	Aramite	Hexachlorocyclohexane	2,4-Dichlorophenol	Methidathion	Mirex
Bis(chloromethyl) ether	Nickel subsulfide	Azobenzene	HxCDD, mixture	2,4-Dinitrophenol	Methoxone	Parathion
Bromoform		Benzo[a]pyrene	Hydrazine	2,6-Dimethylphenol	Methyl mercury	Polychlorinated biphenyls
Coal tars		Benzoic trichloride	N-Nitrosodi-n-butylamine	2-Chlorophenol	Methyl parathion	
DDT		Benzyl chloride	N-Nitrosodi-n-propylamine	2-Cyclohexyl-4,6-dinitrophenol	Mirex	
Dichloromethane		Beryllium	N-Nitrosodiethanolamine	3,4 Dimethylphenol	Molinate	
Dieldrin		beta-BHC	N-Nitrosodiethylamine	Acephate	Molybdenum	
Epichlorohydrin		Bis(2-chloroethyl) ether	N-Nitrosodimethylamine	Acetaldehyde, trichloro-	Naled	
Formaldehyde		Bromoform	N-Nitrosomethylethylamine	Acetonitrile	NuStar	
Hexachlorocyclohexane		Chlorodibromomethane	N-Nitrosopyrrolidine	Acifluorfen, sodium salt	Octabromodiphenyl ether	
Hexachlorodibenzo p dioxin, mixture (HxCDD)		Cyclotrimethylene trinitramine	Polychlorinated biphenyls	Acrylamide	Oxydiazon	
Hydrazine		DDD	Vinylidene chloride	Alachlor	Oxyfluorfen	
Nickel compounds		DDE		Aldicarb	p-Chloroaniline	
N-Nitrosodi-n-butylamine		DDT		Aldicarb sulfone	Paraquat dichloride	
N-Nitrosodiethylamine		Di(2-ethylhexyl) phthalate		Aldrin	Pentabromodiphenyl ether	
N-Nitrosodimethylamine		Dichlorobromomethane		Allyl alcohol	Pentachlorobenzene	
N-Nitrosopyrrolidine		Dichloromethane		Aluminum phosphide	Phenylmercuric acetate	
Nickel subsulfide		Dieldrin		Ametryn	Phosphine	
Propylene oxide		Epichlorohydrin		Amitraz	Phosphorus	
Vinylidene chloride		Folpet		Antimony	Pirimiphos methyl	
		Fomesafen		Avermectin B1	Prochloraz	
		Furmecyclox		Bentazon	Prometryn	
		Hexachlorocyclohexane		Beryllium	Propachlor	
		Hexachlorodibenzo p dioxin, mixture (HxCDD)		Bis(tributyltin) oxide	Propanil	
		Hydrazine		Bromomethane	Propargyl alcohol	
		Isophorone		Captafol	Propiconazole	
		N-Nitrosodi-n-butylamine		Carbamothioic acid, dipropyl-, S-propyl ester	Quinalphos	
		N-Nitrosodi-n-propylamine		Carbofuran	Quizalofop-ethyl	
		N-Nitrosodiethanolamine		Carbosulfan	Rotenone, Commercial	
		N-Nitrosodiethylamine		Chlorpyrifos	S,S,S-Tributyltrithiophosphate	
		N-Nitrosodimethylamine		Copper cyanide	Selenious acid	
		N-Nitrosodiphenylamine		Cyclotrimethylene trinitramine	Simazine	
		N-Nitrosomethylethylamine		Cyhalothrin	Sodium azide (Na(N3))	
		N-Nitrosopyrrolidine		DDT	Sodium fluoroacetate	
		Polychlorinated biphenyls		Demeton	Strychnine	
		Prochloraz		Dicrotophos	Sulfotep	
		Propylene oxide		Dieldrin	Terbacil	
		Vinylidene chloride		Dimethoate	Terbutryn	
				Dinitrobutyl phenol	Tetraethyl lead	
				Diquat	Thallium chloride TlCl	
				Disulfoton	Thallium(I) acetate	
				Diuron	Thallium(I) carbonate	
				Dodine	Thallium(I) nitrate	
				Endosulfan	Thallium(I) sulfate	
				EPN	Thiobencarb	
				Ethion	Thiram	
				Fenamiphos	Triallate	
				Fluvalinate	Tribenuron methyl	
				Fonofos	Vanadium pentoxide	
				Furan	Vinylidene chloride	
				Furfural	Warfarin	
				Glufosinate ammonium	Zinc phosphide	

EXHIBIT 4-12 TRI RELEASES AND NON-CONFIDENTIAL TSCA PRODUCTION VOLUME DATA FOR THE KNOWN AND POSSIBLE NON-HAZARDOUS INDUSTRIAL WASTE CONSTITUENTS

Chemical CAS	Chemical Name	1994 TRI Release Volume > 1 million lbs.	1994 Non-Confidential TSCA Production Volume > 1 million lbs.
Known Chemicals			
0000071-55-6	1,1,1-Trichloroethane	X	
0000079-00-5	1,1,2-Trichloroethane		X
0000095-63-6	1,2,4-Trimethylbenzene	X	
0000107-06-2	1,2-Dichloroethane	X	
0000542-75-6	1,3-Dichloropropylene		X
0000075-07-0	Acetaldehyde	X	
0000075-05-8	Acetonitrile	X	X
0000079-06-1	Acrylamide	X	X
0000079-10-7	Acrylic acid	X	
0000107-13-1	Acrylonitrile	X	
0007429-90-5	Aluminum (fume or dust)	X	
0007664-41-7	Ammonia	X	
0000062-53-3	Aniline	X	
----	Antimony compounds	X	
0000071-43-2	Benzene	X	
0000074-83-9	Bromomethane	X	CBI
0000075-15-0	Carbon disulfide	X	
0000056-23-5	Carbon tetrachloride		X
0007782-50-5	Chlorine	X	
0000108-90-7	Chlorobenzene	X	
0000075-00-3	Chloroethane	X	
0000067-66-3	Chloroform	X	X
0000074-87-3	Chloromethane	X	
0007440-47-3	Chromium	X	
0007440-50-8	Copper	X	
0008001-58-9	Creosote	X	
0001319-77-3	Cresol (mixed isomers)	X	
0000098-82-8	Cumene	X	
----	Cyanide compounds	X	
0000075-71-8	Dichlorodifluoromethane	X	
0000075-09-2	Dichloromethane	X	
0000100-41-4	Ethylbenzene	X	
0000107-21-1	Ethylene glycol	X	
0000050-00-0	Formaldehyde	X	
0000064-18-6	Formic acid	X	
----	Glycol Ethers	X	
0000067-72-1	Hexachloroethane		X
0000074-90-8	Hydrogen cyanide	X	
0007664-39-3	Hydrogen fluoride	X	
0007783-06-4	Hydrogen sulfide		X
0007439-96-5	Manganese	X	
0000067-56-1	Methanol	X	
0000078-93-3	Methyl ethyl ketone	X	
0000108-10-1	Methyl isobutyl ketone	X	
0000080-62-6	Methyl methacrylate	X	
0000071-36-3	n-Butyl alcohol	X	
0000091-20-3	Naphthalene	X	
----	Nickel compounds	X	
0000095-47-6	o-Xylene	X	
0000106-42-3	p-Xylene	X	
0000108-95-2	Phenol	X	
0000100-42-5	Styrene	X	
0000127-18-4	Tetrachloroethylene	X	X
0000108-88-3	Toluene	X	
0000079-01-6	Trichloroethylene	X	
0000075-69-4	Trichlorofluoromethane	X	
0000108-05-4	Vinyl acetate	X	
0000075-01-4	Vinyl chloride	X	X
0001330-20-7	Xylene (mixed isomers)	X	
0007440-66-6	Zinc	X	
Possible Chemicals			
0000106-99-0	1,3-Butadiene	X	
0000576-26-1	2,6-Dimethylphenol		X
0001332-21-4	Asbestos (friable)		X
0010049-04-4	Chlorine dioxide	X	
0000126-99-8	Chloroprene	X	
0000121-82-4	Cyclotrimethylene trinitramine		X
0000076-13-1	Freon 113	X	
0000121-69-7	N,N-Dimethylaniline		X
0000075-56-9	Propylene oxide	X	

EXHIBIT 4-13 VOLATILITY, PERSISTENCE, AND BIOACCUMULATION/BIOCONCENTRATION SUMMARY POTENTIAL OF KNOWN AND POSSIBLE NON-HAZARDOUS INDUST

Vapor Pressure > 1.3e-3 atm.	Air Half-Life > 75th Percentile	Low Soil/Water Degradation Constant (< 0.5)	Kow >10^5	High Fish BAF (>1000)	High Fish BCF (>1000)
1,1,1,2-Tetrachloroethane	Dichloromethane	1,2-Dichloropropane	2,3,7,8-TCDD	1,2,4,5-Tetrachlorobenzene	2,3,4,6-Tetrachlorophenol
1,1,1-Trichloroethane	Polychlorinated biphenyls	2,3,7,8-TCDD	3-Methylcholanthrene	alpha-Hexachlorocyclohexane	3-Methylcholanthrene
1,1,2,2-Tetrachloroethane		3-Methylcholanthrene	7,12-Dimethylbenz[a]anthracene	beta-BHC	Aldrin
1,1,2-Trichloroethane		Aldrin	Aldrin	DDE	Butyl benzyl phthalate
1,2,3-Trichloropropane		Antimony	Benz[a]anthracene	DDT	Chlorobenzilate
1,2-Dibromoethane		Benz[a]anthracene	Benzo(a)phenanthrene		DDD
1,2-Dichlorobenzene		Benzo(a)phenanthrene	Benzo[a]pyrene		Diallate
1,2-Dichloroethylene, trans		Benzo[a]pyrene	Benzo[b]fluoranthene		Dibutyl phthalate
1,2-Dichloropropane		Benzo[b]fluoranthene	DDD		Dieldrin
1,3-Dichloropropylene		Beryllium	DDE		Diethylstilbestrol
1,4-Dioxane		Copper	DDT		Hexachlorocyclopentadiene
2-Chlorophenol		DDD	Di(2-ethylhexyl) phthalate		Kepone
2-Ethoxyethanol		DDE	Dibenz[a,h]anthracene		Pentachlorobenzene
2-Nitropropane		DDT	Dieldrin		
Acetone		Dibenz[a,h]anthracene	Diethylstilbestrol		
Acetonitrile		Dieldrin	Fluoranthene		
Acrolein		Indeno(1,2,3-cd)pyrene	Hexachlorocyclopentadiene		
Acrylonitrile		Kepone	Indeno(1,2,3-cd)pyrene		
Allyl chloride		Manganese	Kepone		
Benzyl chloride		Molybdenum	n-Dioctylphthalate		
Bis(2-chloroethyl) ether		Nickel	Pentachlorobenzene		
Bromoform		Pyrene	Polychlorinated biphenyls		
Bromomethane		Thallium	Pyrene		
Carbon disulfide		Vanadium (fume or dust)			
Chlorodibromomethane		Zinc			
Chloromethane					
Chloroprene					
cis-1,2-Dichloroethylene					
cis-1,3-Dichloropropene					
Cumene					
Dichlorobromomethane					
Dichlorodifluoromethane					
Dichloromethane					
Epichlorohydrin					
Ethane, 1,1'-oxybis-					
Ethyl acetate					
Ethyl methacrylate					
Ethylbenzene					
Ethylidene Dichloride					
Formaldehyde					
Formic acid					
Freon 113					
Furan					
Isobutyl alcohol					
Methanol					
Methyl isobutyl ketone					
Methyl methacrylate					
Methylene bromide					
n-Butyl alcohol					
N-Nitrosodi-n-propylamine					
N-Nitrosodiethylamine					
N-Nitrosodimethylamine					
N-Nitrosomethylethylamine					
p-Chloroaniline					
Styrene					
Toluene					
trans-1,3-Dichloropropene					
Trichlorofluoromethane					
Vinylidene chloride					
Xylene (mixed isomers)					

TRIAL WASTE CONSTITUENTS

Beef Biotransfer Factor > 7.8e-4
1,2,4,5-Tetrachlorobenzene
2,3,7,8-TCDD
3-Methylcholanthrene
7,12-Dimethylbenz[a]anthracene
Aldrin
Antimony
Benz[a]anthracene
Benzo(a)phenanthrene
Benzo[a]pyrene
Benzo[b]fluoranthene
Beryllium
Butyl benzyl phthalate
Copper
DDD
DDE
DDT
Di(2-ethylhexyl) phthalate
Dibenz[a,h]anthracene
Dibutyl phthalate
Dieldrin
Diethylstilbestrol
Fluoranthene
Hexachlorocyclopentadiene
Indeno(1,2,3-cd)pyrene
Kepone
Molybdenum
n-Dioctylphthalate
Nickel
Pentachlorobenzene
Polychlorinated biphenyls
Pyrene
Thallium
Vanadium (fume or dust)

EXHIBIT 4-16 LOWEST PROPOSED EXIT LEVELS FOR CHEMICALS

Constituent	Lowest Exit Level for chemicals from HWIR waste models (mg/L)	Model
1,1,1,2-Tetrachloroethane	0.0078	Groundwater
1,1,1-Trichloroethane	0.0539	Groundwater
1,1,2,2-Tetrachloroethane	**0.0037**	**Direct inhalation**
1,1,2-Trichloroethane	0.0018	Groundwater
1,2,3-Trichloropropane	0.34	Groundwater
1,2,4,5-Tetrachlorobenzene	0.0317	Groundwater
1,2,4-Trichlorobenzene	**0.685**	**Direct inhalation**
1,2-Dibromo-3-chloropropane	0.000114	Groundwater
1,2-Dichlorobenzene	6.1	Groundwater
1,2-Dichloropropane	0.0023	Groundwater
1,3,5-Trinitrobenzene	0.003	Groundwater
1,3-Dichloropropylene (1,3-Dichloropropene)	0.00085	Groundwater
1,3-Phenylenediamine	0.3	Groundwater
1,4-Dioxane	0.0136	Groundwater
2,3,4,6-Tetrachlorophenol	0.58	Groundwater
2,3,7,8-TCDD	1.78E-10	Groundwater
2,4,5-T acid	0.64	Groundwater
2,4-Dichlorophenol	0.18	Groundwater
2,4-Dimethylphenol	1.19	Groundwater
2,4-Dinitrophenol	0.105	Groundwater
2,6-Dinitrotoluene	0.064	Groundwater
2-Chlorophenol	0.32	Groundwater
2-Ethoxyethanol	**14.7**	**Direct inhalation**
2-Nitropropane	**0.00019**	**Direct inhalation-worker**
3,3'-Dimethoxybenzidine	0.0102	Groundwater
3-Methylcholanthrene	1.41E-06	Groundwater
7,12-Dimethylbenz[a]anthracene	2.76E-06	Groundwater
Acenaphthene	4.9	Groundwater
Acetone	6	Groundwater
Acetonitrile	0.3	Groundwater
Acetophenone	6.4	Groundwater
Acrolein	**0.00248**	**Direct inhalation-worker**
Acrylamide	0.000038	Groundwater
Acrylonitrile	0.00034	Groundwater
Aldrin	**5.64E-07**	**Beef/milk ingestion**
Allyl chloride	**0.0742**	**Direct inhalation**
alpha-Hexachlorocyclohexane	**0.000142**	**Vegetable/root ingestion**
Aniline	0.017	Groundwater
Antimony	0.053	Groundwater
Benz[a]anthracene	4.30E-06	Groundwater
Benzidine	6.80E-07	Groundwater
Benzo(a)pyrene	7.04E-06	Groundwater
Benzo[b]fluoranthene	0.0000661	Groundwater
Benzyl alcohol	15	Groundwater
Benzyl chloride	**1.13**	**Vegetable/root ingestion**
Beryllium	0.00032	Groundwater

EXHIBIT 4-16 (CONTINUED - PAGE 2)
LOWEST PROPOSED EXIT LEVELS FOR CHEMICALS

Constituent	Lowest Exit Level for chemicals from HWIR waste models (mg/L)	Model
beta-BHC	0.00021	Groundwater
Bis(2-chloroethyl) ether	0.00036	Groundwater
Bis(2-chloroisopropyl) ether	0.0019	Groundwater
Bromoform	0.018	Groundwater
Bromomethane (Methyl bromide)	**0.37**	**Direct inhalation**
Butyl benzyl phthalate	64	Groundwater
Carbon disulfide	**0.738**	**Direct inhalation**
Chlorobenzilate	0.0057	Groundwater
Chlorodibromomethane	0.0018	Groundwater
Chloromethane (Methyl chloride)	**0.0959**	**Direct inhalation**
Chloroprene (Chloro-1,3-butadiene, 2-)	**0.515**	**Direct inhalation**
cis-1,2-Dichloroethylene	0.64	Groundwater
cis-1,3-Dichloropropene	0.00485	**Direct inhalation**
Copper	**5.91**	**Ecological (aquatic plants)**
DDD	**0.000126**	**Beef/milk ingestion**
DDE	**9.11E-06**	**Beef/milk ingestion**
DDT	**0.0000181**	**Beef/milk ingestion**
Di(2-ethylhexyl) phthalate (BEHP)	**0.00044**	**Beef/milk ingestion**
Diallate	0.26	**Vegetable/root ingestion**
Dibenz[a,h]anthracene	6.34E-07	Groundwater
Dibutyl Phthalate (Di-n-butyl phthalate)	25.2	Groundwater
Dichlorodifluoromethane	11.9	Groundwater
Dieldrin	**0.000059**	**Beef/milk ingestion**
Diethyl Phthalate	54	Groundwater
Diethylstilbestrol	2.47E-11	**Beef/milk ingestion**
Dimethoate	0.77	Groundwater
Dimethyl Phthalate	**3**	**Multimedia model**
Diphenylamine	2.6	Groundwater
Disulfoton	0.0131	Groundwater
Endosulfan	0.94	Groundwater
Epichlorohydrin	**0.335**	**Direct inhalation-worker**
Ethyl acetate	114	Groundwater
Ethyl methacrylate	6.6	Groundwater
Ethylbenzene	8.1	Groundwater
Fluoranthene	1.74	Groundwater
Fluorene	3.4	Groundwater
Formaldehyde	**0.0158**	**Direct inhalation-worker**
Formic acid	105	Groundwater
Glycidylaldehyde	6.2	Groundwater
Hexachlorocyclopentadiene	**0.00521**	**Direct inhalation**
Hexachlorophene	5.15E-06	**Beef/milk ingestion**
Indeno(1,2,3-cd)pyrene	0.0000241	Groundwater
Isobutyl alcohol	15	Groundwater
Isophorone	0.162	Groundwater
Kepone	0.0000264	**Beef/milk ingestion**

EXHIBIT 4-16 (CONTINUED - PAGE 3)
LOWEST PROPOSED EXIT LEVELS FOR CHEMICALS

Constituent	Lowest Exit Level for chemicals from HWIR waste models (mg/L)	Model
m-Dinitrobenzene (1,3-Dinitrobenzene)	0.0064	Groundwater
Methanol	30	Groundwater
Methyl isobutyl ketone	3	Groundwater
Methyl methacrylate	8.1	Groundwater
Methyl parathion	**0.662**	**Vegetable/root ingestion**
Methylene bromide	0.19	Groundwater
Molybdenum	1.83	Groundwater
n-Dioctyl phthalate	**0.002**	**Beef/milk ingestion**
N-Nitroso-dimethyl amine	3.40E-06	Groundwater
N-Nitrosodi-n-butylamine	0.000036	Groundwater
N-Nitrosodi-n-propylamine	0.000017	Groundwater
N-Nitrosodiethylamine	3.18E-06	Groundwater
N-Nitrosodiphenyl amine	0.046	Groundwater
N-Nitrosomethylethylamine	6.80E-06	Groundwater
N-Nitrosopyrrolidine	0.000068	Groundwater
Naphthalene	2.7	Groundwater
Nickel	4.89	Groundwater
p-Chloroaniline	0.16	Groundwater
Parathion	**0.128**	**Ecological (fish/aquatic organisms)**
Pentachlorobenzene	0.0543	Groundwater
Phenol	32	Groundwater
Phenylmercuric acetate	0.0045	Groundwater
Phorate	**0.106**	**Vegetable/root ingestion**
Polychlorinated biphenyls	4.81E-06	Groundwater
Pyrene	1.69	Groundwater
Safrole	0.00095	Groundwater
Strychnine	0.0041	**Vegetable/root ingestion**
Styrene	15.4	Groundwater
Thallium	0.0192	Groundwater
Toluene	12.6	Groundwater
trans-1,2-Dichloroethylene	1.12	Groundwater
trans-1,3-Dichloropropene	**0.0049**	**Direct inhalation**
Trichlorofluoromethane	16	Groundwater
Tris(2,3-dibromopropyl) phosphate	0.000099	Groundwater
Vanadium (fume or dust)	3.71	Groundwater
Xylenes	**22.4**	**Direct inhalation**
Zinc	38.4	Groundwater

Notes:
Bolded chemicals have the lowest exit level in a non-groundwater pathway

CHAPTER 5. POTENTIAL GAPS ASSOCIATED WITH NATURAL RESOURCE DAMAGES AND LARGE-SCALE ENVIRONMENTAL PROBLEMS

This chapter discusses risks associated with non-hazardous industrial waste management that are not addressed in Chapters 3 or 4. Chapter 3 examined potential gaps inherent in the current hazardous waste characteristics, thereby focusing on the adverse effects that the characteristics were meant to address, namely risks arising primarily from acute events such as fires, explosions, and acute exposures of waste management and transportation workers, and health risks caused by local environmental contamination near waste management units. Chapter 4 examined potential gaps associated with adverse human health or localized ecological effects from constituents not included in the toxicity characteristic. This chapter addresses a third set of risks associated with non-hazardous industrial waste management.

- Section 5.1 addresses the pollution of groundwater by constituents that diminish the value and usability of the resource without threatening human health;

- Section 5.2 addresses damage from non-hazardous industrial waste management to air quality through odors that harm the quality of life but may not have severe health effects; and

- Section 5.3 examines possible contributions to regional and global environmental problems from the management of non-hazardous industrial waste, including: air deposition to the Great Waters, damages from airborne particulates, global climate change, potential damage from endocrine disruptors, red tides, stratospheric ozone depletion, tropospheric ozone and photochemical air pollution, and water pollution.

These environmental problems may or may not meet the RCRA statutory or regulatory definitions of the types of risks that the hazardous waste management program is meant to address.

5.1 Damage to Groundwater Resources

As noted in Chapter 2, the most common and well-documented impact of releases from non-hazardous industrial waste management is groundwater contamination. If contamination is present at high enough concentrations, the use of the groundwater as a water supply for human consumption or other use may result in adverse effects on health. Human health risks associated with exposure to toxic pollutants are not the only concern associated with groundwater contamination, however. Non-toxic pollutants such as iron, chloride, or total dissolved solids may be present in concentrations that damage the aesthetic qualities and usability of the water without posing outright health hazards. In areas where groundwater is used as a drinking water supply, such water pollution must be remediated, limitations must be placed on its use, and/or alternative sources must be found. These actions may be expensive and strain existing water supplies. Where alternative supplies are not economically available, groundwater resources of marginal quality, which do not exceed health-based levels, may continue to be used. Even where the polluted groundwater is not used for drinking water, the value of the resource may decline because it is no longer available for future use as drinking water without remediation.

This non-toxic pollution of groundwater from non-hazardous industrial waste management was found relatively often in the environmental release descriptions summarized in Chapter 2. Seventy-five (84 percent) of the 89 release descriptions with data on regulatory levels had constituents detected at levels exceeding non-health-based or non-ecologically-based standards, principally on aesthetic or usability criteria developed under the Safe Drinking Water Act as Secondary Maximum Contaminant Levels (SMCLs). Releases at 70 of these 75 sites also exceeded health and/or ecological-based standards. Of the 177 non-TC constituents identified in the release case studies, 9 constituents (plus pH and total dissolved solids) have SMCLs. (Some of these constituents also have health-based or ecologically-based levels.) Exhibit 5-1 lists all constituents with SMCLs and shows how frequently they were found among the 89 case studies where concentration and regulatory standards data were available. The most commonly detected constituents, iron, chloride, and manganese, all have SMCLs. Also, all SMCLs, except those for foaming agents, color, and corrosivity, were violated by at least several documented releases. (See Exhibit 2-6 for additional data on the concentrations at which these constituents were detected.)

Exhibit 5-1
Constituents/Properties with SMCLs Found in Release Descriptions

Constituents/Properties	Number of Times Detected	Number of Times Detected Above SMCL
pH	66	24
Iron	54	49
Chloride	52	32
Sulfate	50	29
Total dissolved solids	48	29
Manganese	39	34
Zinc	33	13
Copper	17	2
Aluminum	12	12
Fluorides	12	4
Color	0	0
Corrosivity	0	0
Odor	0	0
Foaming agents	0	0

5.2 Damage to Local Air Quality from Odors

Noxious odors historically have been reported in the vicinity of waste management facilities. Odor problems have caused minor health problems, reduced the quality of life, and reduced property values near such facilities. Information on the extent of such problems from non-hazardous industrial waste management is very limited. Odor problems were reported in several of the release descriptions initially identified by EPA, but these cases were excluded because they did not meet the Agency's strict selection criteria. Only one release description included reports by residents of odor problems. Nevertheless, the case study development methodology may have missed many cases of odor problems from non-hazardous industrial waste management facilities because state regulatory programs largely focus on groundwater concerns. Also, odor problems are often handled at the local level and thus the states may not get involved.

The potential for odor problems clearly exists at non-hazardous industrial waste facilities that manage certain types of wastes. For example, food processing facilities (e.g., slaughterhouses that must dispose of offal and alimentary contents from slaughtered animals) may have odor problems if their air releases are not carefully managed. In addition to food wastes, potential odor problems may arise from chemical wastes. Exhibit 5-2 lists a number of the chemicals identified in the release descriptions (although not necessarily for odor) that have extremely low odor thresholds in either air or water. Ten of these chemicals have threshold odor concentrations in air (the lowest concentrations at which odors can be detected or recognized) of 0.01 mg/m^3 or less, and six of them can be detected by odor in water solutions at concentrations of 0.006 mg/l or less.

Exhibit 5-2
Chemicals from Release Descriptions with Low Odor Thresholds

Chemical Name	Threshold Odor Concentrations in Air (mg/m^3)	Threshold Odor Concentrations in Water (mg/l)
1,2,4-Trichlorobenzene	-	0.005
2,4,6-Trichlorophenol	0.001	-
2,4-Dimethylphenol	0.001	-
Acetophenone	0.01	-
Benzenethiol	0.0005	-
beta-BHC	-	0.0003
Chlordane	-	0.0000025
Cresol (mixed isomers)	0.001	-
Diphenyl ether	0.01	-
Hexachloro-1,3-butadiene	-	0.006
Hexachlorocyclopentadiene	-	0.0016
Hexachloroethane	-	0.001
Methyl mercaptan	0.0002	-
Nitrobenzene	0.01	-
o-Cresol	0.0003	-
p-Cresol	0.004	-

Source: Verscheuren, Karel, Handbook of Environmental Data on Organic Chemicals, Second Edition, 1983

Because odor problems typically are handled locally and these problems likely do not meet the RCRA definition of risks meant to be addressed by the hazardous waste management program, EPA does not plan to investigate this area further following the Scoping Study.

5.3 Large-Scale Environmental Problems

EPA considered whether any major large-scale environmental problems (e.g., global climate change, potential damage from endocrine disruptors) might be caused, at least to some extent, by non-hazardous industrial wastes. Depending on the types of wastes and on the relative contributions of these wastes to the problem areas, changes in the hazardous waste characteristics might be one method to help reduce further damages.

EPA began this phase of the Scoping Study by developing an initial list of major large-scale environmental problems (or possible problems) that have potential links to non-hazardous industrial wastes (see Exhibit 5-3). Several of these problems overlap considerably with each other and with exposure and other damage pathways discussed previously. Furthermore, EPA recognizes that other environmental problems have potential links to non-hazardous industrial waste; however, given the limited resources available for this Scoping Study, the Agency chose to limit this analysis to some of the more likely areas of concern.

Exhibit 5-3. Initial List of Large-Scale Environmental Problems

- ✓ Air deposition to the Great Waters
- ✓ Damages from airborne particulates
- ✓ Global climate change
- ✓ Potential damages from endocrine disruptors
- ✓ Red tides
- ✓ Stratospheric ozone depletion
- ✓ Tropospheric ozone and photochemical air pollution
- ✓ Water pollution

Following the development of this list, EPA conducted preliminary evaluations of the problem areas to try to characterize the contributions to the problems from non-hazardous industrial wastes. Because these problems are typically characterized by highly complex interactions of a large number of factors, determining the exact contribution of non-hazardous industrial wastes to each problem is difficult and beyond the scope of this study. Instead, EPA was able to conduct only initial evaluations to identify areas that may have a significant contribution from non-hazardous industrial wastes and thus may warrant further analysis following the Scoping Study.

For environmental problems with a possible link to non-hazardous industrial wastes, EPA identified (where possible) the industries and waste streams that could be contributing to the problems and the relevant statutes and programs that are addressing the areas. The environmental problems evaluated for this Scoping Study are discussed below in the order (alphabetical) listed in Exhibit 5-3.

5.3.1 Air Deposition to the Great Waters

Pollutants emitted into the atmosphere are transported various distances and can be deposited to aquatic ecosystems far removed from their original sources.[1] Studies show that significant portions)often greater than 50 percent)of pollutant loadings to the Great Waters (i.e., Great Lakes, Lake Champlain, Chesapeake Bay, and coastal waters) are from atmospheric deposition. Thus, this pathway is an important factor in the degradation of water quality and the associated adverse health and ecological effects. Because of the mounting concern that air pollution contributes to water pollution, Congress included Section 112(m), Atmospheric Deposition to Great Lakes and Coastal Waters, in the Clean Air Act Amendments of 1990.

Both local and distant air emission sources contribute to a pollutant load at a given location. The sources of concern for the Great Waters primarily include industrial activities and processes involving

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[1] U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, *Deposition of Air Pollutants to the Great Waters, First Report to Congress*, EPA-453/R-93-055, May 1994.

combustion. At present, however, a complete and comprehensive inventory of the locations of particular sources and the amount of individual toxic pollutants that each source emits to the air is lacking. Nevertheless, EPA has identified several known air pollutants of concern for Great Waters. Exhibit 5-4 lists these pollutants and selected U.S. sources. Most pollutants in this exhibit are TC analytes, while a smaller set are chemicals (or chemical groups) of concern discussed in Chapter 4. Thus, these pollutants are likely candidates for further analysis as potential gaps in the hazardous waste characteristics.

Exhibit 5-4. U.S. Sources of Air Pollutants of Concern for Great Waters[a]

Pollutant	Sources of Air Emissions
Cadmium and compounds	Fossil fuel combustion; aluminum production; cadmium, copper, lead, and zinc smelting; iron and steel production; battery manufacturing; hazardous waste and sewage sludge incineration; municipal waste combustion; petroleum refining; lime manufacturing; cement manufacturing; pulp and paper production; combustion of waste oil; pigment manufacturing; soil-derived dust; volcanoes
Chlordane	Insecticide application;[b] volatilization from soils, water, and treated building foundations due to past insecticide application; suspension of eroded soil particles
DDT/DDE	Insecticide application;[b] volatilization from soils and water due to past insecticide application
Dieldrin	Insecticide application;[b] volatilization from soils and water due to past insecticide application
Hexachloro-benzene	Manufacturing of chlorine and related compounds; combustion of materials containing chlorine; pesticide manufacturing; municipal waste combustion; fungicide application;[b] volatilization from soils and water due to past fungicide application
α-HCH	Insecticide application;[b] volatilization from soils and water due to past insecticide application
Lindane	Insecticide application;[b] volatilization from soils and water due to past insecticide application
Lead and compounds	Fossil fuel combustion; aluminum production; lead smelting; ferroalloys production; iron and steel production; battery manufacturing; hazardous waste and sewage sludge incineration; municipal waste combustion; petroleum refining; lime manufacturing; cement manufacturing; asphalt and concrete manufacturing; pulp and paper production; combustion of waste oil; paint application;[b] motor vehicles;[b] forest fires; suspension of eroded soil particles; volcanoes
Mercury and compounds	Fossil fuel combustion; copper and lead smelting; hazardous waste; municipal waste, medical waste, and sewage sludge incineration; lime manufacturing; cement manufacturing; chlorine and caustic soda manufacturing; paint application;[b] suspension of eroded soil particles; erosion from soils and water; volcanoes
PCBs	Incineration and improper disposal of PCB-contaminated waste; disposal of waste oil; malfunction of PCB-containing transformers and capacitors; electrical equipment manufacturing; pulp and paper production; volatilization from soils and water; municipal solid waste incineration and unregulated combustion
Polycyclic organic matter	Combustion of plant and animal biomass and fossil fuels; municipal waste combustion; petroleum refining; steel production; coke by-product recovery; aluminum production; plywood and particle board manufacturing; surface coating of auto and light duty trucks; asphalt processing; dry cleaning (petroleum solvent); fabric printing, coating, and dyeing; forest fires

Exhibit 5-4. U.S. Sources of Air Pollutants of Concern for Great Waters[a] (continued)

Pollutant	Sources of Air Emissions
2,3,7,8-TCDF	Hazardous, industrial, municipal, and medical waste and sewage sludge incineration; combustion of fossil fuels and organic materials containing chlorine; by-product of various metals recovery processes, such as copper smelting; accidental fires of treated wood products and PCB-containing transformers and capacitors; improper disposal of certain chlorinated wastes; pesticide production, application, and spills; pulp and paper production; volatilization and erosion of dust from landfill sites; forest fires
2,3,7,8-TCDD	Hazardous, industrial, and medical waste and sewage sludge incineration; municipal waste combustion; combustion of fossil fuels and organic materials containing chlorine; by-product of various metals recovery processes, such as copper smelting; accidental fires of treated wood products and PCB-containing transformers and capacitors; improper disposal of certain chlorinated wastes; pesticide production, application, and spills; pulp and paper production; volatilization and erosion of dust from landfill sites; forest fires
Toxaphene	Insecticide application;[b] volatilization from soils and water due to past insecticide application
Nitrogen compounds	Fossil fuel and other types of combustion; motor vehicles; fertilizer application; animal waste

[a] From Table 9 of U.S. EPA, *Deposition of Air Pollutants to the Great Waters, supra* footnote 1.
[b] Not currently a significant source in the U.S. due to manufacturing or use restrictions.

5.3.2 Airborne Particulates

Airborne particulate matter (PM) is one of the six high-priority research topics identified for the next few years by the EPA Office of Research and Development (ORD).[2] PM includes dust, dirt, soot, smoke, and liquid droplets directly emitted into the air by sources such as factories, power plants, transportation sources, construction activity, fires, and windblown dust. Concern regarding PM from non-hazardous industrial waste includes toxic constituents entrained on particulates. PM is also formed in the atmosphere by condensation or transformation of emitted gases such as sulfur dioxide, nitrogen oxides, and volatile organic compounds into small droplets.

Based on studies of human populations exposed to high concentrations of particles (often in the presence of sulfur dioxide) and on laboratory studies of animals and humans, the major concerns for human health include effects on breathing and respiratory symptoms, aggravation of existing respiratory and cardiovascular disease, alterations in the body's defense systems against foreign materials, damage to lung tissue, carcinogenesis, and premature death. The major subgroups of the populations that appear likely to be most sensitive to the effects of particulate matter include individuals with chronic obstructive pulmonary cardiovascular disease, individuals with influenza, asthmatics, the elderly, and children. Particulate matter may injure crops, trees and shrubs, and may damage metal surfaces, fabrics, and other materials. Fine particulates also impair visibility by scattering light and reducing visibility. The haze caused by fine particles can diminish crop yields by reducing sunlight.

PM is increasingly being identified as posing a high potential for health and environmental risk and other potential damages. Nevertheless, EPA does not believe that PM is a significant waste characterization issue but rather a waste management issue. Furthermore, other programs (e.g., CAA National Ambient Air Quality Standards)

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[2] U.S. Environmental Protection Agency, Office of Research and Development, *Strategic Plan for the Office of Research and Development,* ORD, EPA/600/R-96/059, May 1996.

are designed to address this area. Therefore, airborne particulates are not planned for further study as a potential gap.

5.3.3 Global Climate Change

Evidence is mounting that the increasing concentrations of greenhouse gases (GHGs) will ultimately raise (and some believe are currently raising) atmospheric and ocean temperatures significantly, which may in turn alter global weather patterns.[3] Global climate already has changed over the past century, and the balance of evidence suggests a discernible human influence.[4] Climate is expected to continue to change in the future.

EPA conducted a brief review of the major anthropogenic sources of the two predominant GHGs, carbon dioxide (CO_2) and methane (CH_4), to determine the relative contributions of non-hazardous industrial wastes, including their co-disposal with municipal solid waste (MSW). Before describing the results of this review, it is essential to understand some of the international conventions used to evaluate GHG emissions, as these conventions have a strong bearing on the results.

The United States and all other parties to the Framework Convention on Climate Change agreed to develop inventories of GHGs for purposes of developing mitigation strategies and monitoring the progress of those strategies. The Intergovernmental Panel on Climate Change (IPCC) developed a set of inventory methods to be used as the international standard.[5] The screening methodology used in this section to evaluate emissions and sinks of GHGs attempts to be consistent with IPCC's guidance.

One of the elements of the IPCC guidance that deserves special mention is the approach used to address CO_2 emissions from biogenic sources. For many countries, the treatment of CO_2 releases from biogenic sources is most important when addressing releases from energy derived from biomass (e.g., burning wood), but this element is also important when evaluating waste management emissions (for example, the decomposition or combustion of grass clippings or paper). The carbon in paper and grass trimmings was originally removed from the atmosphere by photosynthesis, and under natural conditions, it would eventually cycle back to the atmosphere as CO_2 due to degradation processes. The quantity of carbon that these natural processes cycle through the earth's atmosphere, waters, soils, and biota is much greater than the quantity added by anthropogenic GHG sources. But the focus of the Framework Convention on Climate Change is on anthropogenic emissions – emissions resulting from human activities and subject to human control – because these emissions have the potential to alter the climate by disrupting the natural balances in carbon's biogeochemical cycle.

Thus, for processes with CO_2 emissions, if the emissions are from biogenic materials and the materials are grown on a sustainable basis, then those emissions are considered to simply close the loop in the natural carbon cycle; that is, they return CO_2 to the atmosphere that was originally removed by photosynthesis. In such cases, the CO_2 emissions *are not* counted (and thus most CO_2 emissions from landfills are not counted). On the other hand, CO_2 emissions from burning fossil fuels *are* counted because these emissions would not enter the cycle were it not for human activity. Likewise, CH_4 emissions from landfills *are* counted, even though the source of carbon is primarily

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[3] U.S. Environmental Protection Agency, Office of Policy, Planning, and Evaluation, *Environmental Goals for America, with Milestones for 2005 (Draft for Federal Review)*, June 1996.

[4] Intergovernmental Panel on Climate Change (IPCC), *Climate Change 1995: The Science of Climate Change*, Second Assessment Report, Cambridge University Press, 1996.

[5] IPCC, WGI Technical Support Unit, *IPCC Guidelines for National Greenhouse Gas Inventories: Reporting Instructions*, Bracknell, U.K., 1995.

biogenic. CH_4 would not be emitted but for the human activity of landfilling the waste, which creates anaerobic conditions conducive to CH_4 formation.[6] This approach does not distinguish between the timing of CO_2 emissions, provided that they occur in a reasonably short time scale relative to the speed of the processes that affect global climate change. That is, as long as the biogenic carbon would eventually be released as CO_2, it does not matter whether it is released virtually instantaneously (e.g., from combustion) or over a period of a few decades (e.g., decomposition on the forest floor).

CO_2 accounts for the largest share of U.S. GHG emissions, comprising 1,408 million metric tons of carbon equivalent (MMTCE) out of total 1994 U.S. emissions of 1,666 MMTCE.[7] Combustion of fossil fuels results in the vast majority of the CO_2 emissions (1,390 MMTCE), with the remainder from industrial processes such as cement production, lime production, limestone consumption (e.g., iron and steel production), soda ash production and use, and CO_2 manufacture. CO_2 emitted from landfills as a product of both aerobic and anaerobic decomposition of organic wastes is not counted, as described above.

Methane is the second most important GHG; U.S. emissions in 1994 were 166 MMTCE.[8] Of the anthropogenic C sources, the largest is landfills (which contribute 36 percent of the total U.S. methane emissions), agricultural activities (32 percent), coal mining (15 percent), production and processing of natural gas and oil (11 percent), fossil fuel combustion (3 percent), and wastewater treatment (0.6 percent).[9] As explained above, CH_4 from landfills is counted as an anthropogenic GHG.

The majority of landfill CH_4 emissions result from MSW landfills (90 to 95 percent), with the remaining methane emitted from the disposal of industrial wastes. Methane emissions from large MSW landfills, however, are currently regulated under EPA's recent New Source Performance Standards and Emissions Guidelines,[10] which require collection and control of landfill gas. Small MSW landfills and industrial waste monofills are not subject to these new regulations and thus may warrant further investigation. This is particularly true for small landfills or monofills managing non-hazardous industrial wastes that have a high biochemical oxygen demand (such as wastes from paper mills and food processing), which have a high potential for generating CH_4.

In conclusion, non-hazardous industrial wastes may contribute to GHG emissions to the extent that they are highly degradable and either are disposed in small landfills (which are not subject to the landfill gas rule) or are released directly to the atmosphere. The emissions attributable to these wastes are small compared to other sources of GHGs. Nevertheless, the same highly putrescible wastes that would be of concern when disposed in a landfill environment are likely to cause taste and odor problems that adversely affect local air and water quality. To a large degree, the climate change risk (and much of the potential groundwater resource damage) could be readily averted for highly putrescible wastes by biological pretreatment prior to land disposal to reduce the potential for (a) methane formation and (b) production of odiferous compounds generated in an anaerobic environment. Further research could be conducted in this area to determine whether the potential contribution of

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[6] Because CH_4 has a higher global warming potential than CO_2, CH_4's incremental global warming potential is counted.

[7] U.S. Environmental Protection Agency, Office of Policy Planning and Evaluation, *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-1994*, EPA 230-R-96-006, November 1995.

[8] *Ibid.*

[9] *Ibid.*

[10] 61 *Federal Register* 9905, March 12, 1996.

non-hazardous industrial wastes to GHG emissions could be significant. However, given the current coverage of this problem area by other programs besides Subtitle C of RCRA, EPA does not plan to pursue global climate change within the context of the hazardous characteristics at this time.

5.3.4 Potential Damages from Endocrine Disruptors

Over the past decade, increased attention has been given to a class of chemicals with high persistence, bioaccummulation potential, and toxicity. These chemicals, often referred to as PBTs,[11] include a wide range of substances, generally several metals and a variety of organic compounds. EPA's involvement in PBT research and regulation has encompassed many programs. One of these programs, waste minimization, developed the Waste Minimization National Plan.[12] This plan established a national goal to reduce the most persistent, bioaccumulative, and toxic chemicals in hazardous wastes by 25 percent by the year 2000 and by 50 percent by the year 2005. Currently many international organizations, including the North American Commission for Environmental Cooperation and various United Nations groups, are debating PBT public policy and ultimately could generate binding commitments (e.g., treaties) that could affect U.S. national policy on PBTs. For example, an initial list of 12 PBTs is being considered for control under an international protocol.

Recently, interest in PBTs has escalated due to the growing attention on a subgroup of these chemicals called "endocrine disruptors" (EDs). EDs are substances that have the potential to interfere with hormonal systems in ecological and human receptors. The results of such interference might include adverse reproductive or developmental effects, certain kinds of cancers, learning and behavioral problems, and immune system deficiencies.[13] Recent concern has focused on the potential synergistic effects of EDs.[14]

Significant scientific debate still exists regarding which chemicals are EDs and the degree to which EDs have caused or have the potential to cause adverse human health and environmental effects. This debate has prompted great interest in researching the scope of ED impacts. For example, the study of EDs is one of the six high-priority research topics identified by EPA's Office of Research and Development (ORD) for the next few years.[15] It has also been made a high priority by the U.S. chemical industry; the Chemical Industry Institute for Toxicology (CIIT) has reprogrammed much of its research budget into this area. To the extent that the impact of EDs on the environment are largely unknown, these chemicals may represent a substantial gap in the hazardous waste regulations.

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[11] Several other terms are and have been used, such as persistent organic pollutants, which actually are a subset of PBTs.

[12] U.S. Environmental Protection Agency, Office of Solid Waste, "The Waste Minimization National Plan," EPA530-R-94-045, 1994.

[13] Center for the Study of Environmental Endocrine Effects, *Environmental Endocrine Effects: An Overview of the State of Scientific Knowledge and Uncertainties*, Discussion Draft (first released for public comment at the Sept. 22, 1995 public meeting of the Science Advisory Board of the U.S.-Canada International Joint Commission), Washington, DC (also available on the World Wide Web at http://www.endocrine.org).

[14] Arnold, SF, Klotz, DM, Collins, BM, Vonier, PM, Guillette Jr., LJ, and McLachlan, JA, "Synergistic Activation of Estrogen Receptor with Combinations of Environmental Chemicals," *Science*, 272 (5267):1489, June 7, 1996; and Suplee, C, "`Environmental Estrogens' May Pose Greater Risk, Study Shows," The Washington Post, p. A4, June 7, 1996.

[15] *Strategic Plan for the Office of Research and Development*, *supra* footnote 2.

Notwithstanding the current debate, recent review articles summarize convincing evidence that a variety of chemical pollutants can act as endocrine disruptors in wildlife populations.[16] Some specific examples include the following:

- **Reptiles.** Researchers found that the reproductive development of alligators from Lake Apopka, Florida was severely impaired, apparently due to DDE, a metabolite of DDT and dicofol.[17] The lake is located adjacent to an EPA Superfund site where a dicofol spill had occurred. The specific adverse effects included decreased testosterone and abnormal testicular cells in males and increased estrogen and altered ovaries (increased polyovular follicles and polynuclear oocytes) in females.

- **Birds.** A number of researchers have documented severely impaired reproductive success in herring gulls from the Great Lakes.[18] Some specific observations include large clutch sizes (attributed to nest sharing by two females), female-female pair bonds, embryonic and chick mortality, and altered nest defense and incubation behavior. These effects were associated with high levels of organochlorines (e.g., DDT, dioxins, and mirex) in the 1960s and early 1970s. Reproductive success increased as levels of these compounds declined in the late 1970s and 1980s. Organochlorines that have been identified as estrogenic to bird embryos in laboratory studies include DDT and methoxychlor.[19]

In these cases, some of the causative agents appear to be organochlorine pesticides that are no longer produced (e.g., DDT) yet persist in the environment due to the nature of their chemical/physical properties. Although these chemicals are not generally expected to be components of non-hazardous industrial wastes, a number of similar chemicals currently used in industry have demonstrated similar endocrine disrupting properties in laboratory studies. These EDs are often present in treated sewage effluent,[20] and are likely to be components of non-hazardous industrial waste.

A recent field study found that effluent from sewage treatment works induced vitellogenin synthesis in male fish, indicating that the effluent is estrogenic.[21] The effects were pronounced and occurred at all sites

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[16] Colborn, T., vom Saal, F.S., and Soto, A.M., "Developmental Effects of Endocrine-Disrupting Chemicals in Wildlife and Humans," Environmental Health Perspectives, 101(5):378-384, 1993; Guillette, L.J., Crain, D.A., Rooney, A.A., and Pickford, D.B., "Organization Versus Activation: The Role of Endocrine-Disrupting Contaminants (EDCs) During Embryonic Development in Wildlife," Environmental Health Perspectives, 103(Supp 7):157-164, 1995.

[17] Guillette, L.J., Gross, T.S., Masson, G.R., Matter, J.M., Percival, H.F., and Woodward, A.R, "Developmental Abnormalities of the Gonad and Abnormal Sex Hormone Concentrations in Juvenile Alligators From Contaminated and Control Lakes in Florida," Environmental Health Perspectives, 102(8):680-688, 1994.

[18] Fox, G.A., "Epidemiological and Pathobiological Evidence of Contaminant-Induced Alterations in Sexual Development in Free-Living Wildlife," in Colborn, T., and Clement, C. (eds.), Chemically-Induced Alterations in Sexual and Functional Development: The Wildlife/Human Connection, Princeton Scientific Publishing, Princeton, NJ, pp. 147-158, 1992.

[19] Fry, D.M., "Reproductive Effects in Birds Exposed to Pesticides and Industrial Chemicals," Environmental Health Perspectives, 103(Supp 7):165-171, 1995.

[20] Sumpter, J.P., and Jobling, S., "Vitellogenesis as a Biomarker For Estrogenic Contamination of the Aquatic Environment," Environmental Health Perspectives, 103(Supp 7):173-178, 1995.

[21] *Ibid*.

tested. The identity of the chemical or chemicals in the sewage effluent causing the effects is not known, however. A number of chemicals known to be present in sewage effluent were tested for estrogenic effects in fish. These chemicals included nonylphenol, octylphenol, bisphenol-A, DDT, and PCBs. Furthermore, a mixture of different estrogenic chemicals was found to be considerably more potent than each of the chemicals when tested individually, a finding that recently was replicated.[22]

In addition to the effects described above, other documented endocrine disrupting effects in wildlife populations from industrial effluents have unknown causative agents. For example, kraft mill effluent caused a variety of effects in two fish species: white suckers and mosquitofish.[23] Lake Superior white suckers collected from a site receiving primary-treated bleached kraft mill effluent exhibited increased age to maturity, smaller gonads, lower fecundity with age, and an absence of secondary sex characteristics. Masculinization of female mosquitofish was noted downstream from the discharge of kraft mill effluent in Elevenmile Creek in Florida.[24]

Several of the chemicals identified in this section are also identified in Chapter 4 as known or possible non-hazardous industrial waste constituents. Some of the relevant chemical groups are described in more detail below.

- **Alkylphenol Compounds.** Alkylphenol-polyethoxylates are non-ionic surfactants commonly used in industrial and domestic detergents as well as some shampoos and cosmetics. Alkylphenols are used as antioxidants in some clear plastics. Alkylphenol-polyethoxylates are biodegraded to alkylphenols during sewage treatment. These compounds persist in rivers and their sediments and can migrate to groundwater. These compounds also have the ability to bioconcentrate in animals.

- **Bisphenol-A.** This compound is used to manufacture polycarbonate, a component in a wide array of plastics and other polymer products. Bisphenol-A also is used to manufacture epoxy resins, which are components of a variety of lacquers and adhesives.

- **Phthalates.** Phthalates are one of the most abundant man-made chemicals in the environment. Phthalate esters are used in the production of various plastics. Butylbenzyl phthalate (BBP) also is used in the production of vinyl floor tiles, adhesives, and synthetic leather. Di-n-butylphthalate (DBP) is a common plasticizer in food-packaging materials and polyvinyl chloride. Thousands of tons of plastics are disposed of annually in landfills, thus possibly enabling phthalate esters to migrate into soil and groundwater. These compounds have the ability to bioconcentrate in animals.

As seen in Chapter 4, other categories of chemicals with ED characteristics (e.g., heavy metals) are present in wastes generated by numerous industries.

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[22] Arnold, S.F., et al., *supra* footnote 14.

[23] Munkittirck, K.R., Portt, C.B., Van Der Krakk, G.J., Smith, I.R., and Rokosh, D.A., "Impact of Bleached Kraft Mill Effluent on Population Characteristics, Liver MFO Activity, and Serum Steroid Levels of A Lake Superior White Sucker (*Catostomus Commersoni*) Population, Can. J. Fish. Aquat. Sci., 48:1371-1380, 1991.

[24] Davis, W.P., and Bortone, S.A., "Effects of Kraft Mill Effluent on the Sexuality of Fishes: An Environmental Early Warning?" in Colborn, T., and Clement, C. (Eds.), Chemically-Induced Alterations in Sexual and Functional Development: The Wildlife/Human Connection, Princeton Scientific Publishing, Princeton, N.J., pp. 113-127, 1992.

In conclusion, the evidence that alkylphenols, bisphenol-A, and phthalates are endocrine disruptors is based mainly on laboratory studies. The effects of these chemicals on wildlife populations is not known. Based on the endocrine disrupting effects of organochlorines on populations of fish, birds, reptiles, and mammals, however, it is possible that alkylphenols, bisphenol-A, phthalates, and other chemicals also could have endocrine disrupting effects in wildlife. Furthermore, as seen in Chapter 4, it is likely that some of these chemicals (e.g., the phthalates) are also components of several non-hazardous industrial wastes.

5.3.5 Red Tides

Red tides are rapid increases in growth (i.e., blooms) of freshwater and marine plants called dinoflagellates, which typically are microscopic unicellular organisms that photosynthesize but also have tails for movement. A red tide occurs when dinoflagellates multiply rapidly due to optimal growth conditions such as abundant dissolved nutrients and sunlight. They produce toxins to defend themselves from zooplankton and other aquatic grazers. The term red tides includes orange, brown, red, and even green blooms.

Shellfish, such as clams, mussels, oysters, or scallops, consume dinoflagellates and can accumulate the toxins in their flesh. Usually, the shellfish are not severely affected, but they can contain enough toxins to sicken and even kill humans. The recently discovered *Pfiesteria piscida* is one of many species of dinoflagellate that causes red tides. It produces potent toxins that cause bleeding sores in fish and can adversely affect humans via air releases. It recently has caused massive fish kills in the Neuse and Pamlico Rivers in North Carolina.[25]

Several case studies have shown the relationship between the levels of nutrients, such as phosphorus, nitrogen, silicon, and iron, in coastal and fresh waters, and the proliferation of red tides.[26] Studies also have shown that the high levels of nutrients and eutrophication of the water (which favors the development of red tides) are often caused by surrounding human development and industrial and domestic wastewaters.[27] Recent development of agribusiness and factory farms in coastal areas releases wastes with high levels of nutrients into the water that may favor red tides.[28]

Some researchers believe that the occurrence of red tides has been increasing over the years, although improvements in the monitoring and reporting of red tides could account for this.[29] Even if such an increase were occurring, however, a commensurate increase in human poisoning from ingestion of shellfish contaminated with dinoflagellate toxins has not been seen, likely because of the improved monitoring and reporting of red tides.[30]

Notwithstanding the potential link between red tides and constituents that are often found in non-hazardous industrial waste, little if any evidence has been found during this review concerning the degree to

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[25] Broad, W.J., "A Spate of Red Tides Menaces Coastal Seas," The New York Times, August 27, 1996; and Lewitus, A.J., R.V. Jesien, T.M. Kana, J.M. Burkholder, H.B., Jr., Glasgow, E. May, "Discovery of the Phantom Dinoflagellate in Chesapeake Bay," Estuaries 18(2):373-378, 1995.

[26] Ikeda, T., T. Matsumoto, H. Kisa, Y. Ishida, A. Kawai, "Analysis of Growth Limiting Factors Causative of Freshwater Red Tide by Dinoflagellate Peridinum Bipes F. Occultatum," Jap.-J.-Limnol.-Rikusuizatsu, 54(3): 179-189, 1993; Jiang, G., "The Preliminary Study on The Eutrophication and the Red Tide in the South Coastal Area of Zhejiang, Donghai-Mar.-Sci.-Donghai-Haiyang, 11(2): 55-6, 1993; Okaichi, T., S. Montani, A. Hasui, "The Role of Iron in the Outbreaks of Chattonella Red Tide," Red Tides: Biology, Environmental Science, and Toxicology, Proceedings of the First International Symposium on Red Tides, held in November 10-14, 1987, in Takamatsu, Kagawa-Prefecture, Japan, p. 353-356; and "Thousands of Gulf Fish Die; Red Tide Is Probable Cause," The New York Times, September 1996.

[27] Skojoldal, H.R., "Eutrophication and Algal Growth in the North Sea," Mar. Environ. Cent., Mar. Res., Bergen-Nordnes, Norway, p. 445-478, undated.

[28] Wu, R.S.S., "The Environmental Impact of Marine Fish Culture: Towards a Sustainable Future," International Conference on Marine Pollution and Ecotoxicology, held in Hong Kong, Jan. 22-26, 1995, Vol. 31, no. 4-12, p. 159-166; and Broad, *supra* footnote 25.

[29] Personal communications with Tony Amos, University of Texas Marine Science Institute, Port Aransas, Texas, and Daniel Baden, School of Marine and Atmospheric Science, Miami, Florida, on October 22, 1996.

[30] Personal communication with Scott Rippey, U.S. Food and Drug Administration, October 21, 1996.

which these wastes may be contributing to the problem. Therefore, for the purposes of this hazardous waste characteristic gaps study, EPA does not plan to conduct further research in this area at this time.

5.3.6 Stratospheric Ozone Depletion

The stratospheric ozone layer protects living organisms from damaging solar ultraviolet radiation (UV-B). Depletion of the ozone layer means a greater amount of UV-B radiation is reaching the earth's surface, which increases human skin cancers and cataracts, impairs human immune systems, reduces crop yields, and damages plant and animal life.[31] Several industrial chemicals, including chlorofluorcarbons (CFCs), halons, carbon tetrachloride, methyl chloroform, and methyl bromide, are known to be stratospheric ozone-depleting substances (ODSs).

For many years, ODSs have been used in a variety of manufacturing and other activities. With the ratification of the Montreal Protocol and its subsequent amendments and adjustments, the United States agreed to eliminate the production of ODSs by January 1, 1996 (with a few exceptions). In addition, the disposal of ODSs is tightly controlled in order to prevent further ozone depletion. Thus, EPA believes that, for purposes of the hazardous waste characteristic gaps analysis, ozone-depleting and non-ozone-depleting risks (e.g., via inhalation during combustion or from groundwater during land disposal of residuals) do not need to be examined further at this time.

In a related area (though not necessarily a large-scale environmental problem), the ultimate elimination of ODSs has spurred the development of a large number of alternative chemicals and technologies to replace ODSs. In the United States, the Significant New Alternatives Policy (SNAP) Program was put in place by EPA to ensure that alternatives implemented to replace ODSs are not themselves environmentally harmful or unsafe for workers and others who might be exposed to the new chemicals. As part of this program, EPA has developed a series of SNAP Technical Background Documents to address the ODS substitutes.[32] Before a new alternative is developed and introduced into interstate commerce, EPA must review the alternative and categorize it as acceptable, acceptable with limitations, or unacceptable, based on a risk screen of the alternative's characteristics. This risk screen addresses global atmospheric effects of the alternative, as well as worker, consumer, and general population exposure. Thus, groundwater damage and other more local adverse effects of the alternative from solid waste generation and management are included in this screening process. Therefore, EPA does not intend to conduct further investigations into the solid waste and hazardous characteristics implications of the SNAP-approved alternatives at this time.

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[31] *Environmental Goals for America, with Milestones for 2005 (Draft for Federal Review), supra* footnote 3.

[32] The majority of these documents were developed to support the first key substitutes rulemaking (59 *Federal Register* 13044, March 18, 1994).

5.3.7 Tropospheric Ozone and Photochemical Air Pollution

Photochemical reactions between organic chemicals, nitrogen oxides, and other oxidizing agents can produce ozone and photochemical oxidant pollution. Such pollution occurs in areas where sunlight is intense, emissions of nitrogen oxides and volatile organic compounds (VOCs) are high, and atmospheric conditions impede regional air circulation. Some chemicals emitted from non-hazardous industrial waste management units could contribute to the total emissions of volatile organics in some locations. As shown in Exhibit 4-2, many potentially reactive VOCs have been found as constituents of non-hazardous industrial wastes. This contribution, however, appears to be quite small. Recent emissions studies[33] have shown that, in most municipal areas where photochemical pollution is a problem, mobile and utility sources contribute the largest single portion of these emissions, with emissions from other sources generally contributing a smaller amounts. Thus, the Agency did not pursue this issue further as a potential gap in the hazardous waste characteristics.

5.3.8 Water Pollution

Based on information reported to EPA by States, Tribes, and other jurisdictions with water quality responsibilities, about 40 percent of the Nation's surveyed rivers, lakes, and estuaries are not clean enough for basic uses such as fishing or swimming.[34] Polluted runoff from rainstorms and snowmelt is the leading cause of this impairment. As seen below, the causes of this damage are highly varied.

- **Rivers.** Runoff from agricultural lands is the largest source of pollution for rivers. Municipal sewage treatment plants, storm sewers/urban runoff, and resource extraction also are among the leading sources. Bacteria, which can cause illnesses in swimmers and others involved in water-contact sports, are the most common pollutants impacting rivers. Siltation, nutrients (such as phosphates and nitrates),[35] oxygen-depleting substances, and metals are the other leading causes of river pollution.

- **Lakes.** As with rivers, runoff from agricultural lands is the largest source of pollution. Municipal sewage treatment plants, storm sewers/urban runoff, and unspecified nonpoint sources also lead the list. Leading causes of lake pollution are nutrients, siltation, oxygen-depleting substances, metals, and suspended solids.

- **Estuaries.** Storm sewers and urban runoff are the leading sources of pollution in estuaries. Municipal sewage treatment plants, agriculture, industrial point sources, and petroleum activities also lead the list. Nutrients, such as phosphates and nitrates, are the most often reported pollutant in estuaries. Other leading causes of pollution are bacteria, oxygen-depleting substances, and oil and grease.

Although non-hazardous industrial wastes contribute to this pollution to some degree (e.g., via sewage treatment and industrial point and non-point sources), it is unclear whether this contribution constitutes an actual gap in the hazardous waste characteristics. For example, significant changes in EPA's definition of solid waste would be needed before the hazardous waste characteristics could be used to prevent some of these wastes from

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[33] U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, National Air Quality and Emission Trends Report, 1991, EPA 454/R-95-014, October 1995.

[34] U.S. Environmental Protection Agency, Office of Water, *National Water Quality Inventory Report to Congress*, 1994.

[35] In excess, nutrients can create a chain of impacts that include algal blooms, fish kills, foul odors, and weed growth.

entering surface waters and resulting in risks or damage. Industrial wastewaters that are point source discharges subject to regulation under the Clean Water Act are exempt from the definition of solid waste.[36] Many of the wastes from agriculture – one of the largest contributers to water pollution from runoff – are exempt from the definition of hazardous waste (although they are solid wastes).[37] Alternatively, EPA could increase controls on point and non-point sources of water pollution via other programs.[38] Thus, for purposes of the hazardous characteristic scoping study, EPA does not plan to research this area further at this time.

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[36] 40 CFR 261.4(a)(2). This exemption applies only to the actual point source discharge. It does not exclude industrial wastewater while they are being collected, stored, or treated before discharge; nor does it exclude sludges generated by industrial wastewater treatment.

[37] 40 CFR 261.4(b). This exemption applies to wastes that are returned to the soil as fertilizers, such as animal manures and the unused portion of crops.

[38] Some of these controls currently are being implemented. For example, a recent final National Pollutant Discharge Elimination System (NPDES) storm water multi-sector general permit was published for industrial activities (60 *Federal Register* 50803, September 29, 1995).

CHAPTER 6. STATE EXPANSIONS OF THE TOXICITY CHARACTERISTIC AND LISTINGS

States may adopt hazardous waste regulations that are broader or more stringent than federal RCRA Subtitle C regulations. A number of states have done so by regulating additional wastes as hazardous. For example, states have:

- Expanded the ignitability, corrosivity, or reactivity (ICR) characteristics;
- Expanded the toxicity characteristic (TC);
- Listed wastes as hazardous that are not hazardous under the federal rules; and
- Restricted exemptions from the federal program.

These expansions beyond the federal hazardous waste identification rules reflect state judgments about gaps in the federal program and thereby constitute potential gaps that may merit further investigation.

EPA has identified examples of such expansions by using readily available information on state hazardous waste identification rules. In 1992, the EPA Office of Solid Waste examined state hazardous and non-hazardous industrial waste programs in 32 states.[1] The study identified "state only" hazardous wastes, as well as high-risk designations for non-hazardous wastes. For the purposes of this Scoping Study, EPA used data from this report and briefly reviewed current hazardous waste regulations of eight states: California, Michigan, New Hampshire, Oregon, Rhode Island, Texas, Washington, and New Jersey.

The first three sections of this chapter address state expansion of the TC, state only hazardous waste listings, and state restrictions on exemptions from the federal regulations, respectively. (State expansions of the ICR characteristics are addressed in Chapter 3.) In addition, Section 6.4 summarizes the findings of the chapter.

6.1 State Expanded Toxicity Characteristics

States have expanded the federal toxicity characteristic by:

- Adding constituents to the list of TC analytes;

- Establishing regulatory levels for TC analytes that are more stringent than federal levels;

- Specifying alternative tests for identifying toxic hazardous waste; and

- Using alternative approaches (other than listing constituents and regulatory levels) to identify toxic hazardous wastes.

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[1] U.S. Environmental Protection Agency, Office of Solid Waste, *Identifying Higher-Risk Wastestreams in the Industrial D Universe: The State Experience*, draft prepared by Science Applications International Corporation and Kerr & Associates, Inc., July 30, 1993.

California, Michigan, and Washington have added constituents to the list of TC analytes, as shown in Exhibit 6-1. Both California and Michigan have added zinc, and both California and Washington have added PCBs.[2] Other additional constituents include certain metals, pesticides, dioxins, and potential carcinogens. An example of a state regulatory level that is lower that the federal TC level is California's regulatory level of 1.7 mg/l for pentachlorophenol (versus 100 mg/l under the federal TC).

As discussed in Section 3.6, California requires use of the Wet Extraction Test (WET) in addition to the TCLP. Use of the WET test identifies several metal-containing wastes as hazardous that are generally not identified as hazardous using the TCLP. These wastes include spent catalysts from the petroleum refining and food industries and metal dusts, metal sludges, and baghouse wastes from industries including fabricated metals, leather and apparel, electric and electronic products, primary metals, motor vehicles, transportation equipment, chemicals and allied products, and others.[3]

Both California and Washington have established toxicity criteria for wastes based on acute oral LD50, acute dermal LD50, acute inhalation LC50, and acute aquatic 96-hour LC50 (see Exhibit 6-2). A waste is designated hazardous if a representative sample of the waste meets any of the acute toxicity criteria. For example, Washington specifies rat and fish (for acute aquatic toxicity) bioassay tests in a State test methods manual. Generators must either test a representative sample of the waste or use their knowledge of waste constituents and the literature regarding toxicity of those constituents to determine if the waste meets any of the acute toxicity criteria.

Finally, California's regulations state that a waste exhibits the characteristic of toxicity if the waste, based on representative samples, "has shown through experience or testing to pose a hazard to human health or environment because of its carcinogenicity, acute toxicity, chronic toxicity, bioaccumulative properties or persistence in the environment" (22 CCR 66261.24(a)(8)). This broad provision tends to shift the burden of identifying toxic wastes to the generator, because in the absence of specific state criteria (e.g., constituents and regulatory levels) the generator is responsible for being aware of experience or tests that show a waste poses a hazard.

6.2 State Only Listings

In addition to expanded characteristics, some states have listed state only hazardous wastes. The most common state-only listed wastes are PCBs and waste oil. At least four states include additional "F" Wastes; three include additional "K" wastes; five include additional "P" wastes; and six include additional "U" wastes. Examples of state listed wastes include but are not limited to the following:[4]

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[2] New Jersey had also added a TC regulatory level for PCBs, but the State recently adopted the federal regulations by reference and will now use the same characteristics and listings as the federal program. A number of states have added PCB wastes to their hazardous waste listings.

[3] *Identifying Higher-Risk Wastestreams in the Industrial D Universe: The State Experience, supra* footnote 1 at pages 20A-B.

[4] *Ibid*., pages 8-14.

Exhibit 6-1
State Toxicity Characteristics:
Additional Constituents and More Stringent Regulatory Levels

CALIFORNIA

Constituent	Regulatory Level (mg/l in leachate unless otherwise noted)
antimony	15
aldrin	0.14
asbestos	1 percent
beryllium	0.75
chromium (VI)	5
chromium (III)	560
cobalt	80
copper	25
DDT, DDE, DDD	0.1
2,4-dichlorophenoxyacetic acid	10
dieldrin	0.8
dioxin (2,3,7,8-TCDD)	0.001
fluoride salts	180
kepone	2.1
lead compounds, organic	13 mg/kg
mirex	2.1
molybdenum	350
nickel	20
pentachlorophenol	1.7 (lower regulatory level than federal)
PCBs	5
thallium	7
2,4,5-trichlorophenoxypropionic acid	1
vanadium	24
zinc	250

Any of the following substances at a single or combined concentration equal to or exceeding 0.001 percent by weight:

2-acetylaminofluorene (2-AAF)
acrylonitrile
4-aminodiphenyl
benzidine and its salts
bis(chloromethyl) ether (BCME)
methylchloromethyl ether
1,2-dibromo-3-chloropropane (DBCP)
beta-propiolactone (BPL)
3,3,-dichlorobenzidine and its salts (DCB)
4-dimethylaminoazobenzene
ethyleneimine (EL)
alpha-naphthylamine (1-NA)
beta-naphthylamine (2-NA)
4-nitrobiphenyl
n-nitrosodimethylamine (DMN)
vinyl chloride (VCM)

Exhibit 6-1 (continued)
State Toxicity Characteristics:
Additional Constituents and More Stringent Regulatory Levels

MICHIGAN

Constituent	Regulatory Level (mg/l)
aflatoxin	1
copper	100
dioxin (1,2,3,4,7,8-HxCDD)	1
dioxin (1,2,3,6,7,8-HxCDD)	1
dioxin (1,2,3,7,8,9-HxCDD)	1
dioxin (1,2,3,7,8-PoCDD)	1
dioxin (2,3,7,8-TCDD)	1
furan (2,3,7,8-TCDF)	1
zinc	500

WASHINGTON

Constituent	Regulatory Level (mg/l)
PCBs	2

Exhibit 6-2
State Toxicity Criteria Applied to Whole Waste
(Representative Sample)

CALIFORNIA	
acute oral LD50	< 5,000 mg/kg
acute dermal LD50	< 4,300 mg/kg
acute inhalation LC50	< 10,000 ppm
acute aquatic 96h LC50	< 500 mg/l
WASHINGTON	
acute oral LD50	< 5,000 mg/kg
acute dermal LD50	< 20,000 mg/kg
acute inhalation LC50	< 200 mg/l
acute aquatic 96h LC50	< 1,000 mg/l
RHODE ISLAND	
acute oral LD50	< 5,000 mg/kg
OREGON	
acute aquatic 96h LC50	< 250 mg/l (only includes certain pesticide residues)

- In California, wastes containing any of almost 800 listed materials are presumed hazardous, unless proven through testing not to exhibit any of California's criteria for identifying hazardous waste.

- Maine has listed certain wastes from the production of linuron and bromacil, and has listed *proposed* additions to the federal list of hazardous wastes.

- Maryland has listed 9 specific chemical warfare agents.

- Michigan has added certain chemical production wastes to its "K" or specific source list, and has listed many state-only "U" wastes including organics, inorganics in particle form, pharmaceuticals (e.g., phenobarbital), chemical warfare agents, and herbicides.

- New Hampshire has added a number of wastes to its "F" or non-specific source list, including certain wastes from industrial painting operations and from metals recovery operations.

- Oregon has listed certain pesticide residues and certain blister agents and nerve gas.

6.3 State Restrictions on Exemptions

Another way that states have expanded the universe of wastes they regulate as hazardous is by choosing not to adopt exemptions in the federal regulations. Examples include but are not limited to the following:[5]

- Colorado does not recognize exemptions for certain injected groundwater that exhibits the TC and is reinjected pursuant to free phase hydrocarbon recovery operations at petroleum facilities (40 CFR 261.4(b)(11)), certain used chlorofluorocarbon (CFC) refrigerants that are reclaimed for further use (40 CFR 261.4(b)(12)), or non-terne plated used oil filters (40 CFR 261.4(b)(13)).

- Connecticut, New Hampshire, Oregon, and Washington do not include exemptions for certain chromium-bearing wastes from leather tanning and finishing (40 CFR 261.4(b)(6)(ii)).

- Maine does not recognize exemptions at 40 CFR 261.4(b)(6) through (13). These include:

    - TC chromium wastes where chromium in the waste is nearly exclusively trivalent chromium;
    - certain chromium-bearing wastes from leather tanning and finishing;
    - specified mining and mineral processing wastes;
    - cement kiln dust;
    - certain arsenical-treated wood wastes;
    - petroleum contaminated media and debris that fail the TC;
    - certain injected groundwater;
    - used CFC refrigerants; and
    - non-terne plated used oil filters.

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[5] *Ibid*.

- Massachusetts, New York, and North Dakota do not recognize exemptions at 40 CFR 261.4(b)(10) through (13). (These wastes include the last four wastes named directly above.)

6.4 Summary

Some states appear to be regulating a significant number of wastes as hazardous that are not covered under federal RCRA regulations. Moreover, a few states have taken different approaches to identifying characteristic hazardous wastes. In particular, California and Washington regulations go beyond constituent-by-constituent definitions and apply acute toxicity criteria to the whole waste. State expansions of hazardous waste identification regulations reflect state judgment about gaps in the federal program. State expansions have filled these gaps, but only in the specific states with such expansions. Such potential gaps apparently are *not* being filled in the remaining states that have not expanded the federal hazardous waste definitions.

CHAPTER 7. SUMMARY OF POTENTIAL GAPS

This chapter reviews the broad categories of potential gaps identified in the previous three chapters. Different ways of organizing the potential gaps are discussed, and a single comprehensive list of the potential gaps is presented. This review lays the groundwork for evaluating the significance of the potential gaps in the following three chapters.

7.1 Organization of the Analysis of Potential Gaps

EPA has identified five categories of potential gaps in the hazardous waste characteristics using different approaches in each area:

- ICR Characteristics. EPA identified potential gaps associated with these characteristics by reviewing the original 1980 rulemaking record and comparing the ICR definitions and test methods to approaches taken to controlling similar hazards under other federal and state regulatory schemes.

- TC Characteristic. The Agency identified potential gaps associated with this characteristic by examining the properties of the TC analytes to determine how they could pose hazards to human health or the environment.

- Non-TC Chemicals. In contrast with the prior step, EPA began with a set of properties (including the potential to appear in non-hazardous industrial wastes) and then identified individual chemicals and groups of chemicals that could constitute potential gaps in the characteristics.

- Natural Resource Damages and Large-scale Environmental Problems. The Agency examined evidence of possible gaps using a hybrid approach that considered potential gap chemicals on the basis of their hazardous properties (e.g., endocrine disruption, stratospheric ozone depletion) and reviewed other potential gaps starting from possible risks to the environment, which, in turn, implied that certain waste constituents might be of concern.

- State Expansion of TC and State Listings. EPA reviewed how states have expanded their TC and listed as hazardous certain wastes that are not hazardous under the federal rules. These expansions reflect state judgments about gaps in the federal rules and thereby constitute potential gaps for this Scoping Study.

The potential gaps presented in the following section are organized primarily by the major categories identified above. Where appropriate, these categories are subdivided into groups of chemicals posing similar types of hazards, and occasionally are subdivided even further by specific hazardous properties or exposure pathways of concern. Some of the potential gaps overlap. For example, endocrine disruptors appear among the concerns associated with the non-TC analytes as well as in a category by themselves under large-scale environmental risks. Although this overlap is inevitable, the potential gaps have been organized so as to minimize it, without omitting any potentially significant gaps.

EPA considered other methods of classifying the potential gaps for purposes of further analysis. Gaps could be identified, for example, in terms of individual chemicals and their specific properties and hazards. Alternatively, the gaps could be organized around groups of chemicals with specific hazardous properties or types of risks. EPA rejected these approaches for purposes of this Scoping Study as impractical because too many individual chemicals or groups of chemicals, risks, and pathways are involved. In addition, defining potential gaps in categories that do not parallel the approaches used to identify such gaps would make it more difficult to appreciate the evidence and uncertainty associated with each potential gap.

7.2 Summary of Potential Gaps

Exhibit 7-1 lists the potential gaps in the hazardous waste characteristics identified by EPA in the preceding chapters. The individual gaps are organized according to the section or chapter in which they are discussed, with reference to specific chemical classes, exposure pathways, or types of risks, as appropriate. Potential gaps are evaluated in the following chapters in order to assess their potential significance in terms of potential risks to health and the environment. Because of data limitations, most of this evaluation focuses on potential gaps associated with the TC analytes and other chemicals. Chapter 8 examines the relationship between potential gaps, specific industries, and waste management methods. Chapter 9 discusses the extent to which the various potential gaps may already be addressed to some extent by existing regulatory systems. Finally, Chapter 11 presents a Summary evaluation of the potential gaps against a number of risk and regulatory criteria.

Exhibit 7-1. Summary of Potential Gaps in the Hazardous Waste Characteristics

Category of Potential Gap	Nature of Potential Gap
Potential Gaps in the ICR Characteristics (Sections 3.2 to 3.4)	<u>Ignitability</u> ● Exclusion of DOT combustible liquids ● Exclusion of aqueous flammable liquids ● References outdated DOT regulations ● No test method for non-liquids <u>Corrosivity</u> ● Exclusion of corrosive non-liquids ● pH limits are potentially not protective ● pH test methods are not predictive of risk ● Corrosion of non-steel materials is not addressed ● Solubilization of non-metals is not addressed ● Exclusion of irritants and sensitizers <u>Reactivity</u> ● Definition is broad, non-specific ● References outdated DOT regulations ● No test methods are specified
Potential Gaps Associated With the TC Analytes (Sections 3.5 and 3.6)	<u>Groundwater Pathway Risks</u> ● DAF values potentially not protective

Exhibit 7-1. Summary of Potential Gaps in the Hazardous Waste Characteristics (continued)

Category of Potential Gap	Nature of Potential Gap
Potential Gaps Associated With the TC Analytes (Sections 3.5 and 3.6) (continued)	<u>Ecological Risks Not Addressed</u> ● Potent ecological toxicants ● Persistent/bioaccumulative pesticides <u>Non-Groundwater Pathways Not Addressed</u> ● Inhalation (volatile organics) ● Surface water pathway ● Indirect/food chain (volatile, persistent, and bioaccumulative chemicals) <u>TCLP Limitations</u> ● May not accurately predict leachate concentration or risks for certain wastes and units
Potential Gaps Associated with Known and Possible Constituents of Non-hazardous Industrial Waste other than TC Analytes (Chapter 4)	<u>Major Constituents/Properties of Non-Hazardous Industrial Wastes Not Addressed</u> ● Metals/inorganics -- groundwater pathway ● Volatile chlorinated organics -- groundwater and inhalation pathway exposures ● Volatile hydrocarbons -- groundwater and inhalation pathways ● Other volatile organics -- groundwater and inhalation pathways ● Pesticides and related compounds -- inhalation and indirect food chain pathways ● Phthalate esters -- indirect pathways ● Phenolic compounds -- groundwater and indirect pathways ● Polycyclic aromatic hydrocarbons -- indirect pathway exposures ● Other semivolatile organic compounds -- all pathways <u>Generation of LNAPLs and DNAPLs</u> ● Facilitated transport of organic chemicals ● Long-lasting and difficult to remediate

Exhibit 7-1. Summary of Potential Gaps in the Hazardous Waste Characteristics (continued)

Category of Potential Gap	Nature of Potential Gap
Potential Gaps Associated with Natural Resource Damages and Large-Scale Environmental Problems (Chapter 5)	<u>Natural Resource Damages</u> ● Groundwater resource damage without health risks ● Odors <u>Large-scale Environmental Problems</u> ● Air deposition to the Great Waters ● Airborne particulates ● Global climate change ● Potential damage from endocrine disruptors ● Red tides ● Stratospheric ozone depletion ● Tropospheric ozone and photochemical pollution ● Water pollution
Potential Gaps Associated with State Expansion of TC and Listings (Chapter 6)	<u>State Expansion of TC</u> ● Additional TC constituents ● More stringent regulatory levels ● Alternative test methods ● Use of acute oral, dermal, inhalation, and aquatic LD50 or LC50 criteria applied to representative samples of waste <u>State Only Listings</u> <u>State Restrictions on Federal Exemptions</u>

CHAPTER 8. POTENTIAL GAPS AS FUNCTION OF INDUSTRY AND WASTE MANAGEMENT METHODS

This Chapter evaluates the significance of potential gaps by linking the known and possible non-hazardous industrial waste constituents to specific industries and management practices. It is organized as follows:

Section 8.1	describes the primary data sources used in this chapter and their major limitations;
Section 8.2	discusses the amount of non-hazardous industrial wastes generated by various industries and the constituents found in their wastes; and
Section 8.3	reviews the methods of managing non-hazardous industrial wastes and the associated risks to human health and the environment.

8.1 Data Sources and Major Limitations

Over the past 15 years, EPA has made several substantial efforts to gather information on the types and amounts of non-hazardous industrial wastes generated by specific industries and the management methods used for specific wastes. Despite these efforts, significant gaps, inconsistencies, and other limitations remain in the available information. Considerably fewer data are available on non-hazardous industrial wastes than on hazardous wastes, in part, because of the limited federal role in regulating non-hazardous industrial wastes and the lack of widespread reporting requirements.

The major sources of data on non-hazardous industrial waste generation and management are as follows:

- Industrial Studies Database (ISDB). EPA has maintained the ISDB since 1982. The database contains information on waste generation, management, and point-of-generation constituent concentrations for 16 industries. The sources of the information include RCRA Section 3007 questionnaires, plant visit reports, sampling and analysis site visit reports, engineering analysis reports, and data collected for hazardous waste listing decisions.

- The Industrial Subtitle D Telephone Screening Survey. This survey was conducted between November 1986 and April 1987. Over 18,000 facilities in 17 industry sectors were questioned about the quantities and types of non-hazardous industrial wastes generated and managed on-site in 1985, the number and design of on-site management units, and the amounts of such waste managed in on-site landfills, surface impoundments, waste piles, and land application units.

- National Survey of Treatment, Storage, Disposal, and Recycling Facilities (TSDR Survey). The TSDR Survey was conducted in 1986 to gather information on waste generation and management practices for 1986 and any projected changes in waste management capacity prior to 1992. The Survey questioned approximately 2,500 facilities that manage hazardous waste on-site, including the 2,400 RCRA-permitted or interim status treatment, disposal, or recycling facilities, and approximately 100 of the 700 storage facilities. The Survey addressed both hazardous and non-hazardous waste management at these hazardous waste management facilities. This data source provided information related to non-hazardous industrial waste management practices and waste generation by industry groups.

- Background documents for recent Agency listings decisions. Reports prepared for the Agency's proposed decision not to list certain dyes and pigments wastestreams as hazardous and the proposed decision not to list certain solvent wastestreams as hazardous. The document identifies the industries responsible for these wastestreams.

In addition, this Chapter uses data from the 1992 Toxic Release Inventory (TRI) on the amount of certain toxic substances released to land or injected underground by various industries. This data source is discussed in Section 8.2.4. At the time this Study was prepared, facility-specific data from the 1994 TRI were not available. Therefore, 1992 TRI data were used in this chapter. While the use of 1992 instead of more recent TRI data will not significantly affect the analysis, it will limit the results to a smaller set of chemicals and will not reflect recent pollution prevention progress.

The first three data sources have the disadvantage of being relatively old. They reflect non-hazardous industrial waste generation and management practices prevalent a decade or more ago. Since then, patterns of waste generation and management are likely to have changed in some significant ways in response to the implementation of RCRA hazardous waste regulations and other federal and state programs. In addition, the ISDB is rather limited in the number of facilities surveyed in each industry sector, particularly with regard to organic analytes. The ISDB and Telephone Screening Survey also address only certain industries.

The data sources are not entirely consistent. For example, the estimates of non-hazardous industrial waste generation for similarly defined industry groups often differ substantially among the sources. These inconsistencies arise, in part, from the use of different data collection and summarization methods. In the analyses discussed below, the Agency has used what it considers to be the most reliable and complete data concerning waste generation and management from these sources.

EPA has previously analyzed the data from the first three data sources to investigate various aspects of non-hazardous industrial waste generation and management practices. Most of the data presented below come from two of these studies, the "Industrial D Industry Profiles"[1] and the 1988 "Report to Congress: Solid Waste Disposal in the United States."[2] The former document summarizes non-hazardous industrial waste generation and management practices in 25 industry sectors, while the latter source focuses on the land disposal of all non-hazardous solid waste covered by the RCRA Subtitle D criteria.

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[1] Systems Applications International Corporation, August 8, 1992, draft.

[2] U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response, October 1988.

8.2 Potential Gaps as a Function of Industry/Waste Source

This section discusses non-hazardous industrial waste generation by various industries as follows:

Section 8.2.1 reviews available data on the volume of such waste generated by specific industries or industry groups;

Section 8.2.2 compares these data with the industries responsible for the releases documented in Chapter 2;

Section 8.2.3 identifies the industries responsible for generating non-hazardous industrial wastes containing constituents with the highest risk of adverse human health effects; and

Section 8.2.4 identifies the industries with facilities reporting TRI releases to land and underground injection of known or possible non-hazardous industrial waste constituents.

8.2.1 Non-Hazardous Industrial Waste Generation by Industry

In 1988, the Agency estimated that approximately 7.6 billion tons of non-hazardous industrial waste was generated and managed on-site annually in the United States.[3] Approximately 68 percent of this waste came from four major industry groups:

- Paper and allied products (SIC 26): 2.25 billion tons (29.6 percent);
- Chemicals and allied products (SICs 2812-2819, 2821, 2824, 2851, 2891, 2865, 2869, and 287): 1.39 billion tons (18.2 percent);
- Primary metals industries (SICs 3312-3321 and 3331-3399): 1.37 billion tons (18.0 percent); and
- Petroleum refining and related industries (SIC 29): 168 million tons (2.2 percent).

On the basis of the amounts of waste generated and risk-based screening of waste constituents, the Office of Solid Waste identified these four industry groups as "priority industries" for possible further regulation. Other industries that generate more non-hazardous industrial wastes than petroleum refining were not identified as priority industries on the basis of risk-based screening of waste constituents. Exhibit 8-1 summarizes the estimates of non-hazardous industrial waste generation for the four priority industries and corresponding industry sectors and for other relatively high volume industries and sectors.

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[3] Ibid., p.2. This volume may include some special wastes, such as in the primary metals or electrical power generation industries.

Exhibit 8-1
Estimated Generation of Non-Hazardous Industrial Waste by Major Industry Group

Industry Group	SIC	Total On-site Generation (thousand tons/yr.)
Paper and Allied Products	26	2,251,700
Primary Metals Industry[a]	33	1,367,611
Primary Iron and Steel	332	1,300,541
Primary Non-ferrous Metals	333	67,070
Chemicals and Allied Products[b]	28	1,324,722
Industrial Inorganic Chemicals	281	919,725
Fertilizer and Agricultural Chemicals	287	165,623
Plastics and Resins Manufacturing	282	180,510
Industrial Organic Chemicals	286	58,864
Electric, Gas, and Sanitary Services[c]	49	1,151,123
Electric Power Generation	4911	1,092,277
Water Treatment	4941	58,846
Stone, Clay, Glass, and Concrete	32	621,974
Food and Kindred Products	20	373,517
Textile Manufacturing	22	253,780
Petroleum Refining	29	168,632
Rubber and Miscellaneous Products	30	24,198
Transportation Equipment	37	12,669
Leather and Leather Products	31	3,234

Source: U.S. Environmental Protection Agency, "Report to Congress: Solid Waste Disposal in the United States," Volume II, Table 3-5, October 1988.

[a] The Primary Metals Industry includes only SICs 332 (Primary Iron and Steel) and 333 (Primary Non-ferrous Metals).

[b] Chemicals and Allied Product Industry includes only SICs 281 (Industrial Inorganic Chemicals), 282 (Plastics and Resins Manufacturing), 286 (Industrial Organic Chemicals), and 287 (Fertilizer and Agricultural Chemicals).

[c] Electric, Gas, and Sanitary Services Industry includes only SICs 4911 (Electric Power Generation) and 4941 (Water Treatment).

The listing documents for solvent wastes and wastes from the dye and pigment industries are another source of information on non-hazardous industrial waste. All of the information related to waste volumes and constituents concentrations for the dye and pigment industries, however, was claimed proprietary by the submitters and, therefore, could not be included in this Study. EPA recently identified non-hazardous industrial solvents in developing a recent proposed rulemaking. The amounts of solvent wastes have not been broken down by industry and, therefore, could not be included in Exhibit 8-1.

8.2.2 Industries Responsible for Documented Non-Hazardous Industrial Waste Releases

The environmental release descriptions discussed in Chapter 2 provide additional evidence about the industries (and waste management practices) associated with potential gaps in the characteristics. Exhibit 8-2 tabulates, by industry, the frequency of documented releases and their exceedence of health-based or ecologically-based regulatory standards. As shown in this exhibit, some of the industries that show up frequently in the release descriptions are among the high-volume industries identified above. The most frequently occurring industry group in the release descriptions is electric, gas, and sanitary services (SIC 49) with all of those release descriptions originating in the refuse systems sector (SIC 4953). This industry sector includes commercial waste management facilities. As noted in Chapter 2, most of these commercial non-hazardous industrial waste management units are located in California, where considerable monitoring data were available. From these data, EPA could not determine the industries that generate the wastes managed by these commercial facilities.

The next three industry groups with the most documented releases are the paper and allied products (27 releases), chemicals and allied products (11 releases), and food and kindred products (10 releases). These industry groups also are among the largest generators of non-hazardous industrial waste. The primary metals industry, another high-volume group, also has a moderate number of documented releases; they account for 6 of the 112 total releases documented in Chapter 2.

Exhibit 8-2 also shows the numbers of documented releases at which the maximum detected concentrations of constituents exceeded health-based or ecologically-based standards.[4] All but six of the 101 releases with data on the standards exceeded had exceedences of health- or ecologically-based standards.[5] These six releases exceeded secondary maximum contaminant levels (SMCLs) only. Sixty-five of these releases also violated other standards.

Exhibit 8-3 shows the total numbers of times particular chemicals were found in the release descriptions for various industry sectors. (The totals are the sums of the number of individual chemicals detected at each site, counting all chemicals for each site, even if a chemical is detected at more than one site. For example, the total detections at two sites having 10 chemicals each, 3 of which are the same, is 20, not 17.) In addition, the exhibit shows the numbers of times such

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[4] Health-based or ecologically-based standards included Primary MCLs, MCLGs, and state standards established to protect health or the environment. Non-health-based or non-ecologically-based standards are those set to preserve groundwater usability or aesthetics, such as Secondary MCLs or standards for which any health or ecological bases were not explained.

[5] EPA lacks information on the regulatory standards that were exceeded for all releases from California and for two releases from other states. All releases described in this Study, however, were documented to have exceeded one or more applicable federal, state, or local regulatory standards.

Exhibit 8-2
Chemicals Exceeding Health-Based and Non-Health-Based Regulatory Levels in the Release Descriptions for Non-Hazardous Waste Management

Industry Group (SIC)	Number of Release Descriptions			
	Total[a]	With Both Health/ Ecological and Non-Health/Non-Ecological Exceedences	With Only Health/ Ecological Exceedences	With Only Non-Health/Non-Ecological Exceedences
Electric, Gas, and Sanitary Services (49)	35	11	11	4
Paper and Allied Products (26)	27	22	4	1
Chemicals and Allied Products (28)	11	8	3	0
Food and Kindred Products (20)	10	6	3	0
Primary Metal Industries (33)	6	2	4	0
Nonmetallic Minerals, Except Fuels (14)	4	4	0	0
Petroleum Refining (29)	4	3	1	0
Fabricated Metal Products (34)	3	0	2	1
Transportation Equipment (37)	3	3	0	0
Agricultural Production--Livestock (02)	2	2	0	0
Electronic and Other Electronic Equipment (36)	2	1	0	0
Stone, Clay, and Glass Products (32)	2	2	0	0
Apparel and Other Textile Products (23)	1	1	0	0
Industrial Machinery and Equipment (35)	1	0	1	0
Instruments and Related Products (38)	1	0	1	0
Total	112	65	30	6

[a] The total number of release descriptions in column 2 may not equal the sum of the release descriptions in columns 3, 4, and 5. Column 2 includes all release descriptions for chemicals that were documented to have exceeded at least one applicable federal, state, or local regulatory standard. Columns 3, 4, and 5 include only those release descriptions in Column 2 for which supporting data indicate which regulatory standards were exceeded. Information was not available on the regulatory standards that were exceeded for all releases from California and for two releases from other states.

Exhibit 8-3
Numbers of Chemical Detections and Frequencies of Regulatory Exceedences in Release Descriptions

Industry Group (SIC)	Number of Release Descriptions	Chemical Detections		Regulatory Exceedences		Health- or Ecologically-Based Exceedences	
		Total	Mean Per Release	Total	Mean Per Release	Total	Mean Per Release
Electric, Gas, and Sanitary Services (49)	35	350	10	91	3	58	2
Paper and Allied Products (26)	27	340	13	148	5	85	3
Chemicals and Allied Products (28)	11	250	23	97	9	73	7
Food and Kindred Products (20)	10	72	7	22	2	13	1
Primary Metal Industries (33)	6	58	10	27	5	24	4
Nonmetallic Minerals, Except Fuels (14)	4	91	23	49	12	34	9
Petroleum Refining (29)	4	40	10	16	4	8	2
Fabricated Metal Products (34)	3	12	4	7	2	5	2
Transportation Equipment (37)	3	48	16	19	6	14	5
Agricultural Production--Livestock (02)	2	18	9	8	4	5	3
Electronic and Other Electronic Equipment (36)	2	16	8	4	2	1	0
Stone, Clay, and Glass Products (32)	2	33	17	14	7	10	5
Apparel and Other Textile Products (23)	1	3	3	3	3	2	2
Industrial Machinery and Equipment (35)	1	7	7	3	3	3	3
Instruments and Related Products (38)	1	2	2	1	1	1	1
Total	112	1,340	---	509	---	336	---

chemicals were detected above regulatory levels, and the proportions of chemicals found above health-based or ecologically-based standards. The 3 industries with the most releases, electric, gas, and sanitary services (35 releases), paper and allied products (27 releases), and chemicals and allied products (11 releases), also had the highest numbers of chemical detections (350, 340, and 250, respectively). The average number of chemicals detected per facility varies substantially across industries. For example, the 3 industries noted above had means of 10, 13, and 23 chemicals detected per release, respectively. The average number of regulatory and health- or ecologically-based exceedences per release also varies greatly across industries. For example, the electric, gas, and sanitary services industry averages only 3 regulatory and 2 health- or ecologically-based exceedences for every 10 chemical detections. In contrast, the chemical industry averages 9 regulatory and 7 health- or ecologically-based exceedences for every 23 chemical detections.

8.2.3 Occurrence of High-Hazard Industrial Waste Constituents by Industry

Another indicator of the potential severity of hazards associated with releases from non-hazardous industrial waste management in various industries is the frequency of occurrence of waste constituents with the highest risk to humans. Exhibit 8-4 identifies the chemicals that appeared most frequently in the release descriptions, the number of total appearances, and the number of times the chemical was present in groundwater above regulatory or other health-based levels based on 10^{-5} cancer risks or a hazard quotient greater than 1.0. As noted in Section 5.1, many of the most frequently occurring chemicals do not have health-based or ecologically-based standards, but may have SMCLs or other regulatory levels. Among these are the three most common constituents found in the release descriptions: iron, chloride, and sodium, as well as manganese, zinc, calcium, magnesium, potassium, copper, aluminum, and silver.

A substantial number of potentially toxic chemicals were detected in the release descriptions. For example, 11 of the 52 most frequently detected chemicals are known or suspect carcinogens by ingestion or inhalation.[6] Only one of the most frequently detected chemicals (phosphorous) is identified as having a low RfD, although several other chemicals on the list are generally considered toxic, including lead, mercury, cadmium, arsenic, and chromium. Seven of the most frequently detected chemicals are chlorinated volatile organics, with trichlorethylene, occurring most often (17 times). While all of the inorganic analytes appearing on the list are persistent, none of the most frequently occurring organic chemicals were identified as persistent in Chapter 4. In fact, none of the persistent bioaccumulative chlorinated pesticides identified as posing potentially high risks are seen in the release descriptions more than three times and most were seen in only one release description.

Exhibit 8-5 shows the number of occurrences and the number of regulatory, health-based, or ecologically-based exceedences for the constituents detected most frequently in the release descriptions for each industry group. For each group, the 15 most frequently detected chemicals or all detected chemicals are shown, whichever is smaller. In almost all industry groups, inorganic chemicals are found more often than organics. This finding may be due, in part, to a lack of analytical data for organic chemicals in some industries. Volatile organic chemicals are rarely found among the most frequently detected chemicals, with a few exceptions. Iron, manganese, and sulfate were among the most frequently found chemicals in the electric, gas, and sanitary services release descriptions, and volatile organics represent the bulk of the most frequently detected chemicals for the electronic and other electronic equipment industry and the petroleum refining industry. The relative scarcity of

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[6] These are chemicals that were identified as having Cancer Slope Factors or Unit Risks in IRIS or HEAST.

Exhibit 8-4
Most Frequently Occurring Constituents in the Release Descriptions

Constituent	Number of Occurrences in Release Descriptions	Number of Occurrences Above Regulatory Levels or HBLs[a]
TC Constituents		
Lead	37	22
Chromium	36	21
Arsenic	29	24
Barium	28	28
Cadmium	28	28
Benzene	23	16
Mercury	19	6
Selenium	18	18
Trichloroethylene	17	8
Vinyl chloride	13	6
Silver	12	12
Chlorobenzene	9	9
Tetrachloroethylene	9	9
Chloroform	8	8
1,4-Dichlorobenzene	5	0
SMCL Constituents		
Iron	54	49
Chloride	52	32
Manganese	39	39
Zinc	33	33
Copper	17	17
Aluminum (fume or dust)	12	12
Fluorides	12	4
Other Constituents		
Sodium	40	8
Nitrates	33	30
Magnesium	32	3
Calcium	30	0
Potassium	21	0
Other Constituents (continued)		

Exhibit 8-4 (continued)
Most Frequently Occurring Constituents in the Release Descriptions

Constituent	Number of Occurrences in Release Descriptions	Number of Occurrences Above Regulatory Levels or HBLs[a]
Toluene	20	20
Phenol	18	18
Ammonia	16	11
Calcium carbonate	15	0
Nickel	14	4
Dichloromethane	12	12
Nitrite	11	9
Ethylidene dichloride	10	10
Xylene (mixed isomers)	10	10
Acetone	9	9
Nitrogen	8	0
Beryllium	7	7
cis-1,2-Dichloroethylene	7	7
Ethylbenzene	7	7
Vanadium (fume or dust)	7	6
1,2-Dichloroethylene	6	6
Boron and compounds	6	3
Chloromethane	6	0
Cyanides	6	6
Phosphorus	6	1
1,2-Dichlorobenzene	5	5
Antimony	5	5
Carbon disulfide	5	5
Cobalt	5	0
Naphthalene	5	3

[a] Regulatory levels include MCLs, SMCLs, AWQCs, or other state health- or ecologically-based standards. HBLs are drinking water concentrations corresponding cancer risk of 10^{-5} or Hazard Quotient of 1.0 for an adult, using IRIS or HEAST toxicity criteria.

Exhibit 8-5
Occurrence of Waste Constituents by Industry Group

Industry Group (SIC)	Constituent	Number of Occurrences in Release Descriptions	Number of Occurrences Above Regulatory, Health- or Ecologically-based Levels
Paper and Allied Products (26)	pH[*]	22	12
	Chloride[*]	21	13
	Iron[*]	21	21
	Sulfate[*]	20	12
	Sodium	15	2
	Calcium carbonate	12	0
	Calcium	11	0
	Magnesium	11	2
	Zinc[*]	11	11
	TDS[*]	10	7
	Chromium	9	5
	Manganese[*]	9	9
	Arsenic	8	7
	Barium	7	7
	Cadmium	7	7
Refuse Services (495)	pH[*]	19	3
	Iron[*]	14	10
	Manganese[*]	13	13
	Sulfate[*]	13	4
	Lead	12	4
	Chloride[*]	11	7
	Magnesium	10	1
	Nitrate	10	7
	TDS[*]	10	1
	Trichloroethylene	10	3
	Benzene	9	3
	Calcium	9	0
	Chromium	9	4
	Sodium	9	1
	Vinyl Chloride	9	3
Chemicals and Allied Products (28)	Benzene	7	6

Exhibit 8-5 (continued)
Occurrence of Waste Constituents by Industry Group

Industry Group (SIC)	Constituent	Number of Occurrences in Release Descriptions	Number of Occurrences Above Regulatory, Health- or Ecologically-based Levels
	Chromium	7	4
	Iron*	7	6
	Lead	6	4
	Manganese*	6	6
	Sulfate*	6	4
	TDS*	6	4
	Zinc*	6	6
	Arsenic	5	5
	Chloride*	5	1
	Fluoride*	5	1
	Total Organic Carbon	5	1
	Acetone	4	4
	Barium	4	4
	Cadmium	4	4
Nonmetallic Minerals, Except Fuels (14)	Arsenic	4	2
	Iron*	4	4
	Lead	4	4
	Manganese*	4	4
	pH*	4	2
	Cadmium	3	3
	Chloride*	3	3
	Copper*	3	3
	Nickel	3	1
	Potassium	3	0
	Sodium	3	0
	Sulfate*	3	3
	Zinc*	3	3
	Aluminum	2	2
	Barium	2	2
Food and Kindred Products (20)	Nitrite	6	4
	Nitrate	5	5

Exhibit 8-5 (continued)
Occurrence of Waste Constituents by Industry Group

Industry Group (SIC)	Constituent	Number of Occurrences in Release Descriptions	Number of Occurrences Above Regulatory, Health- or Ecologically-based Levels
	Nitrogen	5	0
	pH*	4	0
	TDS*	4	3
	Total filterable residue	4	0
	Calcium	3	0
	Chloride*	3	2
	Magnesium	3	0
	Sodium	3	2
	Sulfate*	3	2
	Ammonia	2	1
	Bicarbonate	2	0
	Conductivity	2	0
	Copper*	2	2
Primary Metal Industries (33)	Lead	4	4
	Chromium	3	3
	Aluminum*	2	2
	Arsenic	2	2
	Barium	2	2
	Cadmium	2	2
	Chloride*	2	2
	Conductivity	2	0
	Mercury	2	0
	Nickel	2	2
	Zinc*	2	2
	2,4,6-Trichlorophenol	1	0
	2,4-Dichlorophenol	1	1
	2,4-Dimethylphenol	1	1
	2,4-Dinitrophenol	1	1
Petroleum Refining (29)	Chloride*	3	2
	Conductivity	2	1
	Di-n-butylphthalate	2	1

Exhibit 8-5 (continued)
Occurrence of Waste Constituents by Industry Group

Industry Group (SIC)	Constituent	Number of Occurrences in Release Descriptions	Number of Occurrences Above Regulatory, Health- or Ecologically-based Levels
	Naphthalene	2	1
	pH*	2	1
	Sulfate*	2	2
	TDS*	2	2
	1,2-Dichloroethane	1	1
	2-Methylnaphthalene	1	0
	Acenaphthene	1	1
	Acetone	1	1
	Barium	1	1
	Benzene	1	1
	Carbon disulfide	1	1
	Chlorobenzene	1	1
Agricultural Production--Livestock (02)	Ammonia	2	0
	Nitrate	2	2
	TDS*	2	2
	Bicarbonate	1	0
	Calcium	1	0
	Chemical Oxygen Demand	1	0
	Chlorine*	1	1
	Iron*	1	1
	Magnesium	1	0
	Nitrite	1	1
	Nitrogen	1	0
	pH*	1	0
	Phosphorus	1	0
	Sodium	1	1
	Toluene	1	1
Transportation Equipment (37)	Phenol	3	3
	Barium	2	2
	Chromium	2	1
	Total Organic Carbon	2	1

Exhibit 8-5 (continued)
Occurrence of Waste Constituents by Industry Group

Industry Group (SIC)	Constituent	Number of Occurrences in Release Descriptions	Number of Occurrences Above Regulatory, Health- or Ecologically-based Levels
	1,1-Dichloroethane	1	1
	2,4-Dimethylphenol	1	0
	Aluminum*	1	1
	Ammonia	1	1
	Antimony	1	1
	Arsenic	1	1
	BEHP	1	1
	Benzene	1	1
	Beryllium	1	1
	Cadmium	1	1
	Calcium	1	0
Electronic and Other Electronic Equipment (36)	1,1-Dichloroethane	1	1
	Carbon tetrachloride	1	1
	Chloride*	1	1
	Chloroform	1	1
	Iron*	1	1
	Manganese*	1	1
	Methylene chloride	1	1
	pH*	1	0
	Phenolics	1	0
	Sodium	1	0
	Sulfate*	1	1
	Tetrachloroethylene	1	1
	Toluene	1	1
	Total Organic Carbon	1	0
	Total Organic Halogens	1	0
Stone, Clay, and Glass Products (32)	Ammonia	1	1
	Arsenic	1	1
	Barium	1	1
	Benzene	1	1
	Beryllium	1	1

Exhibit 8-5 (continued)
Occurrence of Waste Constituents by Industry Group

Industry Group (SIC)	Constituent	Number of Occurrences in Release Descriptions	Number of Occurrences Above Regulatory, Health- or Ecologically-based Levels
	Cadmium	1	1
	Calcium	1	0
	Carbon disulfide	1	1
	Chemical Oxygen Demand	1	0
	Chloride*	1	0
	Chromium	1	1
	Cobalt	1	0
	Conductivity	1	0
	Copper*	1	1
	Cyanide	1	1
Fabricated Metal Products (34)	Chemical Oxygen Demand	1	0
	Chloride*	1	1
	Chromium	1	1
	cis-1,2-Dichloroethylene	1	1
	Lead	1	0
	Manganese*	1	1
	Nitrate	1	1
	pH*	1	1
	Phenol	1	1
	Total Dissolved Solids*	1	0
	Trichloroethylene	1	1
	Zinc*	1	1

Exhibit 8-5 (continued)
Occurrence of Waste Constituents by Industry Group

Industry Group (SIC)	Constituent	Number of Occurrences in Release Descriptions	Number of Occurrences Above Regulatory, Health- or Ecologically-based Levels
Industrial Machinery and Equipment (35)	Arsenic	1	0
	Cadmium	1	1
	Chromium	1	0
	Lead	1	1
	pH*	1	0
	Phenol	1	1
	Zinc*	1	1
Apparel and Other Textile Products (23)	Cadmium	1	1
	Nitrate	1	1
	Total Organic Carbon	1	1
Instruments and Related Products (38)	Grease and Oil	1	0
	Phenol	1	1

* Constituents with Secondary Maximum Contaminant Levels.

organics for some of the industries could be slightly misleading. For example, a large number of volatile organic chemicals were detected in the release descriptions from the chemicals and allied products industry and petroleum refining, but each chemical was detected infrequently, so they do not appear in Exhibit 8-5.

The persistent chlorinated pesticides were not among the most frequently detected chemicals, except in two industries. Pentachlorophenol was detected in a single release description from the primary metals industry. Semivolatile organics are likewise not among the most frequently detected analytes in the release descriptions, but this may be a function of the poor mobility of many of these chemicals in groundwater, rather than their lack of presence in the wastes. As was the case for the volatile organics, a large number of pesticides and semivolatile organics were detected in the release descriptions from the chemicals and allied products sector and each such chemical was found only one or a few times.

The pattern of chemical detections and health-based or ecologically-based exceedences varied widely among the industry groups, as discussed in Section 8.1.2. As noted previously, the frequency of non-health-based and non-ecologically-based exceedences is relatively high among some industry groups with the highest number of total chemicals detected. For example, SMCLs, which are based on aesthetic considerations (e.g., water taste and odor), exist for 6 of the 15 most commonly detected analytes for the refuse systems sector (SIC 4953) and the paper and allied products industry (SIC 26), and 7 of the 15 analytes from the chemicals and allied products industry (SIC 28). Again, this finding may be somewhat misleading because many of the less frequently detected analytes from these sectors do have health-based or ecologically-based standards. Furthermore, some constituents with SMCLs may also pose health and ecological risks. The same pattern applies to stone, clay, and gas products (SIC 32), and food and kindred products (SIC 20). In the food and kindred products industry, the only health-based exceedences were for nitrates, nitrites, or both. All of the other most frequent exceedences for this industry group were non-health-based and non-ecologically-based.

8.2.4 Industries Reporting Releases of TC Analytes or Known or Possible Non-Hazardous Industrial W Constituents

Another indication of the potential importance of the various industries with regard to non-hazardous industrial waste management is provided by data concerning the amounts of chemicals these industries release to the environment, as reported under the EPCRA TRI requirements. Exhibit 8-6 identifies, by industry, volumes of TC analytes or known or possible non-hazardous industrial waste constituents that in 1992 were reported released to land or underground injection in an amount exceeding 1 million pounds.[7] Volumes of waste released to land or underground injection are presented in this Study because they are thought to be the most indicative of the volume of non-hazardous waste at the facilities. The listed volumes are the mass of individual constituents in waste streams or other emissions rather than total waste volumes as presented in other exhibits in this chapter. The volumes may include hazardous, special, and municipal solid waste as well as non-hazardous industrial waste.

The largest volume of constituents reported released via underground injection in 1992 were from the chemicals and allied products industry, which contributed 99.3 percent of total volume from underground injection. A significant portion of these constituents may be in hazardous wastewaters. The second and third largest volumes of TRI constituents come from the petroleum refining and primary metals industries, which contributed 0.57 and 0.04 percent of total volume from underground injection, respectively. The two constituents released in the largest volumes to underground injection from the chemicals and allied products industry were methanol and acetonitrile, with 38 and 29 percent of total volume for that industry, respectively. Methanol was also released in the highest volume from the petroleum refining industry, comprising 57 percent of the total constituent volume reported for that industry.

The largest volume of constituents released to land originates from the primary metals industry, which contributes 74.2 percent of the total volume. Most of that volume (99 percent) is comprised of constituents, such as zinc, copper, and chromium, that may be present in large volume special wastes. (Further investigation is needed to determine whether any of these releases involve special or hazardous wastes.) The two chemicals comprising almost equal proportions released by this industry are zinc and copper, with about 48 percent each. The second and third largest volumes of constituents were from the petroleum refining and paper and allied products industries, respectively. Petroleum refining contributed 10.1 percent of total volume and paper and allied products contributed 8.4 percent of total volume released to land. Naphthalene and xylene, with 43 and 32 percent of total volume reported released to land, constituted the largest proportion of the constituents from the

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[7] Detailed 1994 TRI facility-specific data were not available when this Study was prepared, therefore, 1992 TRI data were used.

Exhibit 8-6 **Non-Hazardous Industrial Waste Constituents Reported Released by Industry**

Exhibit 8-6 Non-Hazardous Industrial Waste Constituents Reported Released by Industry (continued)

petroleum refining industry. Almost 99 percent of the volume of constituents released to land by the paper and allied products industry was methanol.

8.3 Potential Gaps as a Function of Management Practices

This section of the Scoping Study reviews the available information related to management practices:

Section 8.3.1 examines the prevalent management practices among the major non-hazardous industrial waste generating industries;

Section 8.3.2 reviews the evidence regarding environmental releases as a function of management type for major management technologies;

Section 8.3.3 describes limited data available on the potential hazards associated with use constituting disposal; and

Section 8.3.4 briefly discusses the potential nature of the hazards associated with less well-characterized management practices.

8.3.1 Waste Management Practices by Waste Type and Industry

As noted previously, the data related to non-hazardous industrial waste management practices are quite limited and may be somewhat outdated. Inconsistencies frequently were found between data from the different sources. Exhibit 8-7 summarizes the information for the relatively high volume generation industries. Based on the available information, the vast majority of non-hazardous industrial waste is aqueous and is managed in surface impoundments before treatment and ultimate discharge under NPDES. The proportion of these wastes going to surface impoundments in 1985 ranged from 78.6 percent in the food and kindred products industry to 99.7 percent in the textile manufacturing industry, with a total of 96.5 percent of all wastes managed in this fashion in the 15 industries included in the exhibit. The second most widely used land-based management technology was land application. Only about 1.3 percent of the waste volume from the 15 industries was managed in this fashion in 1985, with substantially larger proportions going this route in the organic chemicals industry (3.1 percent), the food and kindred products industry (20 percent), and water treatment industry (15 percent). Landfills and waste piles each accounted for about one percent of the total waste managed in the 15 industries.

Exhibit 8-8 estimates the number of active landfills, surface impoundments, land application units, and waste piles used to manage non-hazardous waste in various industry groups in 1985. At that time, 55 percent of these land-based units were surface impoundments. This finding indicates that, on average, surface impoundments handled larger volumes of waste than other management units since they managed a substantially greater percentage (96 percent) of total on-site non-hazardous industrial waste. In all industries except primary iron and steel and transportation equipment, surface impoundments were the most common type of management units. Waste piles constituted 19 percent of the total units. They were the most common type of unit in the primary iron and steel and transportation equipment industries, were the second most common type in eight industries, and tied for second in another. Land application units represented 16 percent of all units. Over 70 percent of these units, however, were in the food and kindred products industry. Landfills represented only 10 percent of all units.

Exhibit 8-7
Volume of Non-Hazardous Industrial Waste Managed in Land-Based Facilities in 1985

Major Industry Group (SIC)	Treatment or Disposal Method (percentages)[a]				Total
	Landfill	Surface Impoundment	Land Application	Waste Piles	Tons Managed (1000 tons/yr.)
Paper and Allied Products (26)	0.30%	99.30%	0.40%	0.07%	2,251,700
Primary Metals Industry (33)[b]	0.39	98.5	0.04	1.1	1,367,611
Primary Iron and Steel (332)	0.3	99.2	<0.01	0.5	1,300,541
Primary Non-ferrous Metals (333)	2.1	84.3	0.6	13	67,070
Chemicals and Allied Products (28)[c]	0.74	95.3	0.21	3.7	1,324,722
Industrial Inorganic Chemicals (281)	0.4	95.1	0.01	4.5	919,725
Plastics and Resins Manufacturing (282)	0.05	98.2	0.02	1.7	180,510
Fertilizer and Agricultural Chemicals (287)	3.5	93.1	0.5	2.9	165,623
Industrial Organic Chemicals (286)	0.4	96.3	3.1	0.08	58,864
Electric, Gas, and Sanitary Services (49)[d]	4.7	94.5	0.78	0.08	1,151,123
Electric Power Generation (4911)	4.9	95	0.03	0.08	1,092,277
Water Treatment (4941)	0.3	84.5	15	0.1	58,846
Stone, Clay, Glass, and Concrete (32)	1.2	97.3	<0.01	1.5	621,974
Food and Kindred Products (20)	1	78.6	20	0.1	373,517
Textile Manufacturing (22)	0.03	99.7	0.3	<0.01	253,780
Petroleum Refining (29)	0.2	99.6	0.2	0.05	168,632
Rubber and Misc. Products (30)	2.2	97.4	0.2	0.2	24,198
Transportation Equipment (37)	1.4	93.1	<0.01	4.6	12,669
Leather and Leather Products (31)	0.3	99.4	0	0.3	3,234
Total	1.10%	96.50%	1.30%	1%	7,621,147

Source: U.S. Environmental Protection Agency, "Report to Congress: Solid Waste Disposal in the United States," Volume II, Table 3-5, October 1988.

[a] The entries in each column may not add to their respective totals because of rounding.

[b] The Primary Metals Industry includes only SICs 332 (Primary Iron and Steel) and 333 (Primary Non-ferrous Metals).

[c] Chemicals and Allied Products includes only SICs 281 (Industrial Inorganic Chemicals), 282 (Plastics and Resins Manufacturing), 286 (Industrial Organic Chemicals), and 287 (Fertilizer and Agricultural Chemicals).

[d] Electric, Gas, and Sanitary Services includes only 4911 (Electric Power Generation) and 4941 (Water Treatment).

Exhibit 8-8
Active Non-Hazardous Industrial Waste Management Units in 1985 by Major Industry Group

Major Industry Group (SIC)	Number of Treatment or Disposal Units				
	Landfill	Surface Impoundment	Land Application	Waste Piles	Total
Food and Kindred Products (20)	194	4,166	3,128	540	8,028
Stone, Clay, Glass, and Concrete Products (32)	1,257	3,152	309	2,528	7,246
Paper and Allied Products (26)	259	918	139	232	1,548
Electric Power Generation (4911)	155	1,220	43	110	1,528
Industrial Inorganic Chemicals (2812-2819)	120	1,039	24	98	1,281
Petroleum Refining (29)	61	915	114	158	1,248
Primary Iron and Steel (3312-3321)	201	383	76	464	1,124
Water Treatment (4941)	121	659	147	48	975
Textile Manufacturing (22)	28	741	72	103	944
Primary Non-ferrous Metals (3330-3399)	111	448	9	312	880
Transportation Equipment (37)	63	287	11	362	723
Fertilizer and Agricultural Chemicals (2873-2879)	31	274	160	50	515
Rubber and Miscellaneous Products (30)	77	176	16	123	392
Industrial Organic Chemicals (286)	17	262	27	79	385
Plastics and Resins Manufacturing (2821)	32	292	17	32	373
Selected Chemicals and Allied Products (28, except sectors otherwise noted)	21	219	17	41	298
Leather and Leather Products (31)	9	102	0	54	165
Total[a]	2,757	15,253	4,308	5,335	27,653

Source: Report to Congress, "Solid Waste Disposal in the United States," Volume II, EPA, Office of Solid Waste and Emergency Response, October 1988.

[a] The entries in each column may not add to their respective totals because of rounding.

Surface impoundments, land application, landfills, and waste piles are clearly not the only management technologies that can be used for non-hazardous industrial wastes. The totals in Exhibit 8-7 do not reflect all of the possible options for waste management. Exhibit 8-9 provides data from the Industrial D Industry Profiles discussed in Section 8.1 relating to non-hazardous industrial waste management practices in some industries occurring most frequently in the release descriptions. Most of these data are from the 1987 TSDR, and some are from the ISDB. Waste management practices summarized in this source are substantially different from those shown previously. The data are more detailed, and information is given for additional management methods, including container/tank storage, wastewater treatment systems, underground injection, recycle/reuse, and incineration.

The TSDR/ISDB data identify wastewater treatment systems (WWT and tank systems) as the dominant management methods for most industries, instead of surface impoundments. This difference may be partially due to the characterization of management units in the two surveys. Many of the units identified as "impoundments" in the TSS may have been identified as "WWT units" in the TSDR or ISDB. Also, the populations of facilities and wastes covered in the two surveys are different. For example, the TSDR Survey covered facilities in a wide range of industries, but only if they managed hazardous waste. The ISDB, on the other hand, covered a broader range of facilities, but only if they were in certain industry groups. In any event, the two sources generally agree that land-based treatment for aqueous wastes is the dominant management method for non-hazardous industrial wastes.

Land application, landfills, and waste piles show up as relatively minor management technologies, by volume, in the TSDR/ISDB data, consistent with the TSS data. Underground injection is also a minor but not insignificant management technology, accounting for up to approximately three percent of total waste management in the industries where it is most widely used. Some non-hazardous industrial wastes from all of the industries evaluated are recycled or reused (up to about 1.5 percent). Incineration also accounted for less than one percent of all non-hazardous industrial wastes managed in the various industries. The only waste management technology identified as being important for any industry other than those mentioned is "other processes/methods," which accounted for almost 50 percent of the wastes managed from the stone, clay, glass, and concrete industry. The process used to manage these wastes was not indicated, but it may include use in roadbed or fill.

8.3.2 Management Practices Seen in the Release Descriptions

The release descriptions for non-hazardous industrial waste management contain information about the types of management units at which releases to the environment have occurred. This source provides some direct evidence as to which types of management practices have the greatest potential for causing releases to the environment. Its major limitations, however, are that it covers only facilities for which data were readily available, namely regulated units, and that some of releases are relatively old.

Exhibit 8-9
Non-Hazardous Industrial Waste Management by Industry and Waste Type from TSDR and ISDB

Industry Group (SIC)	Major Waste Type(s)[a,b]	Management Type(s)	Total Amount (thousand metric tons)
Chemicals and Allied Products (280, 282 (except 2821), 285, 288, 289 (except 2891, 2892, 2893))	Aqueous Liquid Organic Liquid	WWT & Tank Systems[c]	79,669
		Surface Impoundments[c]	2,029
		Underground Injection[c]	236
		Incineration[c]	43
		Landfill[c]	14
		Other Processes/Methods[c]	8
		Recycle/Reuse[c]	4
		Land Application[b]	<1
Industrial Inorganic Chemicals (281)	Aqueous Liquid Solid Residue Gas Sludge/Slurry	WWT & Tank Systems[c]	25,421
		Underground Injection[c]	958
		Recycle/Reuse[b]	752
		Other Processes/Methods[b]	395
		Waste Pile Storage[b]	356
		Surface Impoundments[b]	263
		Landfill[b]	43
		Incineration[c]	2
Plastics and Resins (2821)	Aqueous Liquid	WWT & Tank Systems[c]	68,414
		Surface Impoundments[c]	45,842
		Underground Injection[b]	421
		Landfill[b]	132
		Recycle/Reuse[b]	73
		Land Application[b]	41
		Incineration[b]	25
		Waste Pile Storage[b]	5
		Other Processes/Methods[b]	3
		Container/Tank Storage[b]	<1

Exhibit 8-9 (continued)
Non-Hazardous Industrial Waste Management by Industry and Waste Type from TSDR and ISDB

Industry Group (SIC)	Major Waste Type(s)[a,b]	Management Type(s)	Total Amount (thousand metric tons)
Drug and Medical Products (283)	Aqueous Liquid	WWT & Tank Systems[c]	197,143
		Recycle/Reuse[c]	1,818
		Surface Impoundments[c]	193
		Underground Injection[c]	126
		Incineration[c]	18
		Landfill[c]	<1
Industrial Organic Chemicals (268)	Aqueous Liquid Gas Organic Liquid	WWT & Tank Systems[c]	182,642
		Surface Impoundments[c]	78,193
		Recycle/Reuse[b]	3,867
		Other Processes/Methods[b]	3,705
		Underground Injection[b]	3,296
		Incineration[b]	1,667
		Landfill[b]	1,406
		Land Application[b]	225
		Other Processes/Methods[c]	33
		Container/Tank Storage[b]	7
		Waste Pile Storage[c]	3
Agricultural Chemicals (287)	Aqueous Liquid	WWT & Tank Systems[c]	110,869
		Surface Impoundments[c]	664
		Underground Injection[b]	462
		Other Processes/Methods[c]	122
		Incineration[b]	52
		Landfill[b]	37
		Land Application[b]	29
		Container/Tank Storage[b]	20
		Recycle/Reuse[b]	13
		Waste Pile Storage[b]	2

Exhibit 8-9 (continued)
Non-Hazardous Industrial Waste Management by Industry and Waste Type from TSDR and ISDB

Industry Group (SIC)	Major Waste Type(s)[a,b]	Management Type(s)	Total Amount (thousand metric tons)
Products of Petroleum and Coal (29)	Aqueous Liquid Sludge/Slurry	WWT & Tank Systems[c]	137,446
		Land Application[b]	2,323
		Recycle/Reuse[b]	2,189
		Underground Injection[b]	1,946
		Surface Impoundments[c]	1,237
		Other Processes/Methods[b]	513
		Container/Tank Storage[b]	107
		Landfill[b]	64
		Incineration[c]	6
		Waste Pile Storage[c]	5
Stone, Clay, Glass, and Concrete (32)	NA		
		WWT & Tank Systems[c]	2,210
		Other Processes/Methods[c]	2,174
		Surface Impoundments[c]	180
		Recycle/Reuse[c, d]	38
Steel Works, Blasting (331)	Aqueous Liquid	WWT & Tank Systems[c]	428,486
		Recycle/Reuse[b]	2,216
		Surface Impoundments[c]	390
		Underground Injection[b]	332
		Other Processes/Methods[b]	258
		Landfill[b]	47
		Incineration[b]	19
		Container/Tank Storage[b]	<1
		Waste Pile Storage[c]	<1
Iron and Steel Foundries (332)	NA	Surface Impoundments[c]	1,335
		Waste Pile Storage[c]	39
		Other Processes/Methods[c]	39

Exhibit 8-9 (continued)
Non-Hazardous Industrial Waste Management by Industry and Waste Type from TSDR and ISDB

Industry Group (SIC)	Major Waste Type(s)[a,b]	Management Type(s)	Total Amount (thousand metric tons)
Nonferrous Metals Primary Smelting (333)	NA	WWT & Tank Systems[c]	6,656
		Landfill[c]	24
		Recycle/Reuse[c]	<1
Fabricated Metal Products (34)	Aqueous Liquid Sludge/Slurry	WWT & Tank Systems[c]	11349
		Surface Impoundments[c]	668
		Other Processes/Methods[c]	15
		Incineration[c]	4
		Landfill[b]	2
		Recycle/Reuse[b]	<1
		Container/Tank Storage[b]	<1
Electronics & Other Electronic Equipment (36)	NA	WWT & Tank Systems[c]	21,463
		Surface Impoundments[c]	1,447
		Recycle/Reuse[c]	10
		Incineration[c]	5

NA - No data available

[a] Includes waste types greater than 1% of total

[b] ISDB

[c] TSDR; total does not include gases

[d] Reuse of fuel only

Exhibit 8-10 tabulates by industry the number of waste management units of different types found in the release descriptions. Of the 120 waste management units identified in the release descriptions, 73 (61 percent) are landfills, while 28 (23 percent) are surface impoundments. Twelve land application units (10 percent) and 4 waste piles were also identified, along with one trench, 1 evaporation pond, and 1 stormwater retention pond.

These data provide a somewhat different picture than would be expected, merely based on the number of management units in the various industries and the volumes of wastes managed in different types of units. Despite the preponderance of landfills in the release descriptions, the vast majority of the non-hazardous industrial wastes are being managed (or were being managed at the time of the TSS) in surface impoundments. As shown in Exhibit 8-8, for the industries presented, there are 15,253 surface impoundments versus only 2,757 landfills. Several possible explanations for this apparent discrepancy can be advanced. First, better groundwater monitoring data may be available for landfills than for surface impoundments. Second, management methods may have changed substantially in the last 11 years. This explanation seems unlikely; surface impoundments or related treatment systems probably will remain a management method of choice as long as aqueous wastes are the dominant waste form. Some movement to tanks or other treatment systems may have occurred, and process changes may also have reduced the volume of liquid wastes, but EPA has no information as to how extensive these changes may have been. In any event, a large-scale shift away from surface impoundments to landfills seems unlikely, simply based on cost considerations, even if it was technically feasible for some wastes.

Another possible explanation is that the initial concentrations of potentially toxic constituents may be lower, on average, for surface impoundments than for landfills, and the highly concentrated solid residues from the impoundments may themselves end up in landfills, or the surface impoundments may be closed as landfills. Finally, design features of non-hazardous industrial waste landfills may make them more prone to releases, although the other factors just discussed are likely to be more important.

8.3.3 Potential Hazards Associated with Use Constituting Disposal

Few data are available on use that constitutes disposal (UCD) of solid wastes, which is regulated at the state level. Some data, however, are available for one category of these wastes: certain delisted wastes that are now being used in a manner constituting disposal. In the first case discussed below, a full risk assessment of UCD was not done at the time the waste was delisted. In the second case, pending proposals at the federal level would authorize UCD of delisted wastes; some states, however, may already be permitting some UCD practices for these wastes under other regulatory provisions.

Delisted K088 (spent potliners from primary aluminum reduction) that has been treated with lime and heated in a rotary kiln by a specific petitioner and subsequently disposed of primarily in a monofill has caused high leaching rates of cyanides, fluoride, and arsenic. While the treatment residue passes the TCLP test, the leachate from the monofill exceeds the TC level for arsenic and the delisting requirements for cyanides and fluoride. The treatment residual also has a pH of approximately 12.9 and is hazardous and not covered by the petitioner's exclusion. This K088 treatment residual also has been used for on-site road construction, under a state RCRA Subtitle D management permit. A recent site inspection found, after rainfall, large puddles of dark colored water, the same color as the treatment residue used to build the road. Samples of the runoff water are currently being analyzed.

Exhibit 8-10
Waste Management Unit Types in the Release Descriptions[a]

Industry Group	Evaporation Pond	Lagoon/Surface Impoundment	Land Application	Landfill	Stormwater Retention Pond	Trench	Waste Pile	Total
Agricultural Production-Livestock (02)		1	1					2
Apparel and Other Textile Products (23)			1					1
Chemicals and Allied Products (28)		6		5				11
Electric, Gas, Sanitary Services (49)		2		33				35
Electronic and Other Electronic Equipment (36)				1		1		2
Fabricated Metal Products (34)		1		2			1	4
Food and Kindred Products (20)		6	7					13
Industrial Machinery and Equipment (35)		1						1
Instruments and Related Products (38)			1					1
Nonmetallic Minerals, Except Fuels (14)		1		3				4
Paper and Allied Products (26)		5	1	23				29
Petroleum Refining (29)	1	2		1				4
Primary Metal Industries (33)		1		2	1		3	7
Stone, Clay, and Glass Products (32)		1		1				2
Transportation Equipment (37)		1	1	2				4
Total Units	1	28	12	73	1	1	4	120

[a] A facility may have more than one waste management unit.

This case raises two issues:

- The appropriateness of the TCLP test for evaluating the leaching potential of this waste treatment residual.
- The potential unevaluated risks from runoff from this material when used in a manner constituting disposal.

The first issue is discussed in Section 3.6. With respect to the second issue, EPA will evaluate the runoff risks from this site and potentially risks from other instances where states have permitted uses constituting disposal for non-hazardous industrial waste.

Risks from some UCD practices for some delisted wastes may not be fully understood. Comments on UCD proposals to allow several uses of high temperature metals recovery (HTMR) slags derived from K061, K062, and F006 listed wastes expressed concern about the completeness of risk evaluation. The proposed rule[8] would allow the de-listed HTMR slags to be used in road building as top grade material, as aggregate in cement, and as anti-skid material. EPA evaluated the risk from these materials using the TCLP test to estimate potential for leaching to groundwater. Commentors, however, expressed concerns about risks from surface runoff and wind-blown dust pathways and risks to workers. At the time of the proposal in December 1994, models to evaluate non-groundwater pathway risks were not adequately developed. Since then, such models have been developed and were used in a major rulemaking proposal, the December 1995 HWIR-Waste proposal. These models are undergoing revision in response to comments by the public and the Science Advisory Board (SAB). The modeling developed to support HWIR-Waste could used to evaluate UCD of de-listed HTMR slags or other stabilized waste once the models are refined.

8.3.4 Potential Hazards Associated with Other Management Practices

As noted in Section 8.3.1, it is clear that some non-hazardous industrial wastes are being managed in ways that do not involve treatment or final disposal in land-based units such as surface impoundments or landfills. These other management approaches may also pose potential risks to human health and the environment. In the course of the Scoping Study, the Agency has found little recent, reliable information as to the types and volumes of non-hazardous industrial wastes being managed using other technologies. A major complication in this regard is that, unlike the situation for hazardous wastes, generators are not required by federal regulations to identify or report non-hazardous industrial wastes, process residuals, or byproducts. Thus, any residual or byproduct material that has potential economic value does not need to be identified as a waste, and instead may simply be used or sold without restriction. In such cases, the distinction between what constitutes the simple commercial sale of a material that happens to be a byproduct of an industrial process, recycling, or use constituting disposal of a non-hazardous industrial waste may not be clear.

Putting this problem aside, it is certain that some non-hazardous wastes are being managed using techniques other than land storage, treatment, or disposal. Some of these technologies, such as incineration, unambiguously involve releases to the environment. Others such as recycling and reuse may involve releases, depending upon the nature of the use of the materials. In EPA's search for release descriptions, no instances were found where any of these alternative management methods had resulted in documented environmental releases meeting the stringent release selection criteria. In addition, as noted previously, the state non-hazardous industrial waste programs that constitute the major source of the release descriptions may not regulate some of these alternative waste management technologies. Thus, the available data do not allow a conclusion to be drawn about

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[8] 59 *Federal Register* 67256, December 29, 1994.

whether and to what extent such management methods may pose significant risks to human health or the environment. This data gap is discussed in more detail in Chapter 10.

EXHIBIT 8-6 TRI REPORTED RELEASES TO LAND OR UNDERGROUND INJECTION BY CONSTITUENT AND INDUSTRY

	Type of	SIC 20		SIC 21		SIC 22		SIC 24		SIC 25		SIC 26		SIC 27		SIC 28		SIC 29		SIC 30		SIC 31	
Chemical Name[a]	**Chemical**	**UI**	**L**	**UI**	**L**	**UI**	**L**	**UI**	**L**	**UI**	**L**	**UI**	**L**	**UI**	**L**	**UI**	**L**	**UI**	**L**	**UI**	**L**	**UI**	**L**
1,1,1-TRICHLOROETHANE	VCO	5	25	0	0	0	0	0	0	0	5,800	0	0	0	975	553	1,826	0	288	0	17,403	0	0
1,2-DICHLOROETHANE	VCO	0	1,000	0	0	0	0	0	0	0	0	0	0	0	0	6,927	858	0	0	0	0	0	0
1,3-BUTADIENE	VO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1,000	372	0	0	0	0	0	0
ACETALDEHYDE	OVO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1,905,859	289	0	0	0	0	0	0
ACETONITRILE	OVO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20,111,640	29	0	0	0	0	0	0
ACRYLAMIDE	OSO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4,188,680	963	0	0	0	0	0	0
ACRYLONITRILE	OVO	0	0	0	0	0	0	0	0	0	0	0	30	0	0	3,795,670	387	0	0	0	7,654	0	0
ANILINE	OSO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1,195,676	1,173	0	0	0	0	0	0
BENZENE	VO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	268,921	225,952	78,162	114,164	0	0	0	0
BROMOMETHANE	OVO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1,000	0	0	0	0	0	0	0
CARBON DISULFIDE	OVO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2,704	5	0	16	0	0	0	0
CHLOROBENZENE	VCO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	72,000	817	0	0	0	0	0	0
CHLOROFORM	VCO	0	0	0	0	0	0	0	0	0	0	0	11,582	0	0	50,240	17,000	0	0	0	0	0	0
CHLOROMETHANE	VCO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	86,709	0	0	0	0	0	0	0
CHLOROPRENE	VCO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	54,000	0	0	0	0	1,811	0	0
CHROMIUM	IO	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	4,550	0	2,226	0	2	0	7,707
COPPER	M/I	0	0	0	0	0	0	5	250	0	0	0	0	0	0	16,460	14,810	0	0	0	0	0	0
CUMENE	VH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11,000	315	4,100	468	0	0	0	0
DICHLORODIFLUOROMETHANE	VCO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1,722	23	0	0	0	0	0	0
DICHLOROMETHANE	VCO	0	2,100	0	0	0	0	0	0	0	0	0	251	0	0	1,183,867	377	0	10	0	46,620	0	0
ETHYLBENZENE	VH	0	0	0	0	0	0	0	0	0	250	0	0	0	0	190,648	5,735	3,234	271,175	0	0	0	0
FORMALDEHYDE	OVO	0	200	0	0	0	0	0	10,139	0	0	0	4,336	0	0	4,916,248	16,314	0	0	0	0	0	0
FREON 113	CFC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	17	6	0	0	0	0	0	0
METHANOL	OVO	0	20,250	0	0	0	12,482	0	17,495	0	80,327	0	2,957,167	0	3,000	26,852,673	220,185	230,590	1,582	0	0	0	0
METHYL ETHYL KETONE	OVO	0	0	0	0	0	0	0	250	0	27,931	0	6,873	0	0	325,390	26,226	40,000	748	0	10,770	0	0
METHYL ISOBUTYL KETONE	OVO	0	0	0	0	0	0	0	0	0	139,400	0	0	0	0	129,100	1,823	0	35	0	0	0	0
METHYL METHACRYLATE	OVO	0	0	0	0	0	0	0	0	0	0	0	11	0	0	220,000	1,742	0	0	0	2,250	0	0
N-BUTYL ALCOHOL	OVO	0	0	0	0	0	0	0	0	0	8,856	0	0	0	0	2,324,731	519	0	0	0	0	0	0
NAPHTHALENE	OSO	0	0	0	5	0	0	0	1	0	0	0	8,445	0	0	60,654	23,191	573	1,539,299	0	0	0	0
PROPYLENE OXIDE	OVO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	200	2,251	0	0	0	0	0	0
STYRENE	VH	0	0	0	0	0	0	0	0	0	0	0	5	0	0	83,170	60,330	0	0	0	141,153	0	0
TETRACHLOROETHYLENE	VCO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12,780	4,264	0	0	0	1,495	0	0
TOLUENE	VH	0	0	0	0	0	0	0	434	0	65,114	0	798	0	4,300	1,547,118	26,211	26,778	546,483	0	5	0	0
TRICHLOROETHYLENE	VCO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	466	1	0	0	0	0	0	0
TRICHLOROFLUOROMETHANE	VCO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	18,912	0	0	0	0	0	0
VINYL CHLORIDE	VCO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	6	0	0	0	0	0	3,100
XYLENE (MIXED ISOMERS)	VH	0	0	0	0	0	0	1	0	0	44,914	0	250	0	40	200,309	3,129	18,835	1,142,430	5	0	0	0
ZINC (FUME OR DUST)	M/I	0	250	0	0	0	5	0	5	0	0	0	1,100	0	0	120,000	28,710	0	0	0	250	0	0
Total		5	23,825	0	5	0	12,487	11	28,574	0	372,592	0	2,990,848	0	8,315	69,938,141	709,301	402,272	3,618,924	5	229,413	0	10,807

Source: 1992 TRI data.

UI = Underground Injection
L = Land
VCO = Volatile Chlorinated Organics
OVO = Other Volatile Organics
OSO = Other Semivolatile Organics
M/I = Metals/Inorganics
VH = Volatile Hydrocarbons
IO = Inorganics
VO = Volatile Organics
CFC = Chlorofluorocarbons

Industry Groups (SIC)
20 = Food and Kindred Products
21 = Tobacco Products
22 = Textile Mill Products
24 = Lumber and Wood Products
25 = Furniture and Fixtures
26 = Paper and Allied Products
27 = Printing and Publishing
28 = Chemicals and Allied Products
29 = Petroleum Refining
30 = Rubber and Miscellaneous Plastics Products
31 = Leather and Leather Products
32 = Stone, Clay and Glass Products
33 = Primary Metal Industries
34 = Fabricated Metal Products
35 = Industrial Machinery and Equipment
36 = Electronic and Other Electronic Equipment
37 = Transportation Equipment
38 = Instruments and Related Products
39 = Miscellaneous Manufacturing Products

EXHIBIT 8-6 TRI REPORTED RELEASES TO LAND OR UNDERGROUND INJECTION BY CONSTITUENT AND INDUSTRY (continued)

Chemical Name[a]	Type of Chemical	SIC 20		SIC 21		SIC 22		SIC 24		SIC 25		SIC 26		SIC 27		SIC 28		SIC 29		SIC 30		SIC 31	
		UI	L	UI	L	UI	L	UI	L	UI	L	UI	L	UI	L	UI	L	UI	L	UI	L	UI	L
1,1,1-TRICHLOROETHANE	VCO	5	25	0	0	0	0	0	0	0	5,800	0	0	0	975	553	1,826	0	288	0	17,403	0	0
1,2-DICHLOROETHANE	VCO	0	1,000	0	0	0	0	0	0	0	0	0	0	0	0	6,927	858	0	0	0	0	0	0
1,3-BUTADIENE	VO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1,000	372	0	0	0	0	0	0
ACETALDEHYDE	OVO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1,905,859	289	0	0	0	0	0	0
ACETONITRILE	OVO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20,111,640	29	0	0	0	0	0	0
ACRYLAMIDE	OSO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4,188,680	963	0	0	0	0	0	0
ACRYLONITRILE	OVO	0	0	0	0	0	0	0	0	0	0	0	30	0	0	3,795,670	387	0	0	0	7,654	0	0
ANILINE	OSO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1,195,676	1,173	0	0	0	0	0	0
BENZENE	VO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	268,921	225,952	78,162	114,164	0	0	0	0
BROMOMETHANE	OVO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1,000	0	0	0	0	0	0	0
CARBON DISULFIDE	OVO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2,704	5	0	16	0	0	0	0
CHLOROBENZENE	VCO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	72,000	817	0	0	0	0	0	0
CHLOROFORM	VCO	0	0	0	0	0	0	0	0	0	0	0	11,582	0	0	50,240	17,000	0	0	0	0	0	0
CHLOROMETHANE	VCO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	86,709	0	0	0	0	0	0	0
CHLOROPRENE	VCO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	54,000	0	0	0	0	1,811	0	0
CHROMIUM	IO	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	4,550	0	2,226	0	2	0	7,707
COPPER	M/I	0	0	0	0	0	0	5	250	0	0	0	0	0	0	16,460	14,810	0	0	0	0	0	0
CUMENE	VH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11,000	315	4,100	468	0	0	0	0
DICHLORODIFLUOROMETHANE	VCO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1,722	23	0	0	0	0	0	0
DICHLOROMETHANE	VCO	0	2,100	0	0	0	0	0	0	0	0	0	251	0	0	1,183,867	377	0	10	0	46,620	0	0
ETHYLBENZENE	VH	0	0	0	0	0	0	0	0	0	250	0	0	0	0	190,648	5,735	3,234	271,175	0	0	0	0
FORMALDEHYDE	OVO	0	200	0	0	0	0	0	10,139	0	0	0	4,336	0	0	4,916,248	16,314	0	0	0	0	0	0
FREON 113	CFC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	17	6	0	0	0	0	0	0
METHANOL	OVO	0	20,250	0	0	0	12,482	0	17,495	0	80,327	0	2,957,167	0	3,000	26,852,673	220,185	230,590	1,582	0	0	0	0
METHYL ETHYL KETONE	OVO	0	0	0	0	0	0	0	250	0	27,931	0	6,873	0	0	325,390	26,226	40,000	748	0	10,770	0	0
METHYL ISOBUTYL KETONE	OVO	0	0	0	0	0	0	0	0	0	139,400	0	0	0	0	129,100	1,823	0	35	0	0	0	0
METHYL METHACRYLATE	OVO	0	0	0	0	0	0	0	0	0	0	0	11	0	0	220,000	1,742	0	0	0	2,250	0	0
N-BUTYL ALCOHOL	OVO	0	0	0	0	0	0	0	0	0	8,856	0	0	0	0	2,324,731	519	0	0	0	0	0	0
NAPHTHALENE	OSO	0	0	0	5	0	0	0	1	0	0	0	8,445	0	0	60,654	23,191	573	1,539,299	0	0	0	0
PROPYLENE OXIDE	OVO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	200	2,251	0	0	0	0	0	0
STYRENE	VH	0	0	0	0	0	0	0	0	0	0	0	5	0	0	83,170	60,330	0	0	0	141,153	0	0
TETRACHLOROETHYLENE	VCO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12,780	4,264	0	0	0	1,495	0	0
TOLUENE	VH	0	0	0	0	0	0	0	434	0	65,114	0	798	0	4,300	1,547,118	26,211	26,778	546,483	0	5	0	0
TRICHLOROETHYLENE	VCO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	466	1	0	0	0	0	0	0
TRICHLOROFLUOROMETHANE	VCO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	18,912	0	0	0	0	0	0
VINYL CHLORIDE	VCO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	6	0	0	0	0	0	3,100
XYLENE (MIXED ISOMERS)	VH	0	0	0	0	0	0	1	0	0	44,914	0	250	0	40	200,309	3,129	18,835	1,142,430	5	0	0	0
ZINC (FUME OR DUST)	M/I	0	250	0	0	0	5	0	5	0	0	0	1,100	0	0	120,000	28,710	0	0	0	250	0	0
Total		5	23,825	0	5	0	12,487	11	28,574	0	372,592	0	2,990,848	0	8,315	69,938,141	709,301	402,272	3,618,924	5	229,413	0	10,807

Source: 1992 TRI data.

UI = Underground Injection
L = Land
VCO = Volatile Chlorinated Organics
OVO = Other Volatile Organics
OSO = Other Semivolatile Organics
M/I = Metals/Inorganics
VH = Volatile Hydrocarbons
IO = Inorganics
VO = Volatile Organics
CFC = Chlorofluorocarbons

Industry Groups (SIC)
20 = Food and Kindred Products
21 = Tobacco Products
22 = Textile Mill Products
24 = Lumber and Wood Products
25 = Furniture and Fixtures
26 = Paper and Allied Products
27 = Printing and Publishing
28 = Chemicals and Allied Products
29 = Petroleum Refining
30 = Rubber and Miscellaneous Plastics Products
31 = Leather and Leather Products
32 = Stone, Clay and Glass Products
33 = Primary Metal Industries
34 = Fabricated Metal Products
35 = Industrial Machinery and Equipment
36 = Electronic and Other Electronic Equipment
37 = Transportation Equipment
38 = Instruments and Related Products
39 = Miscellaneous Manufacturing Products

EXHIBIT 8-6 TRI REPORTED RELEASES TO LAND OR UNDERGROUND INJECTION BY CONSTITUENT AND INDUSTRY (continued)

	Type of	SIC 32		SIC 33		SIC 34		SIC 35		SIC 36		SIC 37		SIC 38		SIC 39		Invalid				Total
Chemical Name[a]	**Chemical**	**UI**	**L**	**UI**	**L**	**UI**	**L**	**UI**	**L**	**UI**	**L**	**UI**	**L**	**UI**	**L**	**UI**	**L**	**UI**	**L**	**Total UI**	**Total Land**	**Combined**
1,1,1-TRICHLOROETHANE	VCO	0	0	0	2,916	0	39,778	0	6,805	3	10	0	200	0	350	0	0	0	0	561	76,381	76,942
1,2-DICHLOROETHANE	VCO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6,927	1,858	8,785
1,3-BUTADIENE	VO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1,000	372	1,372
ACETALDEHYDE	OVO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1,905,859	289	1,906,148
ACETONITRILE	OVO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20,111,640	29	20,111,669
ACRYLAMIDE	OSO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4,188,680	963	4,189,643
ACRYLONITRILE	OVO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	65,880	0	3,861,550	8,071	3,869,621
ANILINE	OSO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1,195,676	1,173	1,196,849
BENZENE	VO	0	0	8,600	500	0	0	0	0	0	0	0	20	0	0	0	0	0	0	355,683	340,636	696,319
BROMOMETHANE	OVO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1,000	0	1,000
CARBON DISULFIDE	OVO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2,704	21	2,725
CHLOROBENZENE	VCO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	72,000	817	72,817
CHLOROFORM	VCO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	50,240	28,582	78,822
CHLOROMETHANE	VCO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	86,709	0	86,709
CHLOROPRENE	VCO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	54,000	1,811	55,811
CHROMIUM	IO	0	10,526	8	842,104	70	75,306	0	13,226	0	500	250	455	0	510	0	0	0	0	333	957,112	957,445
COPPER	M/I	0	767	271	12,579,039	0	18,368	0	2,620	0	25,709	0	5,130	0	0	0	645	0	0	16,736	12,647,338	12,664,074
CUMENE	VH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15,100	783	15,883
DICHLORODIFLUOROMETHANE	VCO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1,722	23	1,745
DICHLOROMETHANE	VCO	0	77	0	12,705	0	0	0	17,101	0	12	0	0	0	60	0	0	0	0	1,183,867	79,313	1,263,180
ETHYLBENZENE	VH	0	0	0	0	0	11,510	0	48	0	0	0	0	0	0	0	0	0	390	193,882	289,108	482,990
FORMALDEHYDE	OVO	0	105,331	0	38,109	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4,916,248	174,429	5,090,677
FREON 113	CFC	0	0	0	0	0	0	0	0	197	850	0	250	0	7,922	0	0	0	0	214	9,028	9,242
METHANOL	OVO	0	0	0	411	0	4,296	0	2,305	169	0	0	9,041	0	0	0	0	750	0	27,084,182	3,328,541	30,412,723
METHYL ETHYL KETONE	OVO	0	0	0	0	0	95,930	0	62,575	5	0	0	8,291	0	1,500	0	0	0	700	365,395	241,794	607,189
METHYL ISOBUTYL KETONE	OVO	0	0	0	750	0	23,381	0	21,235	0	0	0	8,291	0	0	0	0	0	71	129,100	194,986	324,086
METHYL METHACRYLATE	OVO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	220,000	4,003	224,003
N-BUTYL ALCOHOL	OVO	0	0	0	0	0	46,865	0	190	0	0	0	0	0	0	0	0	0	790	2,324,731	57,220	2,381,951
NAPHTHALENE	OSO	0	0	17,000	96,200	0	0	0	0	0	0	0	0	0	0	0	0	0	0	78,227	1,667,141	1,745,368
PROPYLENE OXIDE	OVO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	200	2,251	2,451
STYRENE	VH	0	97,000	0	5	0	0	0	0	0	0	0	5,686	0	0	0	0	0	0	83,170	304,179	387,349
TETRACHLOROETHYLENE	VCO	0	5	0	0	0	3,585	0	5	0	0	0	0	0	0	0	0	0	0	12,780	9,354	22,134
TOLUENE	VH	0	4,926	0	750	0	41,652	0	4,196	5	5	0	8,944	0	0	0	250	0	4,210	1,573,901	708,278	2,282,179
TRICHLOROETHYLENE	VCO	0	0	0	10,050	0	2,250	0	0	0	0	0	8,420	0	5	0	0	0	0	466	20,726	21,192
TRICHLOROFLUOROMETHANE	VCO	0	0	0	0	0	250	0	599	0	0	0	0	0	0	0	0	0	0	8	19,761	19,769
VINYL CHLORIDE	VCO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	3,106	3,107
XYLENE (MIXED ISOMERS)	VH	0	5	0	102,068	0	104,695	0	1,337	120	4,350	0	10,961	0	0	0	250	0	10,600	219,270	1,434,429	1,653,699
ZINC (FUME OR DUST)	M/I	0	0	0	12,785,679	0	122,303	0	0	0	0	0	102,816	0	0	0	0	0	5	120,000	13,041,123	13,161,123
Total		0	218,637	25,879	26,471,286	70	590,169	0	132,242	499	31,436	250	168,505	0	10,347	0	1,145	66,630	16,766	70,433,762	35,655,029	106,088,791

Source: 1992 TRI data.

UI = Underground Injection
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VCO = Volatile Chlorinated Organics
OVO = Other Volatile Organics
OSO = Other Semivolatile Organics
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Industry Groups (SIC)
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CHAPTER 9. POTENTIAL FOR GAPS TO BE ADDRESSED BY EXISTING REGULATIONS

The potential gaps described in Chapters 3 and 4 of this Scoping Study were identified solely in terms of their relationship to non-hazardous industrial waste management, and not with regard to whether they might be controlled under RCRA or other regulatory programs. This chapter examines the extent to which existing regulatory programs may already address these potential gaps and thereby helps to evaluate the extent of the potential gaps. The programs reviewed are as follows:

- RCRA,
- Clean Water Act (CWA),
- Safe Drinking Water Act (SDWA),
- Clean Air Act (CAA),
- Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA),
- Toxic Substances Control Act (TSCA),
- Pollution prevention initiatives,
- Occupational Safety and Health Act (OSHA), and
- Hazardous Materials Transportation Act (HMTA).

The regulatory control provided by these programs is reviewed in general terms, rather than in detail. Further analysis would be necessary to determine the precise degree of protection that these programs provide against particular risks.

9.1 RCRA Programs

Where there are gaps in the hazardous waste characteristics, the RCRA hazardous waste listings and Subtitle D program may reduce any resulting human health and environmental risks. These two programs are discussed below, including both the direct federal regulatory authorities and state-delegated authorities.

9.1.1 Hazardous Waste Programs

As described in RCRA Section 3001(a)-(b), EPA is required to develop regulations that both specify criteria for listing hazardous waste and to list particular hazardous wastes. In 40 CFR 261.11, EPA has specified three criteria for listing solid wastes as hazardous:

- The waste exhibits a hazardous characteristic;

- The waste is acutely hazardous because is has been found to be fatal to humans in low doses, or is otherwise capable of causing or significantly contributing to an increase in serious irreversible, or incapacitating reversible, illness; or

- The waste contains a toxic constituent listed in 40 CFR Part 261, Appendix VIII[1] and, after considering several risk-based and non risk-based factors, is capable of posing a

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[1] Constituents are included in Appendix VIII if a reputable scientific study has found that the constituent has toxic, carcinogenic, mutagenic, or teratogenic effects on humans or other forms of life.

substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, or disposed of, or otherwise managed.

EPA has established four hazardous waste lists:

- Hazardous waste from non-specific sources, or F wastes;
- Hazardous wastes from specific sources, or K wastes;
- Discarded commercial chemicals that are toxic, or P wastes; and
- Discarded commercial chemicals that are acutely hazardous, or U wastes.

Because the F and K listings focus on waste streams, rather than on particular constituents, identification of a chemical as a constituent in a listed F or K waste does not automatically imply that all or most industrial wastes containing that constituent are regulated by the hazardous waste listings. For example, the F003 listing regulates benzene when it is a spent solvent, but does not regulate other benzene-containing wastes such as petroleum refining wastes. Similarly, for a chemical to be controlled by a P or U listing, it must be a discarded commercial product. If the source of the chemical is different (e.g., from a waste mixture that is not covered by an F or K listing), it is not regulated as a listed waste. For example, 2,4-dimethylphenol, which is a listed U waste (U101) when it is a discarded commercial chemical, was found among the environmental releases from non-hazardous industrial waste management documented in Chapter 2. This chemical also was found in the other two sources of data on non-hazardous industrial waste constituents, the Industrial Studies Database (ISDB) and the Effluent Guidelines Development Documents.

40 CFR Part 261, Appendix VII contains the majority of the "known" non-hazardous industrial waste constituents, including:

- 40 of the 41 known non-hazardous industrial waste constituents found in all three major data sources: the release descriptions, ISDB, <u>and</u> the effluent guideline development documents data; and

- 134 of all 248 known constituents.

Although Appendix VII constituents are the basis for individual hazardous waste listings, they also appear in non-hazardous industrial wastes. The listings, therefore, do not regulate all wastes containing these constituents.

Most states have developed their own hazardous waste programs and have received EPA approval to implement their regulations in lieu of the federal program. These state hazardous waste regulations may be broader or more stringent than federal RCRA Subtitle C regulations. A number of states have done so by regulating additional wastes as hazardous. For example, states have:

- Expanded the ignitability, corrosivity, or reactivity (ICR) characteristics;
- Expanded the toxicity characteristic (TC);
- Listed wastes as hazardous that are not hazardous under the federal rules; and
- Restricted exemptions from the federal program.

These expansions beyond the federal hazardous waste identification rules, which are discussed in Chapter 6, reflect state judgments about gaps in the federal program and thereby fill these potential gaps in particular states. Conversely, these expansions constitute potential gaps in other states.

9.1.2 Subtitle D

States have primary responsibility for managing non-hazardous industrial wastes. Under RCRA Subtitle D, the Federal Government only establishes minimum criteria that prescribe the best practicable controls and monitoring requirements for non-hazardous waste disposal facilities. EPA has developed separate criteria for municipal solid waste landfills (MSWLFs), which must comply with the requirements of 40 CFR Part 258, and for non-hazardous industrial (Industrial D) land application units, which must comply with the requirements of 40 CFR Part 257.

40 CFR Part 258 specifies six categories of MSWLF criteria: location, operation, design, ground-water monitoring and corrective action, closure and post-closure care, and financial assurance. Most relevant to addressing potential gaps in the characteristics, any leachate from new MSWLFs (which began accepting waste after October 9, 1993) must not cause contaminant levels in the uppermost aquifer to exceed maximum contaminant levels (MCLs) specified under the Safe Drinking Water Act. In addition, all MSWLFs must be operated in a way that ensures that they do not release pollutants that violate the Clean Water Act. Beyond meeting the minimum federal criteria, approved States are permitted to develop their own standards for MSWLFs.

The operating and design requirements for MSWLFs under Part 258 are designed to allow protective disposal of conditionally exempt small quantity generator hazardous waste (CESQG). As a result, MSWLFs can accept non-hazardous and CESQG waste from both municipal and industrial sources. Industrial D landfills can accept conditionally exempt small quantity generator (CESQG) waste (e.g., construction and demolition waste) only if they meet the location, groundwater monitoring and corrective action requirements specified in 40 CFR Part 257. Industrial D landfills that do not meet these requirements are not permitted to accept CESQG waste.

To a limited extent, state non-hazardous industrial waste management programs address potential gaps in the hazardous waste characteristics. These state programs, however, vary considerably in the types of requirements imposed, the stringency of such requirements, and even the types of waste management units regulated. They do not provide uniform national coverage of non-hazardous industrial waste management. For example, despite the state requirements placed on these landfills, about 50 chemicals were found in the release descriptions at concentrations above MCLs, including a number of metals (e.g., zinc, nickel, mercury, and lead) and volatile chlorinated organics (e.g., vinyl chloride, carbon tetrachloride, chlorobenzene, and chloroform). Similarly, about 90 percent of all releases were found to be associated with unlined management units; not all states currently require Industrial D units to be lined.

9.2 Medium-Specific Regulations

Medium-specific regulations such as the Clean Water Act, the Safe Drinking Water Act, and the Clean Air Act can both directly and indirectly address potential gaps in the hazardous waste characteristics. These programs regulate exposure via specific pathways of potential concern for non-hazardous industrial wastes, as discussed in Chapters 3 and 4. Medium-specific regulations also could indirectly address potential gaps by discouraging or preventing the occurrence of the specific constituents in non-hazardous industrial waste. For example, CWA regulations may cause a manufacturer to alter a production process so that a particular chemical that requires control is not used in the production process, thereby eliminating that constituent from its solid waste stream. Where substitutions or alterations in the production process are not feasible, however, the medium-specific regulations could result in cross medium transfers, increasing the use of solid waste disposal as the preferred management method of the regulated constituents. The net effect of these two incentives on solid waste disposal practices is uncertain.

9.2.1 Clean Water Act

The CWA is designed to restore and protect the physical, chemical, and biological quality of the nation's surface waters. To achieve this goal, all discharges to navigable waters must be permitted. To help permit writers, EPA has established effluent limitations for 127 toxic pollutants on direct discharges to waters by 34 industrial source categories and publicly-owned treatment works (POTWs). Permit writers use these guidelines to establish discharge limits and other permit conditions. Where effluent guidelines do not exist for an industry, permit writers use best engineering judgment to determine appropriate permit conditions.

CWA regulations and permits directly limit exposures through surface water pathways. The CWA also indirectly addresses exposures to CWA regulated chemicals though other pathways by providing incentives for reducing or eliminating the use of such chemicals or for cross-media transfer of such chemicals.

Chapter 3 identified three potential gaps in the current toxicity characteristic that may be addressed to some extent by the Clean Water Act:

- Potential risks from direct surface water exposures;
- Potential indirect pathway risks involving surface waters; and
- Potential risks to ecological receptors involving surface waters.

As discussed in Chapter 3, surface water exposure pathways may be significant for some TC analytes disposed as non-hazardous industrial waste. Because run-off waters from landfills must be managed according to the requirements of the CWA, risks to human health from surface water exposures are addressed if these TC analytes have effluent limits established under the CWA. These effluent limits may also address risks to ecological receptors from exposure surface water, principally at water bodies near waste management units contaminated from surface water run-off. In addition, persistent and bioaccumulative chemicals discharged to surface waters may contaminate fish and shellfish that, when consumed, cause indirect exposure risk to human health. CWA effluent limits can address indirect exposure risks from those TC analytes for which effluent limits are established.

As Exhibit 9-1 demonstrates, CWA effluent limits are established for 28 of the TC constituents, including all of the TC metals except barium. Many of these TC constituents are commonly found in the release descriptions. For example, 7 of the top 20 frequently occurring constituents in the release descriptions are TC metals. Other TC constituents occurring five or more times in the release descriptions that have CWA effluent limits include benzene, vinyl chloride, chloroform, chlorobenzene, and tetrachloroethylene. Among these constituents, chlorobenzene, mercury, and lead can pose risks to ecological receptors.

Exhibit 9-1
TC Constituents with Effluent Limits Established under CWA

TC Analyte	CWA Effluent Limit	TC Analyte	CWA Effluent Limit	TC Analyte	CWA Effluent Limit
1,1-Dichloroethylene	--	Chloroform	✓	Methyl ethyl ketone	--
1,2-Dichloroethane	✓	Chromium	✓	Nitrobenzene	✓
1,4-Dichlorobenzene	✓	Cresol (mixed isomers)	--	o-Cresol	--
2,4,5-Trichlorophenol	--	Endrin	✓	p-Cresol	--
2,4,6-Trichlorophenol	✓	Heptachlor	✓	Pentachlorophenol	✓
2,4-D, salts and esters	--	Heptachlor epoxide	✓	Pyridine	--
2,4-Dinitrotoluene	✓	Hexachlorobenzene	✓	Selenium	✓
Arsenic	✓	Hexachloro-1,3-butadiene	--	Silver	✓
Barium	--	Hexachloroethane	✓	Silvex (2,4,5-TP)	--
Benzene	✓	Lead	✓	Tetrachloroethylene	✓
Cadmium	✓	Lindane	✓	Toxaphene	✓
Carbon tetrachloride	✓	m-Cresol	--	Trichloroethylene	✓
Chlordane	✓	Mercury	✓	Vinyl chloride	✓
Chlorobenzene	✓	Methoxychlor	--		

The CWA effluent limitations may also address some of the potential gaps identified in Chapter 4 that are associated with non-TC constituents, including indirect pathway exposures to phenolic compounds, DNAPL formation by chlorinated organics, indirect pathway exposure to PAHs, and indirect pathway exposure to phthalate esters. For the CWA to address indirect pathway exposures to these chemicals, releases to surface water from regulated facilities must be involved. Exhibit 9-2 lists chemicals representative of these potential gaps and indicates which chemicals are subject to CWA effluent limitations. Effluent limitations are specified for 7 of the 8 and for 15 of the 18 phenols and PAHs, respectively, on the list of known non-hazardous industrial waste constituents. CWA effluent limitations also control surface water releases of the chemicals that are likely to form DNAPLs, including halogenated chemicals. Exhibit 9-2 lists 35 known non-hazardous volatile chlorinated organics. Of these chemicals, 18 are subject to effluent guideline limits. CWA effluent limitations are specified for all six of the phthalate esters on the list of known non-hazardous industrial waste constituents. Phthalate esters are one class of chemical that bioaccumulate in the environment and may be endocrine disruptors.

Exhibit 9-2
CWA Effluent Limitations Relevant to Certain Known Non-Hazardous Industrial Waste Constituents

Phenols	**CWA Effluent Limit**	**Volatile Chlorinated Organics (Potential DNAPL formers)**	**CWA Effluent Limit**	**PAHs**	**CWA Effluent Limit**
2,4-Dimethylphenol	✓	1,1,1,2-Tetrachloroethane	--	2-Methylnaphthalene	--
2,4-Dinitrophenol	✓	1,1,1-Trichloroethane	✓	7,12-Dimethylbenz[a]anthracene	--
2-Nitrophenol	✓	1,1,2,2-Tetrachloroethane	✓	Acenaphthene	✓
4,6-Dinitro-o-cresol	✓	1,1,2-Trichloroethane	✓	Acenaphthylene	✓
4-Nitrophenol	✓	1,2,3-Trichloropropane	--	Anthracene	✓
p-Chloro-m-cresol	✓	1,2,4,5-Tetrachlorobenzene	--	Benz[a]anthracene	✓
Phenol	✓	1,2,4-Trichlorobenzene	✓	Benzo(a)phenanthrene	✓
Phenolics	--	1,2-Dibromo-3-chloropropane	--	Benzo(k)fluoranthene	✓
		1,2-Dichlorobenzene	✓	Benzo[a]pyrene	✓
		1,2-Dichloroethylene	--	Benzo[b]fluoranthene	✓
		1,2-Dichloroethylene, trans	✓	Benzo[ghi]perylene	✓
		1,2-Dichloropropane	✓	Dibenz[a,h]anthracene	✓
		1,3-Dichlorobenzene	✓	Fluoranthene	✓
		1,3-Dichloropropylene	✓	Fluorene	✓
		Allyl chloride	--	Indeno(1,2,3-cd)pyrene	✓
		Benzoic trichloride	--	Isophorone	✓
		Bis(2-chloroethyl) ether	✓	Methapyrilene	--
		Chlorobromomethane	--	Pyrene	✓
		Chlorodibromomethane	✓		
		Chloroethane	✓		
		Chloromethane	✓		
		cis-1,2-Dichloroethylene	--		
		Dichloro-2-propanol, 1,3-	--		
		Dichlorobromomethane	✓		
		Dichlorodifluoromethane	--		
		Dichloromethane	✓		
		Dichloropropane	--		
		Epichlorohydrin	--		
		Ethylidene Dichloride	✓		
		Hexachlorocyclopentadiene	✓		
		Pentachloroethane	--		
		Tetrachloroethane, N.O.S.	--		
		trans-1,3-Dichloropropene	✓		
		Trichlorofluoromethane	--		
		Trichloromethanethiol	--		

As shown in Exhibit 9-3, considerable overlap exists between the industries with established effluent limits under the CWA and those industries responsible for the releases described in Chapter 2 (see Exhibit 2-3). For example, EPA has established CWA effluent limitations for the paper, chemical manufacturing, and primary metals industries, but not for electric, gas, and sanitary services; the food industry; and the non-metallic minerals industry. Further analysis is necessary to determine whether the chemicals covered by the effluent guidelines for these industries appear in their documented releases.

Exhibit 9-3
CWA Coverage of Industries Represented in Release Descriptions

Industry Group	SIC Code	Total Number of Releases	CWA Effluent Limitations
Electric, Gas, and Sanitary Services (refuse only)	49	35	no
Paper and Allied Products	26	27	yes
Chemicals and Allied Products	28	11	yes; separates organic and inorganic manufacturing
Food and Kindred Products	20	10	no
Primary Metals	33	6	yes; separates nonferrous and iron/steel manufacturing
Non-Metallic Minerals	14	4	no

9.2.2 Safe Drinking Water Act

Under the Safe Drinking Water Act, EPA has identified contaminants in drinking water that may adversely affect human health. For each contaminant, EPA has established a maximum contaminant level (MCL) that must not be exceeded in drinking water. MCLs are based on maximum contaminant level goals (MCLGs), which are the non-enforceable health-based levels at which no known or anticipated adverse effects on the health of people occur and which allow an adequate margin of safety. MCLGs are adjusted to MCLs based on considerations of feasibility, including technical implementation and economic considerations. As discussed in Section 5.1, EPA also has established non-health based or non-ecological based drinking water standards, based principally on aesthetic or usability criteria, which are called Secondary MCLs (SMCLs).

The MCL standards apply to public water systems that regularly supply water to 15 or more connections or to 25 or more individuals at least 60 days per year in the case of residential populations or at least 6 months per year in the case of non-residential populations. The SDWA also regulates, through EPA or approved state programs, the underground injection of wastes to protect aquifers that are or may reasonably be expected to be sources of drinking water. These aquifers must be protected from contamination that violates an MCL or otherwise adversely affect human health.

The SDWA has become important beyond the regulation of public water systems and underground injection of waste because the MCLs have been used in other regulatory contexts. For example, RCRA Subtitle D regulations for municipal solid waste landfills specify that MCLs must not be exceeded in the uppermost aquifer underlying a landfill.

Because the regulatory levels established under the SDWA apply only to public water systems, its ability to address potential gaps resulting from non-hazardous industrial waste management is limited. The 1996 Safe Drinking Water Act (SDWA) Amendments, however, establish a new emphasis on preventing contamination problems through source water protection. Within 18 months after EPA publishes guidance, states must submit a program for delineating source water areas of public water systems and for assessing the susceptibility of such source waters to contamination. Because SDWA MCLs have been established for a number for TC and non-TC constituents that are related to potential gaps, the SDWA could be used under such source water protection programs to regulate contaminants prior to their entry into public water systems, such as at non-hazardous industrial waste management units. The constituents and possible gaps that the SDWA could address under source water protection programs are discussed below. At this point in time, however, no such source protection programs have been developed.

In Chapter 3, groundwater risks associated with TC analytes were identified as a potential gap in the hazardous characteristics. As Exhibit 9-4 shows, MCLs are established for 27 of the TC constituents, including all TC metals with the exception of silver. The seven TC metals with established MCLs are among the top 20 frequently occurring constituents in the release descriptions. MCLs are also established for other constituents frequently occurring in the release descriptions including chlorobenzene, chloroform, tetrachloroethylene, trichloroethylene, and vinyl chloride. The MCLs for chlorobenzene, lead, and mercury may address the ecological risks posed by these constituents, even though EPA did not specifically evaluate ecological risks when setting the MCLs.

Exhibit 9-4
TC Constituents with SDWA MCL Levels

TC Analyte	**SDWA MCL**	**TC Analyte**	**SDWA MCL**	**TC Analyte**	**SDWA MCL**
1,1-Dichloroethylene	--	Chloroform	✓	Methyl ethyl ketone	--
1,2-Dichloroethane	✓	Chromium	✓	Nitrobenzene	--
1,4-Dichlorobenzene	✓	Cresol (mixed isomers)	--	o-Cresol	--
2,4,5-Trichlorophenol	--	Endrin	✓	p-Cresol	--
2,4,6-Trichlorophenol	--	Heptachlor	✓	Pentachlorophenol	✓
2,4-D, salts and esters	✓	Heptachlor epoxide	✓	Pyridine	--
2,4-Dinitrotoluene	--	Hexachlorobenzene	✓	Selenium	✓
Arsenic	✓	Hexachloro-1,3-butadiene	--	Silver	--
Barium	✓	Hexachloroethane	--	Silvex (2,4,5-TP)	✓
Benzene	✓	Lead	✓	Tetrachloroethylene	✓
Cadmium	✓	Lindane	✓	Toxaphene	✓
Carbon Tetrachloride	✓	m-Cresol	--	Trichloroethylene	✓
Chlordane	✓	Mercury	✓	Vinyl chloride	✓
Chlorobenzene	✓	Methoxychlor	✓		

Chapter 4 identified two groups of known non-hazardous industrial waste constituents that may present hazards through the groundwater pathway: toxic metals and volatile chlorinated organic compounds. Exhibit 9-5 lists chemicals representative of these gaps and indicates whether they have MCLs and were detected above MCL levels in the release descriptions presented in Chapter 2. In the release descriptions, most of these constituents were detected in groundwater at levels above their MCLs.

Exhibit 9-5

MCLs for Known Non-Hazardous Industrial Waste Constituents of Concern in Groundwater Pathways

Metals	MCL	Detected above MCL	Volatile Chlorinated Organics	MCL	Detected above MCL
Aluminum (fume or dust)	--	--	1,1,1,2-Tetrachloroethane	--	--
Antimony	✓	✓	1,1,1-Trichloroethane	✓	--
Beryllium	✓	✓	1,1,2,2-Tetrachloroethane	--	--
Chromium(VI)	--	--	1,1,2-Trichloroethane	✓	✓
Cobalt	--	--	1,2,3-Trichloropropane	--	--
Copper	--	--	1,2,4,5-Tetrachlorobenzene	--	--
Iron	--	--	1,2,4-Trichlorobenzene	✓	--
Magnesium	--	--	1,2-Dibromo-3-chloropropane	✓	--
Manganese	--	--	1,2-Dichlorobenzene	✓	--
Molybdenum	--	--	1,2-Dichloroethylene	--	--
Nickel	✓	✓	1,2-Dichloroethylene, trans	✓	✓
Strontium	--	--	1,2-Dichloropropane	✓	--
Thallium	✓	✓	1,3-Dichlorobenzene	--	--
Tin	--	--	1,3-Dichloropropylene	--	--
Titanium	--	--	Allyl chloride	--	--
Vanadium	--	--	Benzoic trichloride	--	--
Zinc	--	--	Bis(2-chloroethyl) ether	--	--
			Chlorobromomethane	--	--
			Chlorodibromomethane	✓	--
			Chloroethane	--	--
			Chloromethane	--	--
			cis-1,2-Dichloroethylene	✓	✓
			Dichloro-2-propanol 1,3-	--	--
			Dichlorobromomethane	✓	--
			Dichlorodifluoromethane	--	--
			Dichloromethane	✓	✓
			Dichloropropane	--	--
			Epichlorohydrin	✓	--
			Ethylidene Dichloride	--	--
			Hexachlorocyclopentadiene	✓	--
			Pentachloroethane	--	--
			Tetrachloroethane, N.O.S.	--	--
			trans-1,3-Dichloropropene	--	--
			Trichlorofluoromethane	--	--
			Trichloromethanethiol	--	--

9.2.3 Clean Air Act Amendments

Section 112 of the Clean Air Act Amendments (CAAA) regulates emissions of 189 toxic constituents, or hazardous air pollutants (HAPs). EPA has defined source categories that emit these HAPs and specified the maximum available control technology (MACT) that must be used by these sources to reduce HAP releases. EPA has promulgated air toxics regulations for three source categories that handle solid waste: RCRA Subtitle C facilities, off-site waste operations, and municipal waste combustors. Of these three categories, only off-site waste operations handle non-hazardous industrial waste.

Off-site waste operations are defined to include hazardous waste treatment, storage, and disposal facilities, industrial wastewater treatment facilities, industrial waste landfills that receive waste from off-site, and other facilities that provide waste management support services or recover and/or recycle spent materials. Municipal waste landfills, POTWs, incinerator units, and site remediation activities are not regulated by this rule. Off-site operations must control emissions from tanks and containers that manage material with an average volatile organic compound (VOC) concentration equal to or greater than 100 parts per million by weight. Land disposal of such wastes is prohibited. In addition, a leak detection and repair program must be implemented for all equipment containing material with total VOC concentration of 10 percent or more. Thus, the CAA regulations for these sources could address potential gaps in the hazardous waste characteristics in two ways:

- Exposures to waste constituents through inhalation are addressed for non-hazardous industrial wastes with average VOC content greater than 100 ppm, if managed in certain facilities; and

- Exposure to VOCs at off-site operations through direct contact with solid waste or from groundwater leachate may be reduced or controlled by the prohibition of land disposal of wastes that contain material with an average VOC concentration equal to or greater than 100 parts per million by weight.

The CAA has the potential to address inhalation exposures from the TC constituents. As Exhibit 9-6 demonstrates, all but seven TC constituents (counting heptachlor expoxide) are designated as HAPs under the CAA.

Inhalation pathway exposure to non-TC volatile chlorinated organic compounds and to persistent organic pesticides were identified in Chapter 4 as a potential gap in the hazardous waste characteristics. As Exhibit 9-7 demonstrates, the CAA regulates emissions of 16 of the 35 known non-hazardous volatile chlorinated organics. EPA also has designated as HAPs two of the six persistent pesticides identified in the second column of Exhibit 4-11.

Like the CWA, the CAA specifies emission limits for selected industries. Thus, for a potential gap to be addressed by the CAA, the gap constituents must be generated by one of the industrial categories regulated by the CAA. Exhibit 9-8 demonstrates that little overlap exists between the industries subject to CAA air toxics emission limits and those industries represented in the release descriptions. Among the industries represented in the release descriptions, the CAA specifies emission limits for segments of the chemicals production industry and off-site waste management operations.

Exhibit 9-6
TC Constituents Designated as HAPs under CAA

TC Analyte	CAA HAP	TC Analyte	CAA HAP	TC Analyte	CAA HAP
1,1-Dichloroethylene	--	Chloroform	✓	Methyl ethyl ketone	✓
1,2-Dichloroethane	✓	Chromium	✓	Nitrobenzene	✓
1,4-Dichlorobenzene	✓	Cresol (mixed isomers)	✓	o-Cresol	✓
2,4,5-Trichlorophenol	✓	Endrin	--	p-Cresol	✓
2,4,6-Trichlorophenol	✓	Heptachlor	✓	Pentachlorophenol	✓
2,4-D, salts and esters	✓	Heptachlor epoxide	--	Pyridine	--
2,4-Dinitrotoluene	✓	Hexachlorobenzene	✓	Selenium	✓
Arsenic	✓	Hexachloro-1,3-butadiene	✓	Silver	--
Barium	--	Hexachloroethane	✓	Silvex (2,4,5-TP)	--
Benzene	✓	Lead	✓	Tetrachloroethylene	✓
Cadmium	✓	Lindane	✓	Toxaphene	✓
Carbon tetrachloride	✓	m-Cresol	✓	Trichloroethylene	✓
Chlordane	✓	Mercury	✓	Vinyl chloride	✓
Chlorobenzene	✓	Methoxychlor	✓		

Exhibit 9-7
CAA Hazardous Air Pollutants (HAPs) Specified for Potential Gap Constituents

Volatile Chlorinated Organics	CAA HAP	Persistent Organic Pesticides	CAA HAP
1,1,1,2-Tetrachloroethane	--	Aldrin	--
1,1,1-Trichloroethane	✓	DDD	--
1,1,2,2-Tetrachloroethane	✓	DDE	✓
1,1,2-Trichloroethane	✓	DDT	--
1,2,3-Trichloropropane	--	Dieldrin	--
1,2,4,5-Tetrachlorobenzene	--	Hexachlorobenzene	✓
1,2,4-Trichlorobenzene	✓		
1,2-Dibromo-3-chloropropane	✓		
1,2-Dichlorobenzene	--		
1,2-Dichloroethylene	--		
1,2-Dichloroethylene, trans	--		
1,2-Dichloropropane	✓		
1,3-Dichlorobenzene	--		
1,3-Dichloropropylene	✓		
Allyl chloride	✓		
Benzoic trichloride	✓		
Bis(2-chloroethyl) ether	✓		
Chlorobromomethane	--		
Chlorodibromomethane	--		
Chloroethane	✓		
Chloromethane	✓		
cis-1,2-Dichloroethylene	--		
Dichloro-2-propanol, 1,3-	--		
Dichlorobromomethane	--		
Dichlorodifluoromethane	--		
Dichloromethane	✓		
Dichloropropane	--		
Epichlorohydrin	✓		
Ethylidene Dichloride	✓		
Hexachlorocyclopentadiene	✓		
Pentachloroethane	--		
Tetrachloroethane, N.O.S.	--		
trans-1,3-Dichloropropene	--		
Trichlorofluoromethane	--		
Trichloromethanethiol	--		

Emissions standards have not yet been established for the paper, food, primary metals, or non-metallic minerals industries. As presented in Exhibit 9-8, however, the most important industry in terms of the potential gaps that the CAA may address is the organic chemicals manufacturing industry. Emissions standards have been established for segments of this industry.

Exhibit 9-8
CAA Coverage of Industries Represented in Release Descriptions

Industry Group	SIC Code	Number of Documented Releases	CAA Air Emission Limits
Electric, Gas, and Sanitary Services (refuse only)	49	35	Off-site waste operations, hazardous waste TSDFs
Paper and Allied Products	26	27	no
Chemicals and Allied Products	28	11	Emissions from synthetic organic chemical industry, elastomer production, epichlorohydrin production
Food and Kindred Products	20	10	no
Primary Metals	33	6	no
Non-Metallic Minerals	14	4	no

9.3 Federal Insecticide, Fungicide, and Rodenticide Act

FIFRA controls chemical pesticides through a process whereby the manufacturer registers the composition of the pesticide and certifies to EPA that the pesticide will perform its intended function without unreasonable adverse impacts in the environment under commonly recognized practices for use. EPA can place a registered substance under special review if the substance is suspected of causing unreasonable adverse effects on the environment. Under this process, EPA can prohibit the distribution, sale, and/or use of a pesticide through a cancellation or suspension of its registration.

Four TC constituents found in the release descriptions are FIFRA active ingredients: 2,4-D, heptachlor, methoxychlor, and pentachlorophenol. Because FIFRA only places conditions on use, and does not set concentration-based regulatory levels or regulate pesticide waste disposal, the regulation of these constituents by FIFRA does not automatically imply that releases will not exceed a certain level. FIFRA could only prevent releases of these constituents if EPA were to cancel or suspend the respective registrations.

Exhibit 9-9 lists the pesticides, intermediates, and degradation products that are TC analytes or known non-hazardous industrial waste constituents and the current status of the pesticide. Of the 41 pesticides and associated products that are known non-hazardous industrial waste constituents, 25 are currently in use and 16 are cancelled or are not currently used. Several of these pesticides passed the multiple toxicity, persistence, volatility, and bioaccumulation screening criteria presented in Exhibit 4-13, including aldrin, DDT, DDD, DDE, dieldrin, heptachlor epoxide, and hexachlorobenzene. With the exception of heptachlor epoxide, these pesticides have been canceled by EPA. The presense of many of these canceled pesticides as known non-hazardous industrial waste may largely be the result of old data. For example, the release descriptions, which were used to identify known constituents, cover waste management units that may have received wastes more than a decade ago.

Exhibit 9-9

Status of Pesticides That are TC Analytes or Known Non-Hazardous Industrial Waste Constituents

Pesticides/Intermediate/Degradation Product	Status
Aldicarb	Active; restricted use
Atrazine	Active; restricted use
Carbofuran	Active; restricted use
2,4-D, salts and esters	Active
Diazinon	Active
Dimethoate	Active
Disulfoton	Active; restricted use
Endosulfan (pesticide is a mixture of alpha and beta isomers)	Active
Endosulfan, alpha-	Active
Endosulfan, beta-	Active
Endosulfan sulfate	Metabolic product of endosulfan
Endothall	Active
Heptachlor	Active; restricted use
Heptachlor epoxide	Degradation product of heptachlor
Lindane (gamma-HCH)	Active; restricted use
Molinate	Active
Mesitylene	Active use (registration not required)
Methyl iodide	Active use (registration not required)
Methoxychlor	Active
Methyl parathion	Active; restricted use
O,O-Diethyl O-pyrazinyl phosphorothioate (Thionazin)	Active
Parathion	Active; restricted use
Pentachlorophenol	Active; restricted use
Phorate	Active; restricted use
Sulfotepp	Active
2,3,4,6-Tetrachlorophenol	Canceled
2,4,5-Trichlorophenol	Canceled
2,4,6-Trichlorophenol	Canceled
Aldrin	Canceled
alpha-HCH	Canceled
beta-HCH	Canceled; no longer produced in U.S.
DDE	Degradation product of canceled ingredient
DDT/DDD	Canceled
Dieldrin	Canceled
Endrin	Canceled
Endrin aldehyde	Byproduct/degradation product of endrin
Endrin ketone	Byproduct/degradation product of endrin
Famphur	Most uses canceled; no currently active products
Hexachlorobenzene	Canceled
Silvex (2,4,5-TP)	Canceled
Toxaphene	Most uses canceled; no currently active products

Sources: *Farm Chemicals Handbook '94*, Meister Publishing Company; U.S. EPA/OPP Database of Pesticide Products, October 8, 1996, http://www.cdpr.ca.gov/docs/epa/epamenu.htm; *Status of Pesticides in Reregistration and Special Review (Rainbow Report),* Office of Pesticides and Prevention, U.S. EPA, June 1994; Merck Index, 12th edition, 1996.

9.4 Toxic Substance Control Act

TSCA was enacted to fill gaps in the Federal Government's authority to regulate problem chemicals. Most EPA regulations, such as the Clean Air Act and the Clean Water Act, regulate chemicals only after they are produced and used. However, there are many opportunities for a chemical to cause harm to human health or the environment prior to it becoming a waste, such as during production or use. Under Section 6 of TSCA, EPA has the authority to regulate the production, use, distribution, and disposal of chemicals that are identified as potentially hazardous. EPA has exercised the authority under Section 6 to regulate the production, distribution, and disposal of PCBs from electrical equipment and as byproducts of chemical manufacturing processes. The presence of PCBs in the release descriptions probably results from the past disposal of old products containing PCBs. Because TSCA bans the production of PCBs, however, their presence in waste should diminish over time. Actions under TSCA do not significantly address any other potential gaps.

9.5 Pollution Prevention

EPA has developed a number of pollution prevention initiatives that could address potential gaps in the characteristics by limiting the production of harmful chemicals. These initiatives include:

- **Source Reduction Review Project (SRRP)**. EPA has an on-going effort to introduce source reduction concepts into individual rules. As part of the SRRP, EPA conducted an in-depth analysis of source reduction measures and cross-media issues in the development of 24 rule makings for air toxics (Maximum Achievable Control Technology or MACT standards), water pollution (effluent guidelines) and hazardous wastes (listing determinations) that were pending in 1993 and 1994. The project's goal is to foster the use of source reduction measures as the preferred approach for achieving environmental protection, followed in descending order by recycling, treatment, and as a last resort, disposal. For the long term, EPA hopes that SRRP will provide a model for the regulatory development efforts in all of its programs.

- **Environmental Technical Initiative (ETI)**. EPA has promoted pollution prevention efforts for selected industries through technology development. For example, the Agency has supported research on recycling plastics, replacing current solvents with less harmful alternatives, and developing cleaner processes in plating and metal finishing.

- **Waste Exchanges**. Waste exchanges provide a mechanism for recycling and reusing industrial waste. In general, waste exchanges try to match generators of waste with companies interested in recycling or reusing these materials. The goals of waste exchanges are to reduce disposal costs, reduce disposal quantities, reduce demand for natural resources, and potentially increase the value of wastes. EPA has supported the non-federal waste exchanges through (1) funding a national computerized listing system, the National Materials Exchange Network (NMEN), and (2) issuing grants to develop support for individual waste exchanges or specific waste exchange activities.

- **Toxics Release Inventory (TRI)**. The TRI can have an instrumental role in pollution prevention by providing communities with the information that can be used to persuade industries to reduce emissions, and by establishing a benchmark to measure progress. For example, EPA established the 33/50 Program whereby companies voluntarily pledged to reduce releases of 17 priority pollutants reported in TRI in 1988 by 33 percent in 1992 and by 50 percent in 1995.

Further research is needed to determine the impact of these initiatives on potential gaps in the characteristics.

9.6 Occupational Safety and Health Act

Workplace safety is largely regulated by the Occupational Safety and Health Act (OSHA). The program that most directly relates to chemical hazards encountered in the workplace is the permissible exposure limits (PELs)[2] established for selected workplace chemicals.

Subpart Z of 29 CFR 1910.1000 specifies PELs for toxic and hazardous substances in the workplace. These PELs are based on threshold limits values (TLVs) established by the American Conference of Governmental Industrial Hygienists (ACGIH) and on the Recommended Exposure Limits (RELs) developed by the National Institute for Occupation Safety and Health (NIOSH). OSHA has adjusted some of these values when developing PELs. The PELs are intended to reduce diseases such as liver and kidney pains, neuropathy and cardiovascular effects, respiratory effects, deterioration of lung function, narcosis, biochemical and metabolic changes, and other health impairments caused by workplace exposure to chemicals.

As discussed above, OSHA regulates workplace inhalation exposure to designated constituents by establishing PELs. As shown in Exhibit 9-10, 33, or over 75 percent, of the TC constituents have PELs established under OSHA.

The majority of potential gaps associated with non-TC analytes identified in Chapter 4 are related to exposures to contaminated media, rather than workplace exposures. OSHA PELs, however, could address workplace exposures to a few of the major chemicals classes that comprise several of the potential gaps, including volatile chlorinated organics, other volatile and semivolatile organics, and pesticides. Exhibit 9-11 demonstrates that 21 of the 35 known non-hazardous volatile chlorinated organics in Exhibit 4-2 have OSHA PELs. Similarly, 33 of the 41 and 20 of the 45 other volatile and semivolatile organics, respectively, have OSHA PELs.

9.7 Hazardous Materials Transportation Act

HMTA gives the Department of Transportation (DOT) the authority to regulate the transportation of hazardous materials in interstate commerce. The HMTA regulates materials not covered by the hazardous waste characteristic, and therefore addresses hazards from these potential gaps, but only in the context of risks in transportation and to transportation workers. These materials include the following:

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[2] A PEL is the average maximum concentration of a chemical in air that is allowable for a worker to be exposed to in the course of an 8-hour working day.

Exhibit 9-10
TC Constituents with Established OSHA PELs

TC Analyte	OSHA PEL	TC Analyte	OSHA PEL	TC Analyte	OSHA PEL
1,1-Dichloroethylene	--	Chloroform	✓	Methyl ethyl ketone	✓
1,2-Dichloroethane	✓	Chromium	✓	Nitrobenzene	✓
1,4-Dichlorobenzene	✓	Cresol (mixed isomers)	✓	o-Cresol	--
2,4,5-Trichlorophenol	--	Endrin	✓	p-Cresol	✓
2,4,6-Trichlorophenol	--	Heptachlor	✓	Pentachlorophenol	✓
2,4-D, salts and esters	✓	Heptachlor Epoxide	--	Pyridine	✓
2,4-Dinitrotoluene	✓	Hexachlorobenzene	--	Selenium	✓
Arsenic	✓	Hexachloro-1,3-butadiene	✓	Silver	✓
Barium	✓	Hexachloroethane	✓	Silvex (2,4,5-TP)	--
Benzene	✓	Lead	✓	Tetrachloroethylene	✓
Cadmium	✓	Lindane	✓	Toxaphene	✓
Carbon Tetrachloride	✓	m-Cresol	--	Trichloroethylene	✓
Chlordane	✓	Mercury	✓	Vinyl Chloride	✓
Chlorobenzene	✓	Methoxychlor	✓		

Exhibit 9-11
OSHA PELs Specified for Known Non-Hazardous Industrial Waste Constituents

Volatile Chlorinated Organics	PEL	Other Volatile Organics	PEL	Other Semivolatile Organics	PEL
1,1,1,2-Tetrachloroethane	--	1,2-Dibromoethane	✓	1,2-Diphenylhydrazine	--
1,1,1-Trichloroethane	✓	1,4-Dioxane	✓	2,3,7,8-TCDD	--
1,1,2,2-Tetrachloroethane	✓	2-Ethoxyethanol	✓	2,4-Diaminotoluene	--
1,1,2-Trichloroethane	✓	2-Hexanone	✓	2,4-Dichlorophenol	--
1,2,3-Trichloropropane	✓	2-Methyllactonitrile	--	2,6-Dinitrotoluene	--
1,2,4,5-Tetrachlorobenzene	--	2-Methylpyridine	--	3,3'-Dimethoxybenzidine	--
1,2,4-Trichlorobenzene	✓	2-Nitropropane	✓	4-Aminobiphenyl	✓
1,2-Dibromo-3-chloropropane	✓	Acetaldehyde	✓	4-Aminopyridine	--
1,2-Dichlorobenzene	✓	Acetone	✓	5-Nitro-o-toluidine	--
1,2-Dichloroethylene	✓	Acetonitrile	✓	Acetophenone	--
1,2-Dichloroethylene, trans	--	Acrolein	✓	Acrylamide	✓
1,2-Dichloropropane	✓	Acrylonitrile	✓	Acrylic acid	✓
1,3-Dichlorobenzene	--	Allyl alcohol	✓	Adipic acid	--
1,3-Dichloropropylene	✓	Benzenethiol	✓	Aniline	✓
Allyl chloride	✓	Benzyl alcohol	--	Benzal chloride	--
Benzoic trichloride	--	Bromoform	✓	Benzoic acid	--
Bis(2-chloroethyl) ether	✓	Bromomethane	✓	Benzyl chloride	✓
Chlorobromomethane	✓	Carbon disulfide	✓	Biphenyl	✓
Chlorodibromomethane	--	Crotonaldehyde	--	Coal tars	✓
Chloroethane	✓	Cyclohexanone	✓	Creosote	--
Chloromethane	✓	Dimethyl sulfate	✓	Dibenzofuran	--
cis-1,2-Dichloroethylene	--	Dimethylamine	✓	Diphenyl ether	✓
Dichloro-2-propanol, 1,3-	--	Ethane, 1,1'-oxybis-	✓	Diphenylamine	✓
Dichlorobromomethane	--	Ethyl acetate	✓	Ethyl dipropylthiocarbamate	--
Dichlorodifluoromethane	✓	Ethylene glycol	✓	Formic acid	✓
Dichloromethane	✓	Ethylene oxide	✓	m-Dinitrobenzene	✓
Dichloropropane	--	Formaldehyde	✓	Maleic anhydride	✓
Epichlorohydrin	✓	Furan	--	Maleic hydrazide	--
Ethylidene Dichloride	✓	Furfural	✓	N-Nitrosodimethylamine	✓
Hexachlorocyclopentadiene	✓	Hydrazine	✓	N-Nitrosodiphenylamine	--
Pentachloroethane	--	Isobutyl alcohol	✓	Naphthalene	✓
Tetrachloroethane, N.O.S.	--	Malononitrile	--	Nitrosamine, N.O.S.	--
trans-1,3-Dichloropropene	--	Methanol	✓	O-Chlorotoluene	✓
Trichlorofluoromethane	✓	Methyl isobutyl ketone	✓	Ortho(2-)Nitroaniline	--
Trichloromethanethiol	--	Methyl isocyanate	✓	p-Chloroaniline	--
		Methyl mercaptan	✓	p-Chlorotoluene	--
		Methyl methacrylate	✓	p-Nitroaniline	✓
		Methylene bromide	--	Pentachlorobenzene	--
		n-Butyl alcohol	✓	Phenanthrene	--
		Urethane	--	Phthalic acid	--
		Vinyl acetate	✓	Phthalic anhydride	✓
				Polychlorinated biphenyls	✓
				Resorcinol	✓
				Thioacetamide	--
				Thiram	✓

- Combustible liquids defined under HMTA as liquids with a flash point above 141 F and below 200 F. Examples include benzonitrile, camphor oil, chlordane, coal tar distillate, di-isobutyl ketone, ethylene glycol ethers, and fuel oil distillate;

- Corrosive solids and liquids;

- aqueous flammable liquids (alcohol solutions < 24 percent);

- Non-flammable compressed gases and cryogenic liquids; and

- Certain materials specifically forbidden under HMTA, including materials likely to polymerize at a temperature of 130 F or less, or decompose at 122 F or less, with an evolution of a dangerous amount of heat or gas.

9.8 Summary

Most of the potential gaps identified in Chapters 3 and 4 are media-specific. As a result, media-specific regulations provide some control over chemical and chemical classes that comprise the potential gaps. In addition, non-media-specific regulations such as FIFRA and TSCA could address potential gaps associated with particular chemical classes, such as pesticides and PCBs. Exhibit 9-12 presents a summary of the non-RCRA statutes and regulatory programs that could address to varying degrees the potential gaps.

Exhibit 9-12
Potential Gaps and Potential Non-RCRA Regulatory Control

Statute or Regulatory Program	Potential Gap Possibly Addressed
Clean Water Act	● Direct surface water exposure to TC analytes ● Indirect pathway exposures to TC analytes involving surface waters ● Risks to ecological receptors involving discharges to surface waters ● Indirect pathway exposures to phenolic compounds involving surface waters ● DNAPL formulation by chlorinated organics ● Indirect pathway exposures to PAHs involving surface waters
Safe Drinking Water Act	● Implementation of 1996 Amendments to CWA has potential to address potential gaps through groundwater exposures to TC constituents, non-TC metals, and non-TC volatile chlorinated organics
Clean Air Act	● Inhalation pathway exposures to volatile chlorinated organics ● Inhalation pathway exposures to persistent organic pesticides
FIFRA	● Endocrine disruption from chlorinated pesticides, phthalate esters
TSCA	● Risks to humans, ecological receptors from PCBs
OSHA	● Inhalation exposures to TC analytes in workplace
HMTA	● Risks posed by gaps in the ICR characteristics

For a potential gap to be addressed by the CWA or CAA, the gap constituents must both have regulatory levels established by the programs and be generated by one of the regulated industrial categories. The CWA and CAA establish limits for about the same number of volatile chlorinated organics. The industrial categories regulated by the CWA, however, overlap more extensively than those regulated by the CAA with the industries represented in the release descriptions. Therefore the CWA effluent limitations will be more effective in addressing potential gaps. Each of the regulations discussed in this chapter do not address all of the known and possible non-hazardous industrial waste chemicals, and therefore none of the potential gaps are completely addressed by non-RCRA regulations.

CHAPTER 10. SUMMARY EVALUATION OF NATURE AND EXTENT OF POTENTIAL GAPS

This chapter evaluates potential gaps in terms of their significance to human health and the environment. It synthesizes and summarizes information presented in previous chapters.

Section 10.1	discusses the objectives of the gaps analysis and the specific criteria used to evaluate potential gaps.
Section 10.2	presents the findings of the evaluation and discusses major data gaps and unresolved issues.
Section 10.3	describes a possible framework for determining an appropriate course of action based on the results of this Scoping Study.

10.1 Overview of the Evaluation of Potential Gaps

10.1.1 Objectives of the Gaps Analysis

Since this Study is a scoping exercise, the human health and environmental impacts of potential gaps have not been definitively analyzed, and potential gaps are not numerically ranked with regard to their impacts. Instead, the Study's objective is to summarize available information in a manner that will be useful in guiding further, more detailed assessment of the most important potential gaps and their possible solutions. The categories of gaps are evaluated qualitatively against criteria that address the potential for adverse human health and environmental impacts.

Many of these criteria have been used in previous chapters to identify and analyze potential gaps. The analysis presented below, however, differs from previous analyses in two ways. First, while the same data sources are used, more detailed analyses are presented for key constituents, pathways, and risks. Second, instead of focusing on individual chemicals, the chapter analyzes groups of chemicals and specific environmental problems. This approach helps to generalize the analysis to include chemicals for which limited data are available regarding appearance in wastes, toxicity, or environmental fate and transport characteristics.

10.1.2 Criteria Used for Evaluating Gaps

Section 10.2 presents a series of exhibits (Exhibits 10-1 through 10-4) comparing the various categories of potential gaps identified and reviewed in previous chapters. Potential gaps are compared using criteria that relate to various dimensions of risks to human health and the environment. These criteria, which correspond to columns in the exhibits, are described below. (Because of data gaps or the inapplicability of some criteria to certain potential gaps, some exhibits do not include all of these criteria.)

<u>Nature of Risks</u>. This criterion qualitatively characterizes the nature of the risks posed by potential gaps, including the types of possible injuries or adverse effects, important toxicological effects (e.g., carcinogenicity, reproductive effects, or mutagenicity), and fate and transport properties. These factors are important in evaluating risk potential.

Presence in Non-Hazardous Industrial Waste. This entry indicates the number of the TC analytes and known or possible non-hazardous industrial waste constituents identified in Chapter 4 that fall into the potential gap and summarizes other available data on presence in waste. The number of chemicals in a given class indicates, to some extent, the potential frequency of their appearance in non-hazardous industrial wastes or use in different industries.

Frequently Detected Constituents in Release Descriptions. This column indicates how frequently the class of chemicals was detected in the documented releases from non-hazardous industrial waste management facilities. These data provide a second indicator of the frequency of the class of chemicals in wastes released to the environment. In some tables, this column also addresses the extent to which the releases had constituent concentrations detected in excess of health- or ecologically-based regulatory standards or other health-based levels. These data address the severity and type of the risk presented by the releases.

TRI Chemicals with Releases > One Million Pounds. This column identifies any constituents falling into the identified potential gaps that have 1994 TRI releases to air, land, water, and underground injection combined greater than one million pounds. Eighty-three of the 250 individual or classes of TRI chemicals for which data were available had reported releases exceeding one million pounds. These data served as a proxy for widespread use and appearance in wastes.

Affected Industries. This column presents two types of data. First, it identifies the industries most often associated with documented releases of a particular class of chemicals in the release descriptions. These data indicate, at least for the population of facilities evaluated, which industries seem to have the highest frequency of releases to the environment of each class of compounds. As noted previously, however, this indicator is imperfect, in part because the available data focus on releases to groundwater and some families of constituents may present risks primarily through other pathways. The column also uses information presented in Chapter 8 to identify the industries with particular classes of chemicals frequently occurring in their non-hazardous industrial wastes.

Affected Management Methods. This column identifies the types of management units at which the various classes of chemicals are detected most frequently in the release descriptions or other data sources. This criterion has the same limitation as the release description information identified above, namely, it focuses on groundwater contamination and thereby may miss chemicals that pose risks through other pathways. However, since presence in groundwater indicates presence in wastes, this column also provides information about the types of management units or practices that have releases to groundwater and are likely to have releases to other media (e.g., volatilization), as discussed in the screening-level risk results from Section 3.5.

Potential Coverage by Other Regulations. This column summarizes information presented in Chapter 5 (for large-scale environmental problems) and Chapter 9 (for TC and non-TC chemicals). It briefly describes the potential extent of coverage of potential gaps by existing regulatory programs. In some cases, despite the appearance that a particular gap is covered by a regulatory program, information from the release descriptions or elsewhere may indicate that such coverage is not preventing releases to the environment.

Comments/Data Gaps. The final column of each table identifies the major analytical uncertainties and limitations in the characterization of potential hazardous waste characteristics gaps. As noted above, a major obstacle to identifying gaps accurately and reliably is the shortage of information regarding the generation, composition, and management of non-hazardous industrial wastes and any human health or environmental damages resulting from the management of such wastes. Data may be available to fill some of the identified gaps, but, due to time constraints, these data were not used in preparing this Scoping Study.

10.2 Findings of the Evaluation

This section summarizes the evaluations of the five different types of potential gaps identified in the previous chapters, namely potential gaps associated with:

- The existing ignitability, corrosivity, and reactivity characteristics;
- The existing toxicity characteristic;
- Chemicals not included in the toxicity characteristic;
- Natural resource damages and large-scale environmental problems; and
- State expansion of the TC and listings.

The last part of this section reviews the major data gaps and uncertainties.

10.2.1 Potential Gaps Associated with the ICR Characteristics

Ignitability

Exhibit 10-1 summarizes the analysis of the potential gaps in the ICR characteristics. (This exhibit does not include a column on the constituents that were frequently detected in the release descriptions because of the difficulty of judging waste ICR properties based on the environmental monitoring data (e.g., groundwater sampling from the release descriptions). The first page of the exhibit addresses the limitations in the ignitability characteristic. The first potential gap in this characteristic relates to the lack of coverage of combustible liquids, that is, liquids with flash points above 140ºF and below 200ºF. The Agency has not found any data on how often non-hazardous industrial wastes exhibit this property. While many non-hazardous industrial waste constituents are flammable, the flash point and fire hazard from a given waste depends on its composition and management practices. Thus, the high frequency of appearance of flammable liquids among the waste constituents or groundwater contaminants does not necessarily reflect a high hazard potential. The release descriptions did not allow EPA to evaluate the frequency of fires and explosions at non-hazardous industrial waste management facilities, let alone to determine whether any fires had resulted from combustible liquids.

Dilute aqueous solutions of alcohol also are identified as a potential gap in the ignitability characteristic. These solutions might flash, even if they are not capable of sustaining combustion. Ethanol, however, is not a known or possible non-hazardous industrial waste constituent or a TC analyte, suggesting that this gap may not be significant. Nevertheless, the narrow definition of this characteristic excludes other organic liquids that can form potentially flammable mixtures with water. The possible limitations of this narrow definition are illustrated by the presence among waste constituents of water-miscible alcohols, such as methanol (with the highest release volume on the TRI list), n-butanol, and isobutanol, as well as other potentially flammable water-miscible solvents, such as acetone, methylethyl ketone, and acetonitrile.

EPA found no data on the extent of potential hazards from ignitable solids. Thus, the consequences of not having a test method for these materials are difficult to characterize. The release

Exhibit 10-1
Evaluation of Potential Gaps Associated With the Ignitability, Corrosivity, and Reactivity (ICR) Characteristics

Potential Gap	Nature of Risk	Presence in Non-Hazardous Industrial Waste	TRI Chemicals with 1994 Reported Releases > One Million lbs.	Affected Industries	Affected Management Methods	Potential Coverage by Other Regulations	Comments/Major Data Gaps
IGNITABILITY ● Exclusion of DOT Combustible Liquids (flash point between 140°F and 200°F)	● Fires under plausible mismanagement scenarios	● Some proportion of wastestreams are likely to be combustible, but are not readily identifiable with existing data. ● Combustible materials include certain alcohols, low molecular weight ethers kerosene, jet fuels, petroleum byproducts, tints and paints, and others.	● N-butyl alcohol, MIBK, acetonitrile, ethylene glycol, acetaldehyde	● Wide range of industries produce combustible materials including chemicals, petroleum refining, asphalt materials and paving ● Industries using paints, adhesives, inks, and fuels	● Hazards may be most relevant for waste handling activities such as generation, storage, and transportation. ● Landfills more likely to be of potential concern than surface impoundments because surface impoundments dilute wastes and thereby reduce ignitability; flammable organic liquids are not likely to be managed in impoundments.	● Variety of local, state, and federal laws address ignitable hazards, including -- DOT transportation rules; -- Fire codes; -- Emergency prevention and preparedness under EPCRA, OSHA, and CAA §112(r); and -- State Industrial D rules limiting landfilling of liquids.	● Flash point of waste depends on various factors including concentrations of constituents. ● Difficult to identify potentially affected wastestreams in the absence of flash point data for specific wastestreams ● No data available on fires from combustible liquids
● Exclusion of Aqueous Flammable Liquids (alcohol solutions < 24 percent)	● These liquids could flash, even if combustion is not sustained.	● Many constituents could form flammable mixtures with water.	● Methanol, n-butanol, iso-butanol, ethylene glycol, acetonitrile, MIBK, acetaldehyde	● Chemicals, refuse services			● DOT has a similar exclusion. ● No data available on fires from these liquids
● References Outdated DOT Regulations	● Confusion regarding definition and test methods due to incorrect DOT citation	● Not applicable	● Not applicable	● Not applicable			● No data available on fires due to improper testing or failures to test
● No Ignitability Test Method for Non-liquids	● More difficult to interpret, comply with, and enforce regulations.	● Could include soils and sorbents contaminated with ignitable materials	● Not addressed	● Not addressed			● Potential gap is difficult to characterize. ● DOT and NFPA have defined test methods for flammable solids.

Exhibit 10-1 (continued)
Evaluation of Potential Gaps Associated With the Ignitability, Corrosivity, and Reactivity (ICR) Characteristics

Potential Gap	Nature of Risk	Presence in Non-Hazardous Industrial Waste	TRI Chemicals with 1994 Reported Releases > One Million lbs.	Affected Industries	Affected Management Methods	Potential Coverage by Other Regulations	Comments/Major Data Gaps
<u>CORROSIVITY</u> ● Exclusion of Corrosive Non-liquids	● Skin, eye injuries and ecological risks, facilitated transport of pollutants	● Not addressed	● Not addressed	● Not addressed	● Not addressed	● Several states regulate corrosive solids as hazardous waste.	● Lack of data on specific substances, wastes, and/or damage cases that fall within potential gaps.
● pH Limits Potentially Not Protective, pH Test Methods Not Predictive of Risk	● pH test may not identify some corrosive materials	● Not addressed	● Not addressed		● Not addressed	● DOT and OSHA rules use a dermal corrosion test (not pH); they cover worker and transportation risks.	
● Corrosion of Non-Steel Materials Not Addressed	● Corrosion of plastic, clay, other liner materials and non-steel containers or tanks	● Many NAPL-formers; alcohols, ketones	● Toluene, xylene, carbon disulfide, styrene, ethylbeneze, trichlorofluoromethane, phenols (as group), various alcohols		● Waste management methods that involve materials such as plastic, clay, and other materials besides steel	● CAA limits disposal of solvents in certain units.	
● Solubilization of Non-Metals Not Addressed	● Organic solvents may solubilize organic constituents	● Many potential LNAPL or DNAPL forming constituents could solubilize other organics.	● Toluene, xylene, carbon disulfide, styrene, ethylbeneze, trichlorofluoromethane, phenols (as group)		● Waste management methods with potential for discharge to water bodies or other habitats	● CAA limits disposal of solvents in certain units.	
● Exclusion of Irritants and Sensitizers	● Allergic reaction in waste management and transportation workers ● Unclear whether this hazard meets RCRA Subtitle C statutory level of concern	● Numerous chemicals including ammonia, beryllium, cobalt, copper, nickel, carbonyl, formaldehyde, isobutyl alcohol, n-Dioctyl phthalate, benzoic acid, and coal tars	● Ammonia, formaldehyde, copper, (of those listed in prior column)		● Waste handling situations where spills could occur	● OSHA hazard communication standard covers irritants and sensitizers, which affords protection to employees at wide range of facilities (e.g., generating facilities, waste management facilities)	

Exhibit 10-1 (continued)
Evaluation of Potential Gaps Associated With the Ignitability, Corrosivity, and Reactivity (ICR) Characteristics

Potential Gap	Nature of Risk	Presence in Non-Hazardous Industrial Waste	TRI Chemicals with 1994 Reported Releases > One Million lbs.	Affected Industries	Affected Management Methods	Potential Coverage by Other Regulations	Comments/Major Data Gaps
REACTIVITY ● Broad, Non-Specific Definition	● Ambiguity may allow substances posing risks of gas generation or violent reaction to be managed improperly.	● Many constituents are DOT-reactive, none are identified as "highly reactive".	● Ammonia, hydrochloric acid, phosphoric acid, nitric acid, sulfuric acid, hydrogen fluoride, hydrogen cyanide, chlorine dioxide	● Not addressed	● Not addressed	● Explosions and other related hazards covered by programs including fire and building codes, DOT regulations (for transportation only), OSHA regulations, and accident prevention and preparedness regulations under EPCRA and CAA §112(r)	● Potential gap is difficult to characterize because reactive wastes are already regulated as hazardous
● References Outdated DOT Regulations	● Confusion about relevant standards may reduce compliance and increase risks of violent reactions.						
● No Test Methods Specified	More difficult to interpret, comply with, and enforce regulations						

descriptions do not, as noted above, identify any fires related to flammable solids. Also, as noted in Chapter 3, various data searches failed to identify any incidents that could be unambiguously related to flammable solids in non-hazardous industrial waste management units. At least one potential variety of flammable solids, soils contaminated with petroleum byproducts, are explicitly excluded by statute from RCRA Subtitle C jurisdiction.

Finally, the test methods referenced in the ignitability characteristic are outdated and need to be revised. The U.S. Department of Transportation has promulgated new methods in different sections of the *Code of Federal Regulations*. EPA, however, is not aware of any fires or other adverse events arising from confusion over the proper test methods.

Corrosivity

The second panel in Exhibit 10-1 addresses potential gaps in the corrosivity characteristic. Several potentially corrosive substances, primarily strong acids, are identified among the known and possible non-hazardous industrial waste constituents. These compounds are not among the most frequently detected groundwater contaminants in the release descriptions, however.[1] No information is available concerning corrosive non-liquids in the release descriptions.

A potential gap associated with the pH range of the corrosivity characteristic also was identified. The release descriptions identify decreased or elevated pH levels in groundwater near management units for a number of the industries. While the reported pH levels are not associated with skin or eye injury or injury to biota, the appearance of elevated or depressed pH in groundwater after dilution indicates that high- and low-pH wastes are frequently encountered among the non-hazardous industrial wastes. The extent to which the pH of these wastes falls into the potential gap between the existing pH limits in the corrosivity characteristic and possible more stringent limits is not known, however.

The corrosivity characteristic also does not address corrosion of materials other than steel. Specifically, the Agency has identified potential corrosion of plastics and clay (common materials used in liners of non-hazardous industrial waste management units) as a potential gap. For example, the plastic liners may be corroded by nonaqueous phase liquids (NAPLs) if present in significant amounts; as is discussed in more detail in Section 4.2.3, a number of TC analytes and known and possible waste non-hazardous industrial constituents could form NAPLs. In addition, certain ketones and alcohols could dehydrate or otherwise adversely affect the physical integrity of clay liners.

Finally, the corrosivity characteristic excludes irritants and sensitizers. The Agency has found a number of allergic sensitizers to be constituents of non-hazardous industrial wastes, including ammonia, beryllium, cobalt, copper, nickel, nickel carbonyl, formaldehyde, isobutyl alcohol, n-dioctyl phthalate, benzoic acid, and coal tars. Further analysis may identify other substances. While the release descriptions do not report any incidents of allergic sensitization, dermatitis is one of the most common occupational illnesses, and non-hazardous industrial waste could contribute to these potential risks to waste management and transportation workers. Occupational Safety and Health Act regulations prescribe measures to limit dermal exposures to hazardous substances in the workplace, however. Thus, this problem is at least partially addressed by non-RCRA regulations.

Reactivity

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[1] "Fluorides/fluorine/hydrogen" (the slashes indicate that the exact chemical species is not identified) are among the frequently detected constituents, but these detections most probably refer to fluoride ion, rather than to the acid.

The final panel of Exhibit 10-1 summarizes the information related to the potential gaps in the reactivity characteristic. A major question for this potential gap is whether the over-broadness of the definition has increased the occurrence of human health or environmental damages or risks due to reactive materials. The release descriptions do not contain information related to violent chemical reactions. Also, while some DOT-classified reactive chemicals are among the non-hazardous industrial waste constituents, there is no evidence that would indicate whether these chemicals are present in forms or concentrations that are reactive. The need to specify test methods is likewise linked both to the severity of reactivity as a problem for non-hazardous industrial waste management operations, and to the extent to which such issues are not already addressed by the DOT regulations, OSHA regulations, or process safety management practices.

10.2.2 Potential Gaps Associated with TC Analytes

Exhibit 10-2 summarizes the analysis of five types of potential gaps associated with the toxicity characteristic:

- TC regulatory levels for the groundwater pathway;
- Risks through non-groundwater pathways, including inhalation, surface water, and indirect pathways;
- Acute human health risks;
- Risks to ecological receptors; and
- Limitations in the TCLP.

Each of these gaps is discussed below, following a brief review of data applicable to all four potential gaps.

One indication of the significance of these potential gaps is that 25 of the 40 TC analytes were detected in at least one of the descriptions of releases from non-hazardous industrial waste management units described in Chapter 2. Many are detected frequently above regulatory levels. Six TC metals and arsenic are among the most commonly detected analytes in the release descriptions.

All TC analytes are regulated under federal and state regulatory schemes in addition to the RCRA hazardous waste characteristics. The TC analytes are included in 40 CFR Part 261, Appendix VIII, and therefore many wastes have been listed based on the presence of TC chemicals. Media-specific regulatory programs also control individual analytes. MCLs or MCLGs have been promulgated to limit exposures to about half the TC analytes in community drinking water systems. Most volatile TC analytes are Hazardous Air Pollutants under the CAA, and most TC analytes have OSHA Permissible Exposure Limits (PELs), which limit occupational exposures. CWA Ambient Water Quality Criteria trigger regulatory control of most of the TC analytes through NPDES permits and state surface water quality standards, although, as noted in Chapter 3, the TC regulatory levels may not be adequately protective against surface water risks for some analytes.

Exhibit 10-2
Evaluation of Potential Gaps Associated with Toxicity Characteristic Analytes and TCLP

Potential Gap	Nature of Risk	Detection in Release Descriptions	TRI Chemicals with 1994 Reported Releases > Million lbs.	Affected Industries	Affected Management Methods	Coverage by Other Regulations	Comments/Major Data Gaps
Groundwater pathway risks from wastes below TC regulatory levels ● Uniform DAF value potentially not protective for some TC constituents.	● Wastes with TC constituents below regulatory levels may pose chronic health cancer risk >10^{-5}, noncancer hazard quotient > 1 in nearby populations exposed through groundwater ingestion.	● 7 TC metals (lead, chromium, arsenic, cadmium, barium, mercury, selenium) are among top 20 frequently detected constituents. ● Other TC constituents occurring > 5 times are benzene, trichloroethylene, vinyl chloride, silver, chlorobenzene, chloroform, and tetrachloroethylene.	● Methyl ethyl ketone, trichloroethylene, chromium compounds, lead compounds, chloroform, tetrachloroethylene, benzene, 1,2-dichloroethane, chromium, arsenic and compounds, chlorobenzene, vinyl chloride	● Industries with frequent detections of metals in release descriptions include chemicals, paper, refuse systems, industrial sand, primary metals, and others.	● Landfills, surface impoundments, land application units, waste piles, potentially others	● RCRA listings, state Industrial D, SDWA	● Variability and uncertainty in calculated DAF values, depending on modeling assumptions ● Limited non-hazardous industrial wastestream data
Inhalation risks were not considered in derivation of TC levels. Volatile organics pose such risks.	For 16 TC organics with inhalation cancer risk data, risk > 10^{-5} was found for: ● 0 and 12 analytes in central tendency and high-end surface impoundments respectively; and ● 0 and 4 in central tendency and high-end LAUs respectively. For 4 TC organics with inhalation non-cancer risk data, HQ > 1 was found for: ● 3 or 4 of central tendency or high-end respectively of both surface impoundments and LAUs.	● Vinyl chloride, chloroform, chlorobenzene, 1,4-dichlorobenzene and carbon tetrachloride are among most frequently detected analytes.	● Methyl ethyl ketone, chloroform, 1,2-dichloroethane, vinyl chloride	● Chemicals, refuse systems, and others	● Surface impoundments, land application units, landfills, and possibly waste handling	● RCRA listings, state Industrial D, CWA NPDES, CAA, OSHA PELs	● Most organic analytes that exceed inhalation risk thresholds are not very persistent in either soil or water. • Release descriptions did not identify inhalation problems. ● Limited wastestream data
Surface water risks to human health were not considered in the derivation of TC levels.	● Potential chronic health cancer risks >10^{-5}, noncancer risks HQ > 1 in nearby populations exposed to surface water by consumptive use or recreational use	● Toxic, bioaccumulative constituents of potential concern were not identified frequently in the release descriptions.	● Specific constituents of potential concern were not identified.	● Not addressed	● Surface impoundments, landfills, land application units, waste piles	● Intentional discharges limited by NPDES; state CWA Industrial D design requirements limit unintentional releases	●Risks may be significant only in narrow range of conditions. ● Limited wastestream data ● Release descriptions include few surface water releases.
Indirect/food chain pathway risks to human health were not considered in derivation of TC levels. Persistent and bioaccumulative chemicals pose such risks.	● Potential human health risks from consumption of fish, crops, beef/dairy products ● Persistent bioaccumulative TC analytes are chlorinated pesticides, chloroform, hexachloro-1,3-butadiene, mercury, arsenic, and lead.	● Lead, mercury, arsenic, chloroform were frequently detected. ● Persistent pesticides were not frequently detected.	● Lead compounds, chloroform, arsenic compounds	● Industries with frequent detection of metals include chemical, paper, and sanitary services.	● Surface impoundments, land application units, and landfills	● RCRA listings, state Industrial D, CWA NPDES, CAA, FIFRA	● Limited data on wastestreams, releases to various media, and resulting damages

Exhibit 10-2 (continued)
Evaluation of Potential Gaps Associated with Toxicity Characteristic Analytes and TCLP

Potential Gap	Nature of Risk	Detection in Release Descriptions	TRI Chemicals with 1994 Reported Releases > Million lbs.	Affected Industries	Affected Management Methods	Coverage by Other Regulations	Comments/Major Data Gaps
Acute adverse health effects were not considered in derivation of TC levels.	● Screening analysis showed that short-term concentrations of all volatile TC organics calculated at fenceline were far below applicable short-term (occupational) exposure standards ● Unusual release events (e.g., fires or explosions) could result in higher exposures	● Specific constituents of potential concern were not identified.	● Specific constituents of potential concern were not identified.	● Not addressed	Not addressed.	● OSHA PELs, CAA	• Acute hazards are addressed by ICR characteristics
Ecological risks were not considered in derivation of TC levels. TC constituents include potent ecotoxins, persistent and bioaccumulative pesticides.	● Potential damage to nearby aquatic ecosystems from releases to surface water and through aquatic and possibly terrestrial food chain exposures from runoff ● TC analytes with a ratio of TC leachate concentration to AWQC > 10,000 include chlorinated pesticides, chlorobenzene, lead, mercury, pentachlorophenol, silver, toxaphene, and 2,4,5-trichlorophenol. ● Ratio is > 100,000 for mercury, methoxychlor, silver, and toxaphene.	● Lead, mercury, silver, and chlorobenzene each were detected at more than 5 of 112 releases.	● Chlorobenzene	● Chemicals, refuse systems, paper, primary metals, and others	● Waste piles, land application units, surface impoundments, landfills	● State Industrial D, CWA effluent limits, FIFRA	● Uncertainty in estimating degradation and dilution ● Limited data on wastestreams and releases to various pathways
TCLP may not accurately predict leachate concentration or risks for certain wastes and units.	● Release concentrations may be higher or lower than predicted, implying higher or lower exposure concentrations and risks. ● Main concerns are for oily wastes; highly alkaline wastes; wastes with multiple constituents; wastes disposed in certain types of landfills; some types of treated wastes; some types of contaminated soil; and non-groundwater pathways.	● Lead, cadmium, chromium, arsenic, barium, benzene, selenium, lindane, and vinyl chloride were detected in groundwater at levels exceeding their TC levels, indicating that TCLP may have underestimated the long-term releases of some wastes.	● Chromium compounds, lead compounds, arsenic compounds, and vinyl chloride (of those listed in prior column)	● Not addressed	● All types	● RCRA listings, state Industrial D; states have developed alternative leaching procedures, e.g., Cal WET	● Limited data on wastestreams and management unit environments ● Waste heterogeneity, sampling procedures, sample preparation, leaching procedure contribute to uncertainty in test results.

TC Regulatory Levels for Groundwater

The first of the potential TC gaps concerns whether the existing leachate concentrations remain demonstrably protective of human health through the groundwater pathway, given advances in toxicological, fate, and transport data and modeling since the TC was promulgated. As noted in Section 3.5.2, the only changes in toxicological values that have occurred since the TC was promulgated are the reduction of the RfD for pentachlorophenol, promulgation of a cancer slope factor for this compound, the reduction in the RfD for p-cresol, the replacement of the MCL for lead with a lower action level, and replacement of the MCL for silver with an SMCL. Of these changes, only the classification of pentachlorophenol as a carcinogen significantly changes the risk implicit in the TC regulatory levels. EPA also has refined its approach for modeling the fate and transport of both organic and inorganic constituents in groundwater. Most recently, groundwater risks were modeled for the TC analytes in the HWIR-Waste proposed rulemaking. This modeling, which is still undergoing revisions, was performed using some assumptions that differ significantly from those made in the derivation of the TC regulatory levels. Nevertheless, the results, which are proposed health-protective exit levels for releases to groundwater, can be interpreted to imply that some TC regulatory levels may not protect human health to the extent originally intended. Without more detailed modeling that duplicates, where appropriate, the TC input assumptions, no firm conclusions can be drawn about which TC regulatory levels do or do not meet the original risk objectives, however.

Risks Through Non-Groundwater Pathways

Another major potential TC gap relates to exposures associated with inhalation, surface water, and indirect exposure pathways. These pathways were not considered when the TC was promulgated. The results of the proposed HWIR-Waste modeling also provide evidence that non-groundwater pathway risks may be important for several TC analytes. For nine of these substances, non-groundwater indirect exposures resulted in the highest risks and thereby determined the HWIR-Waste proposed exit concentrations. These pathways included both air and surface water. In most cases, the proposed exit concentrations for the indirect pathways are considerably lower than those based only on the groundwater pathway. These modeling results provide further evidence that the TC levels may not be sufficiently protective for some highly toxic, volatile, persistent, and/or bioaccumulative chemicals when pathways other than groundwater are considered.

The screening-level modeling in Section 3.5.3 identified various TC constituents that may present inhalation risks when present in wastes at TC regulatory levels. For example, estimated lifetime cancer risks exceeded 10-5 for 12 of the 16 TC analytes for which EPA has promulgated inhalation Unit Risk values, assuming management in “high-end” surface impoundments. Cancer risks exceeded 10-5 for 4 of these 16 analytes when management in a high-end land application unit (LAU) was assumed. None of the analytes posed cancer risks above this level when managed in “central tendency” units.

The Agency has promulgated inhalation pathway Reference Concentrations for only four TC analytes (chlorobenzene, methyl ketone, nitrobenzene, and 1,4-dichlorobenzene). When releases were modeled from high-end impoundments or LAUs, all four analytes had inhalation pathway hazard quotients above 1.0. When the central tendency impoundments are modeled, three of the four analytes (all but 1,4-dichlorobenzene) still have HQ values above 1.0.

All the analytes with screening-level risk estimates above levels of potential concern were found in the release descriptions; several of them occur frequently in the release descriptions. Four of these constituents are among the chemicals with total TRI release volumes greater than one million pounds, as noted in Exhibit 10-2.

EPA did not perform quantitative risk modeling of surface water and indirect pathways. Instead, the Agency reviewed the toxicity and fate and transport parameter values for the TC analytes to develop a qualitative indication of the potential risks to human health that they might present when managed in Subtitle D units, as discussed in Section 3.5.4. A substantial proportion of the analytes have properties, such as volatility, persistence in air, soil, and water, and high bioaccumulation potential, that suggest potential exposure through surface water or indirect pathways might result in significant risks. The proposed HWIR-Waste modeling results for indirect pathways discussed above suggest the need for more detailed modeling, using assumptions consistent with those used to derive the TC regulatory levels, to better determine which indirect pathways are the most important for which TC analytes.

Acute Adverse Effects

The TC was originally established based on the need to protect individuals from adverse health effects due to chronic exposures to the TC constituents consumed in groundwater. This approach to protecting against groundwater exposure risks is conservative because the relatively long time scale generally involved in groundwater transport to receptors means that limiting concentrations in any time period to the low chronic risk-based levels also will protect against short-term adverse effects. This relationship may not apply to exposure through pathways not involving slow releases to groundwater. For example, the rapid evaporation of volatile chemicals from a ruptured container, the catastrophic release due to overtopping of a surface impoundment, or runoff erosion from an extreme storm event has the potential to result in short-term (acute) exposures to humans and environmental receptors.

Thus, EPA evaluated the potential for acute adverse effects associated with rapid volatilization of chemicals from land management units. This screening-level analysis indicated that the short-term concentrations of all volatile TC analytes calculated at the fenceline were far below applicable short-term exposure standards (in this case, occupational exposure standards). This simple modeling does not unconditionally eliminate the possibility of adverse effects from acute exposures to the TC analytes. Unusual release events, such as fires or explosions, could result in higher exposures than calculated assuming simple volatilization. In addition, high winds or other events could result in high concentrations of particle-bound metals and other nonvolatile analytes. The potential for these kinds of release events strongly depends on specific waste characteristics, site conditions, and management practices.

Risks to Ecological Receptors

The next potential gap in the TC is its lack of specific consideration of potential adverse effects on ecological receptors. Section 3.5.7 found that several TC analytes are highly toxic to aquatic biota, which suggests that this potential gap may be significant. Some of these constituents occur frequently in the release descriptions. One potent ecological toxicant (chlorobenzene) is among chemicals with TRI releases greater than one million pounds. Several TC analytes, including the chlorinated pesticides, chlorobenzene, mercury, and silver have TC levels greater than 1,000 times their respective AWQC, which indicates a risk to aquatic biota value if dilution after release is less than 1,000-fold. Mercury, methoxychor, silver, and 2,4,5-trichlorophenol have TC levels more than 10,000 times their AWQCs. In addition, as discussed in more detail in Section 10.2.4, several TC analytes (cadmium, heptachlor, heptachlor oxide, lead, mercury, methoxychlor, and toxaphene) have been identified as suspect endocrine disruptors for wildlife, as well as humans. All these lines of evidence support the importance of this potential gap. Some ameliorating considerations, however, include the relative lack of evidence for environmental damage in the release descriptions summarized in Chapter 2, and the existing bans and/or use restrictions on many of the TC pesticides, which comprise most of the potent ecological toxicants.

TCLP Limitations

The final potential gap in the TC characteristic is the limitations in the ability of the TCLP to accurately predict releases of hazardous constituents from wastes. The Agency has received numerous comments and data on the utility of the TCLP in general and for specific wastes and environments. Potential limitations of the method include difficulties in performing the analysis on oily, hydrophobic wastes and in simulating leachate characteristics for highly alkaline wastes, certain types of landfill environments, long-term mobility of organics in some treated (non-hazardous) wastes, and some contaminated soils. Furthermore, the TCLP was not designed to simulate releases into non-groundwater pathways (e.g., air).

In the context of this Scoping Study, EPA has not identified any significant new information bearing on the magnitude of this potential gap. The Agency has reviewed other possible leaching methods (such as the SPLP and Cal WET methods), but has not found compelling evidence that they are more appropriate for general use than the TCLP. The high frequency of occurrence of TC analytes in groundwater above MCLs or HBLs near non-hazardous industrial waste facilities, as shown in the release descriptions, suggests that the TCLP may not adequately detect situations that could result in harm to human health or the environment. The blame cannot unambiguously be placed on the TCLP, however. Even if the TCLP accurately predicts TC leachate levels, site-specific fate and transport processes (e.g., dilution by a factor of less than 100) and waste management practices could result in the exceedances of MCLs and other regulatory levels.

10.2.3 Potential Gaps Associated with Non-TC Waste Constituents

Exhibit 10-3 summarizes the evaluation of potential gaps associated with non-TC chemicals that are known or possible non-hazardous industrial waste constituents. Separate evaluations are presented for each of the 10 categories of chemicals identified in Chapter 4, which are associated with the groundwater, inhalation, or indirect pathways:

- Metals and other inorganics;
- Volatile chlorinated organics;
- Volatile hydrocarbons;
- Other volatile organics;
- Pesticides and related compounds;
- Phthalate esters;
- Phenolic compounds;
- Polycyclic aromatic hydrocarbons;
- Other semivolatile organic compounds; and
- LNAPLs and DNAPLs.

<u>Nature of Risk</u>. A number of chemicals in some of the groups listed above are suspect carcinogens. Other chemicals have the potential to cause reproductive and/or developmental effects in

Exhibit 10-3
Evaluation of Potential Gaps Associated with Non-TC Chemicals

Chemical Type	Nature of Risk	Presence in Non-Hazardous Industrial Waste[a]	Frequently Detected Constituents in Release Descriptions	TRI Chemicals with 1994 Reported Releases > One Million lbs.	Affected Industries	Affected Management Methods	Potential Coverage by Other Regulations	Comments/Major Data Gaps
GROUNDWATER PATHWAYS								
Metals/Inorganics	● Potential cancer risks > 10^{-5} and noncancer risks of HQ>1	● 61 elements, compounds, or families of compounds; most important are probably the metals, beryllium, copper, manganese, nickel, zinc, cyanides	● Beryllium, manganese, zinc, copper, nickel, cyanides	● Copper, zinc, manganese, cyanides, nickel, antimony	● Chemicals, refuse systems, paper have about 66 percent of detections in release descriptions; 10 other industries have frequent detections	● 78 percent of detections from landfills; 15 percent from surface impoundments; 5 percent from land application units.	● State Industrial D; California TC includes 10 additional metals; Michigan TC includes copper and zinc; many have MCLs or SMCLs	● Exposure at individual residential wells not known
Volatile Chlorinated Organics	● Potential cancer risks > 10^{-5} and noncancer risks of HQ>1 • Many of these chemicals are suspect carcinogens.	● 45 compounds	● Methylene chloride, ethylidene dichloride	● Methylene chloride, trichloroethene, 1,1,1-trichloroethane, chloromethane, Freon 113	● Refuse systems, paper, and chemicals have about 85 percent of detections	● 79 percent of detections from landfills; 13 percent from surface impoundments.	● State Industrial D; most in Appendix VIII; RCRA listings; California TC includes 1,2-dibromo-3-chloropropane; many have MCLs, MCLGs	● Limited data on wastestream and waste management practices contributing to groundwater releases
Volatile Hydrocarbons	● Potential cancer risks > 10^{-5} and noncancer risks of HQ>1.	● 13 compounds	● Toluene, xylenes	● Toluene, xylenes, styrene, ethylbenzene, cumene	● Chemicals, refuse systems, and paper have 80 percent of detections	● 68 percent of detections from landfills; 27 percent from surface impoundments.	● State Industrial D; RCRA listings; all in Appendix VIII; most have MCLs and/or AWQCs	● Petroleum hydrocarbons exempt from RCRA ● Limited data on wastestreams and management practices contributing most to groundwater releases
Other Volatile Organics	● Potential cancer risks > 10^{-5} and noncancer risks of HQ>1 ● Highly variable toxicity and fate and transport properties	● 58 compounds	● Acetone	● Methanol, methyl ethyl ketone, methyl-isobutyl ketone, n-butanol, formaldehyde, acetonitrile, acetaldehyde, acrylonitrile, vinyl acetate, propylene oxide	● Chemicals, refuse systems, and paper industries have 88 percent of detections	● 75 percent of detections from landfills and the remainder from surface impoundments.	● State Industrial D; most in Appendix VIII; RCRA listings; California TC includes acrylonitrile; few have MCLs, MCLGs	● Wide range of toxicological, fate and transport properties ● Limited data on wastestreams and management practices contributing to groundwater releases
Phenolic Compounds	● Potential noncancer risks of HQ>1	● 13 compounds	● Phenol	● Phenol; combined cresols release exceeds one million pounds	● 10 industries with detections; among the most widespread of constituent classes, despite low number of detections	● 56 percent of detections at landfills; 36 percent at surface impoundments; and 8 percent at land application units.	● State Industrial D; all in Appendix VIII	● Most compounds are of relatively low toxicity, biodegradable at low concentrations ● Limited data on wastestreams

Exhibit 10-3 (continued)
Evaluation of Potential Gaps Associated with Non-TC Chemicals

Chemical Type	Nature of Risk	Presence in Non-Hazardous Industrial Waste[a]	Frequently Detected Constituents in Release Descriptions	TRI Chemicals with 1994 Reported Releases > One Million lbs.	Affected Industries	Affected Management Methods	Potential Coverage by Other Regulations	Comments/Major Data Gaps
LNAPLs and DNAPLs	● Facilitated transport of organic chemicals from containment ● Long-lasting, difficult to remediate reservoir of groundwater contamination (DNAPL)	● 33 potential DNAPL formers, 13 potential LNAPL formers	● Potential LNAPL/DNAPL formers were found in many release descriptions ● LNAPLs/ DNAPLs were not reported as problem in any release descriptions, possibly because of limited reporting requirements	● 8 compounds plus the phthalate esters (combined)	● LNAPLs/DNAPLs not reported in release descriptions	● No data. • Management priorities are key to DNAPL generation.	● State Industrial D; RCRA listings; some chemicals have MCLs	● Frequency of NAPL problems in non-hazardous waste appears to be infrequent, especially in recent years ● Limited wastestream and waste management data
Other Semi-volatile Organic Compounds	● Potential cancer risks > 10^{-5} and noncancer risks of HQ>1 ● Some are persistent and/or bioaccumulative. ● Highly variable fate and transport properties	● 67 compounds	● None	● Formic acid, acrylic acid, naphthalene	● Chemicals industry has 45 percent of detections, remainder in five other industries	● Approximately equal frequency in landfills and surface impoundment releases	● State Industrial D; many in Appendix VIII; RCRA listings; a few have MCLs; PCBs covered by TSCA and some state hazardous waste regulations	● Highly variable toxicological, fate, and transport properties ● Limited data on wastestreams and management practices contributing to groundwater releases
INHALATION PATHWAYS								
Volatile Chlorinated Organics	● Potential cancer risks > 10^{-5} and noncancer risks of HQ>1 ● Many of these chemicals are suspect carcinogens	● 45 compounds	● Methylene chloride, ethylidene dichloride	● Methylene chloride, trichloroethene, 1,1,1-trichloroethane, chloromethane, Freon 113	● Refuse systems, paper, and chemicals, have about 85 percent of detections	● 79 percent of detections from landfills; 13 percent from surface impoundments	● State Industrial D; most in Appendix VIII; RCRA listings; California TC includes 1,2-dibromo-3-chloropropane; majority are CAA HAPs; vinyl chloride has NESHAP; many have OSHA PELs	● Limited data on wastestream and waste management practices contributing to air releases
Volatile Hydrocarbons	● Potential noncancer risks of HQ>1 ● Benzene is the only carcinogen	● 13 compounds	● Toluene, xylenes	● Toluene, xylenes, styrene, ethylbenzene, cumene	● Chemicals, refuse systems, and paper have 80 percent of detections	● 68 percent of detections from landfills; 27 percent from surface impoundments	● State Industrial D; all in Appendix VIII RCRA listings; all are CAA HAPs	● Petroleum hydrocarbons exempt from RCRA ● Limited data on wastestreams and management practices contributing most to air releases

Exhibit 10-3 (continued)
Evaluation of Potential Gaps Associated with Non-TC Chemicals

Chemical Type	Nature of Risk	Presence in Non-Hazardous Industrial Waste[a]	Frequently Detected Constituents in Release Descriptions	TRI Chemicals with 1994 Reported Releases > One Million lbs.	Affected Industries	Affected Management Methods	Potential Coverage by Other Regulations	Comments/Major Data Gaps
Other Volatile <Organics	● Potential cancer risks > 10^{-5} and noncancer risks of HQ>1 ● Highly variable toxicity and fate and transport properties	● 58 compounds	● Acetone	● Methanol, methylisobutyl ketone, n-butanol, formaldehyde, acetinitrile, acetaldehyde, acrylonitrile, vinyl acetate, propylene oxide	● Chemicals refuse systems, and paper industries have 88 percent of detections	● 75 percent of detections from landfills and remainder from surface impoundments.	● State Industrial D; most in Appendix VIII; RCRA listings; California TC includes acrylonitrile; most are CAA HAPs; most have OSHA PELs	● Wide range of toxicological, fate and transport properties ● Limited data on wastestreams and management practices contributing to air releases
Pesticides and Related Compounds	● Potential cancer risks > 10^{-5} and noncancer risks of HQ>1 ● Some suspect endocrine disruptors ● Possible reproductive toxicity and human development effects ● Many are persistent and bioaccumulative.	103 compounds	● None	None	● Chemicals industry has 80 percent of detections; refuse systems have 10 percent	● 87 percent of detections at surface impoundments; remainder at landfills	● State Industrial D; RCRA listings; most in Appendix VIII; several are CAA HAPs; FIFRA banned production or restricted use of many	● Future generation is unclear because of production and use restrictions; potential presence in remediation waste may merit examining ● Limited data on management practices contributing to air releases
Polycyclic Aromatic Hydrocarbons	● Potential cancer risks > 10^{-5}. ● Some are persistent and bioaccumulative.	● 19 compounds	● None (but PAHs are not mobile in groundwater)	● None	● Relatively equally frequent in detections from petroleum refining and chemicals industries; low frequency overall	● Relatively equally frequent at landfills and surface impoundments	● State Industrial D; many have CAA HAPs; many have OSHA PELs	● Highly variable toxicological, fate, and transport properties ● Limited data on wastestreams and management practices contributing to non-groundwater releases
Other Semivolatile Organic Compounds	● Potential cancer risks > 10^{-5} and noncancer risks of HQ>1 ● Some are persistent and/or bioaccumulative. ● Highly variable fate and transport properties	● 67 compounds	● None	● Formic acid, acrylic acid, naphthalene	● Chemicals industry has 45 percent of detections, remainder in five other industries	● Approximately equal frequency in landfills and surface impoundment detections	● State Industrial D; many in Appendix VIII; RCRA listings; many have OSHA PELs; some are CAA HAPs	● Highly variable toxicological, fate, and transport properties ● Limited data on wastestreams and management practices contributing to non-groundwater releases

Exhibit 10-3 (continued)
Evaluation of Potential Gaps Associated with Non-TC Chemicals

Chemical Type	Nature of Risk	Presence in Non-Hazardous Industrial Waste[a]	Frequently Detected Constituents in Release Descriptions	TRI Chemicals with 1994 Reported Releases > One Million lbs.	Affected Industries	Affected Management Methods	Potential Coverage by Other Regulations	Comments/Major Data Gaps
INDIRECT/FOOD-CHAIN PATHWAYS								
Pesticides and Related Compounds	● Potential cancer risks > 10^{-5} and noncancer risks of HQ>1 ● Some suspect endocrine disruptors. ● Possible reproductive toxicity and human development effects ● Many are persistent and bioaccumulative.	● 103 compounds	● None	● None	● Chemicals industry has 80 percent of detections; refuse systems have 10 percent	● 87 percent of detections at surface impoundments; remainder at landfills	● State Industrial D; RCRA listings; most in Appendix VIII; several have AWQCs; FIFRA banned production or restricted use of many	● Future generation is unclear because of production and use restrictions; potential presence in remediation waste may merit examining. ● Limited data on management practices contributing to releases
Phthalate Esters	● Potential cancer risks > 10^{-5} (one compound) ● Suspect endocrine disruptors ● Possible reproductive toxicity, human development effects ● Several are persistent and bioaccumulative.	● 6 compounds	● None	● None; combined phthalate ester releases exceed one million pounds, however	● Chemicals industry has 70 percent of detection; petroleum industry has 15 percent	● 54 percent of detections at surface impoundments and 38 percent at landfills	● State Industrial D; di(2-ethylhexyl)phthalate has MCL and AWQC	● High-volume chemicals with high exposure potential, but often low toxicity •Limited understanding of dose-response relationships, especially for endocrine disruption •Unclear significance of exposures from non-hazardous waste relative to other sources
Phenolic Compounds	● Potential noncancer risks of HQ>1	● 13 compounds	● Phenol	● Phenol; combined cresols release exceeds one million pounds	● 10 industries with detections; among the most widespread of constituent classes, despite low number of detections	● 56 percent of detections at landfills; 36 percent at surface impoundments; 8 percent at land application units	● State Industrial D; all in Appendix VIII; several have AWQC	● Most compounds are of relatively low toxicity, biodegradable at low concentrations ● Limited data on wastestreams
Polycyclic Aromatic Hydrocarbons	● Potential cancer risks > 10^{-5} ● Some are persistent, bioaccumulative.	● 19 compounds	● None (but PAHs are not mobile in groundwater)	● None	● Relatively equally frequent in detections from petroleum refining and chemical industries; low frequency overall	● Relatively equally frequent at landfills and surface impoundments	● State Industrial D; most have CWA effluent limits; a few have AWQC; many are CAA HAPs	● Highly variable toxicological, fate, and transport properties ● Limited data on wastestreams and management practices contributing to non-groundwater releases

Exhibit 10-3 (continued)
Evaluation of Potential Gaps Associated with Non-TC Chemicals

Chemical Type	Nature of Risk	Presence in Non-Hazardous Industrial Waste[a]	Frequently Detected Constituents in Release Descriptions	TRI Chemicals with 1994 Reported Releases > One Million lbs.	Affected Industries	Affected Management Methods	Potential Coverage by Other Regulations	Comments/Major Data Gaps
Other Semivolatile Organic Compounds	● Potential cancer risks > 10^{-5} and noncancer risks of HQ>1 ● Some are persistent and bioaccumulative. ● Highly variable fate and transport properties	● 67 compounds	● None	● Formic acid, acrylic acid, naphthalene	● Chemicals and allied products have 45 percent of detections, remainder in five other industries	● Approximately equal frequency in landfills and surface impoundment detections	● State Industrial D; many in Appendix VIII; RCRA listings a few have AWQC	● Highly variable toxicological, fate, and transport properties ● Limited data on wastestreams and management practices contributing to non-groundwater releases

[a] Source: Exhibits 4-2 and 4-8.

humans and ecological receptors. These and other indicators of hazard, combined with indicators of exposure potential, demonstrate the potential for risks to human health or the environment.

Presence in Non-Hazardous Industrial Waste. The numbers of chemicals in the various classes that are known or possible non-hazardous industrial waste constituents varies widely:

- 103 pesticides and related compounds,
- 67 other semi-volatile organic compounds,
- 61 metals or other inorganics,
- 58 other volatile organics,
- 45 volatile chlorinated organics;
- 46 NAPL formers (30 DNAPL formers and 9 NAPL formers),
- 19 polycyclic aromatic hydrocarbons,
- 13 volatile hydrocarbons,
- 13 phenolic compounds, and
- 6 phthalate esters.

Frequently Detected Constituents in Release Descriptions. Six non-TC metals are among the most frequently occurring analytes in the release descriptions, along with three volatile chlorinated organics, one other volatile organics, and one phenolic compound. The other classes of chemicals were not detected frequently in the release descriptions, which predominately included groundwater contamination. The constituents found in the release descriptions, however, frequently violated MCLs and other health-based levels.

TRI Chemicals with 1994 Reported Releases Exceeding One Million Pounds. These broad categories of potential gaps include many chemicals with high TRI release volumes. In the case of the non-TC metals and other inorganics, copper, zinc, manganese, and cyanides (as CNH) fell into this category. As was the case for the frequency of occurrence in the release descriptions, several volatile organic waste constituents (chlorinated and nonchlorinated) that have high TRI release volumes are TC analytes. None of the pesticides, phthalate esters, or PAHs were among the chemicals with TRI releases greater than one million pounds. Two phenolic compounds and three semivolatile organics were among the waste constituents with the highest TRI releases. Many of the potential NAPL forming compounds also are high-release compounds.

Affected Industries. A relatively small number of industries tend to account for the bulk of the occurrences of most categories of wastes with chemicals of concern. For almost all chemical classes, most detections of chemicals constituents[2] identified in the release descriptions were associated with three industry groups: chemicals and allied products, refuse systems, and paper and allied products. Phenolic compounds diverge from this pattern. The three industries identified above account for only about 35 percent of the releases of such compounds, and 8 other industries had detections of phenolic constituents.

Affected Management Methods. As noted in Chapter 8, about 65 percent of the release descriptions were associated with landfills, 28 percent with surface impoundments, and 11 percent from land application units, 4 percent from waste piles, with the other management units accounting for less than 1 percent each. (Several release descriptions involved more than one facility.) This pattern generally applies to the individual classes of chemicals, with a few significant exceptions. Since metals and inorganics were detected much more often than other constituents, data on these detections dominate the overall pattern. The other classes of chemicals with relatively high numbers of detections (volatile hydrocarbons, other volatile organics, phenolic compounds, and

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[2] Each chemical detected at a release site constitutes one detection. Thus, each release may have multiple detections (i.e., multiple constituents) and each chemical may have multiple detections (i.e., be found at multiple releases).

chlorinated volatile organics) were most commonly found in landfill releases, like the metals. For some chemical classes with relatively low numbers of detections, such as other semivolatile organics, phthalate esters, and PAHs, the proportions of detections from landfills and surface impoundments is almost equal, with few releases are reported from other management units.

Potential Coverage by Other Regulations. As noted in Chapter 10, the chemicals associated with potential gaps are subject to regulatory requirements that have some potential for controlling risks to human health and the environment associated with nonhazardous industrial waste management. Since the bulk of these chemicals are included in 40 CFR Part 261, Appendix VII, some wastes containing these chemicals are RCRA listed hazardous wastes. Of course, other wastes with these constituents are not listed.

The design and operation of non-hazardous industrial waste management facilities managing all of the various classes of waste constituents is largely under the control or potential control of state Industrial D programs. All of these programs include a federally-mandated minimum set of design and monitoring requirements for landfills. In some states, as discussed in Chapter 10, these minimum requirements have been expanded for certain types of waste management units, wastes, and/or constituents. These requirements, however, vary considerably from state to state. The appearance of various chemicals in groundwater at levels exceeding regulatory standards suggests that the control of these chemicals under state Subtitle D programs may not afford the intended level of protection nationwide.

The various chemical classes also are subject to medium-specific regulations under Safe Drinking Water Act, Clean Air Act, and Clean Water Act. Most of the metals and commonly occurring inorganic and organic analytes have MCLs established to protect drinking water quality. Many of the volatile chemicals are CAA Hazardous Air Pollutants (HAPs). The effectiveness of this designation in protecting against exposures from waste management is unclear, however, because the regulatory requirements apply only to facilities emitting more than 10 tons of HAPs per year. Vinyl chloride is also controlled by a National Emission Standard for Hazardous Air Pollutants, which is risk-based and protective to roughly the same risk level as the TC. Some of the pesticides, identified as being among the most potentially hazardous waste constituents in Chapter 4, are already banned or strictly limited in their use by FIFRA.

10.2.4 Potential Gaps Associated With Resource Damage and Large-Scale Environmental Problems

Chapter 5 briefly evaluated the following potential gaps in the hazardous waste characteristics related to the following natural resource damages and large-scale environmental problems:

Natural Resource Damages

- Groundwater pollution that may not present a health risk;
- Odor problems;

Large-Scale Environmental Problems

- Air deposition to the Great Waters;
- Damages from airborne particulates;
- Global climate change;
- Potential damages from endocrine disruptors;
- Red tides;
- Stratospheric ozone depletion;
- Tropospheric ozone and photochemical air pollution; and

- Water pollution.

At this time, the Agency does not plan to further consider any of these potential gaps, except possibly air deposition and endocrine disruptions. These two potential gaps are discussed below and summarized in Exhibit 10-4.

Air Deposition to the Great Waters

Few data are available on the contribution of non-hazardous industrial waste management to the deposition of toxic particulates (including toxic metals and persistent chlorinated organic chemicals) in the Great Waters ecosystems. While non-hazardous industrial waste constituents include toxic metals such as cadmium, lead, and mercury, the extent of their long-range transport is unknown. Persistent chlorinated organic chemicals also are among non-hazardous industrial waste constituents. Many of them have been banned from manufacture or further use and therefore are unlikely to be managed in significant quantities as non-hazardous industrial wastes. They may, however, continue to be found in remediation wastes.

Potential Damages from Endocrine Disruptors

The next potential gap is exposure to suspect endocrine disruptors. Depending upon what criteria are used to identify these constituents, 28 suspect endocrine disruptors have been found among the TC analytes and known or possible non-hazardous industrial waste constituents. Only the metals are encountered frequently in the release descriptions, however. These metals are most commonly present in releases detected from facilities in the chemicals and allied products, refuse systems, paper and allied products, industrial sand, and primary metals industries. These releases are most often seen from landfills, followed by surface impoundments, based on the release descriptions summarized in Chapter 2.

One suspect endocrine disruptor, styrene, is high on the TRI list, having total releases of 40 million pounds in 1994. Almost all of the styrene releases are to air, with well under one million pounds being released to land. Releases of the phthalate esters as a class also exceed one million pounds, although the releases of these compounds individually are all less than one million pounds.

The use of many suspect endocrine disrupting pesticides has been banned or strictly limited. A significant portion of the endocrine disruptors are TC analytes or otherwise listed in 40 CFR Part 261, Appendix VIII. The greatest uncertainty concerning this potential gap is a lack of knowledge about dose-response relationships for single and multiple agents, and the relative contribution of non-hazardous industrial waste management to the total exposure of human and environmental receptors.

Exhibit 10-4
Evaluation of Potential Gaps Associated With Certain Large-Scale Environmental Problems

Potential Gap	Nature of Risk	Presence in Non-Hazardous Industrial Waste	Frequently Detected Constituents in Release Descriptions	TRI Chemicals with 1994 Reported Releases > Million lbs.	Affected Industries	Affected Management Methods	Potential Coverage by Other Regulations	Comments/Major Data Gaps
● Air Deposition to the Great Waters	● Adverse ecological effects on Great Lakes, Chesapeake Bay, Lake Champlain, and coastal water ecosystems	Many constituents, such as pesticides, PCBs, dioxins, cadmium, lead, and mercury	● Lead, cadmium, mercury ● Pesticides were not frequently detected.	● Lead compounds	● Chlorinated organics are found in release descriptions from only a few industries and found seldom therein ● Metals are found frequently in release descriptions from many industries	● Metals releases predominantly from landfills and surface impoundments ● Pesticide releases predominantly from surface impoundments	● CAA Section 112(m) and National Emissions Standards for Hazardous Air Pollutants	● Limited data on air deposition contributions from non-hazardous industrial waste management ● Uncertainty about regional transport patterns
● Potential Damage from Endocrine Disruptors	● Impaired reproduction and developmental disorders among humans and wildlife	● 30 suspect endocrine disruptors	● Cadmium, lead, and mercury	● Styrene, lead compounds	● Most major generating industries • Releases descriptions found them in 12 industries, with 70 percent of the detections in the chemicals, paper, and sanitary services industries.	● 68 percent of detections in release descriptions were from landfills and 24 percent from surface impoundments.	● RCRA listings, FIFRA, SDWA, CWA	● Limited waste stream and release data ● Dose-response data for exposure to single or multiple agents is lacking

10.2.5 Gaps Associated with State TC Expansions and Listings

A number of states have expanded their hazardous waste program to regulate additional waste as hazardous. These state expansions include:

- **Adding constituents to the list of TC analytes**. These additional constituents include zinc, other metals, PCBs, pesticides, dioxins, and potential carcinogens.

- **Lowering existing TC regulatory levels**. For example, California lowered the TC regulatory level for pentachlorophenol from 100 mg/l to 1.7 mg/l.

- **Specifying alternative testing methods for identifying toxic hazardous waste**. For example, California requires use of the Wet Extraction Test (WET) in addition to the TCLP. This test identifies several metal-containing wastes as hazardous that are generally not identified as hazardous using the TCLP.

- **Using alternative approaches (other than listing constituents and regulatory levels) to identify toxic hazardous wastes**. For example, both California and Washington have established toxicity criteria for wastes based on acute oral LD50, acute dermal LD50, acute inhalation LC50, and acute aquatic 96-hour LC50 of the wastestreams taken as a whole. A waste is designated hazardous if a representative sample of the waste meets any of the acute toxicity criteria. In addition, California's regulations state that a waste exhibits the characteristic of toxicity if the waste, based on representative samples, "has shown through experience or testing to pose a hazard to human health or environment because of its carcinogenicity, acute toxicity, chronic toxicity, bioaccumulative properties or persistence in the environment."

- **Listing additional wastes as hazardous**. The most common state-only listed wastes are PCBs and waste oil. At least four states include additional "F" Wastes; three include additional "K" wastes; five include additional "P" wastes; and six include additional "U" wastes.

- **Restricting exemptions from the federal rules**. Examples include chromium-bearing wastes from leather tanning and finishing, various special wastes, certain arsenical-treated wood wastes, petroleum contaminated media and debris that fail the TC, certain injected groundwater, used CFC refrigerants that are reclaimed, and non-terne plated used oil filters.

Thus, several states appear to be regulating a significant number of wastes as hazardous that are not covered under federal RCRA regulations. These expansions reflect state judgments about gaps in the federal program and thereby constitute potential gaps that may merit further investigation. State expansions have filled these gaps, but only in the specific states with such expansions. Such potential gaps are possibly *not* being filled in the remaining states that have not expanded the federal hazardous waste definitions.

10.2.6 Major Data Gaps and Uncertainties

The significance of potential gaps in the hazardous waste characteristics directly depends on the magnitude of risks that are not addressed by the current characteristics or other programs. Thus, data gaps in the Agency's ability to assess these risks are critical.

A key step in any risk analysis is characterizing the sources of releases of toxic or otherwise hazardous materials to the environment. Thus, possibly the most important data gap is the lack of current data on the generation, composition, and management of non-hazardous industrial wastes. EPA's most recent comprehensive data on these topics are approximately a decade old. Many of the data are even older. While the basic nature of non-hazardous industrial wastes and waste management practices are not likely to have changed dramatically, nonetheless, some important changes are likely to have occurred because of regulatory, economic, and technical developments since the data were gathered.

Additional data gaps relate to exposure potential. Because of the lack of site-specific data, the Agency had to rely primarily on proxies for exposure and risk potential. Environmental fate, transport, and toxicological parameters have been used as a primary screening criteria to identify and evaluate hazards. As noted in Chapter 5, consistent and reliable data related to these properties are available for only a relatively limited portion of the universe of chemicals under consideration.

Likewise, the Agency has no direct data on the amounts of certain constituents released from non-hazardous industrial waste management units. Instead, 1994 TRI release data were used as proxies for such data. Another data source the Agency employed to assess exposure potential was the release descriptions from non-hazardous industrial waste management facilities. While these data provide direct evidence of environmental contamination, it is often not clear whether the management practices that resulted in releases are still in use.

Some data gaps in this analysis are common to all risk analyses. For example, the need to conduct analysis on a national scale and to consider a wide range of site conditions, facility characteristics, and geographic settings dictates the use of generic, rather than site-specific modeling to estimate exposures through the various pathways. Thus, the analysis of groundwater exposures relies on probabilistically-defined dilution and attenuation values and the screening-level risk modeling uses highly generic release, transport, and exposure models. This approach only roughly approximates potential risks to humans and ecological receptors. Moreover, extensive professional judgment was required to generalize from generic modeling for specific chemicals to broad classes of waste constituents.

Another major source of uncertainty is associated with toxicity of the waste constituents. The dose-response models and data used are the most current available to the Agency. Nevertheless, substantial uncertainty exists regarding the probability and severity of adverse effects as a function of dose for many chemicals. The use of a generically defined "chronic" exposure period may mask important relationships between exposure periods and effects. Also, the Agency was not able to derive any specific dose-response relationships for endocrine disruptors or for any non-additive combinations of pollutant exposures. These uncertainties, unlike some of the others just discussed, are not likely to be resolved in the near future.

10.3 Framework for Determining an Appropriate Course of Action

The U.S. Environmental Protection Agency will consider the appropriate course of action to address significant gaps or potential gaps in the hazardous waste characteristics identified by the Study. This section describes the framework that EPA plans to use in considering what course of action is appropriate. As part of this process, the Agency will consider comments on the Study from interested parties.

EPA's approach for considering a course of action will include two main steps:

Step 1: Identify the critical research needs and associated next steps necessary to analyze key issues and fill major data deficiencies identified in the Scoping Study; and

Step 2: Identify and evaluate options to address the environmental management concerns resulting from any gaps in the characteristics that were clearly identified in the Scoping Study.

Both of these steps are described in more detail below.

10.3.1 Step 1: Identify Critical Research Needs and Next Steps Necessary to Analyze Key Issues and Fill Major Data Deficiencies

The results of the Scoping Study vary greatly in terms of the certainty that can be attributed to gaps in the hazardous waste characteristics. Some of the potential gaps, most notably certain limitations in the ICR characteristics, are clearly identifiable problems. Most potential gaps, however, are associated with considerable uncertainty that limits the degree to which conclusions can be made about either the precise nature and extent of the gap or how, if at all, it should be addressed. Thus, a critical activity in the near-term will be to assess what additional data and analysis are needed to reduce uncertainty and better determine the significance of the most important potential gaps in the characteristics identified by the Scoping Study.

10.3.2 Step 2: Identify and Evaluate Options to Address Any Clearly Identified Gaps

Some of the gaps identified in the Scoping Study are sufficiently defined that the Agency can consider options for addressing the problem. Modifying an existing characteristic or developing a new characteristic may be an appropriate method of filling some of these gaps. Other gaps may be better addressed through other regulatory programs or in coordination with such programs. Thus, the list of options that the Agency may consider include:

- Specifying additional or revised test methods;
- Expanding the definitions of existing characteristics;
- Modifying the characteristics to reflect new risk data and modeling techniques;
- Creating new characteristics, including contingent characteristics based on management method or the type of generator or waste;
- Identifying new hazardous waste listings or modifying existing listings;
- Modifying other regulatory programs (e.g., Subtitle D);
- Developing a non-regulatory approach (e.g., recycling, waste minimization); and
- Promoting voluntary industry programs.

In evaluating a range of feasible options for particular gaps, the Agency will consider a variety of factors including, but not necessarily limited to the following:

- Affected industries, wastes, and management practices;
- Human health and environmental benefits, such as reduced hazards and loadings of hazardous constituents;

- Compliance costs and difficulties; and
- Implementation and administration costs and difficulties.

Evaluating options can be a highly complex and data-intensive activity. Thus, the Agency may be unable to determine quickly that a particular approach is appropriate. Nevertheless, analyzing options can help to narrow the range of feasible and appropriate actions and help to identify the critical issues that need to be resolved in selecting an approach.

HAZARDOUS WASTE CHARACTERISTICS SCOPING STUDY

APPENDICES

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U.S. Environmental Protection Agency
Office of Solid Waste

November 15, 1996

APPENDIX A

ENVIRONMENTAL RELEASE DESCRIPTIONS

The U.S. Environmental Protection Agency developed this appendix to illustrate the contamination caused by releases from the management of non-hazardous industrial wastes. The appendix contains 112 release descriptions fron states, covering groundwater, surface water, and soil contamination from a variety of industries, waste management prac and constituents. This appendix has three sections:

- Section A.1 presents 73 release descriptions compiled from file reviews of state industrial solid waste prograr and state Superfund programs;
- Section A.2 contains six release descriptions for construction and demolition landfills, which are taken from another draft Agency report; and
- Section A.3 lists 29 California “designated waste” landfills that the State’s Solid Waste Assessment Test (SWAT) database identifies as having releases to groundwater or surface water above regulatory standards.

Within each of the three sections, the release descriptions are organized by state in alphabetical order and within each st by alphabetical order of facility name.

The Agency contacted the states and facility owners/managers to solicit comments on draft versions of the releas descriptions. The Agency also released a draft version of the individual release descriptions to the public for comment ar review on October 29, 1996 (see 61 *Federal Register* 55800). This final report reflects all relevant facility-specific comments that were received as of November 8, 1996.

SECTION A.1:

STATE INDUSTRIAL SOLID WASTE AND STATE SUPERFUND RELEASE DESCRIPTIONS

AGRICO CHEMICAL SITE FLORIDA

Facility Overview

Facility Name: Agrico Chemical Site

Location: Pensacola, Florida

Waste Stream: Wastewater

The 35-acre Agrico Chemical Site was used for the production of sulfuric acid and fertilizers from 1889 through 1975. The former plant buildings and process equipment were removed by 1979, leaving only concrete foundations.

In 1889, the founding company's industrial processes included producing sulfuric acid. Fertilizer production was the main activity from 1920 to 1975. The American Agricultural Chemical Company began fertilizer production in 1920 and operated the plant until 1963. Continental Oil Company owned and operated the facility from 196 1972. Agrico Chemical Company bought the facility in 1972 and continued production until June 1975. The site was ther sold in August 1977 to a privately held firm.

Due to the age of the facility, plant processes are not well documented. Operations from 1889 to 1920 included t production of sulfuric acid from pyrite. By 1920, sulfuric acid was produced from elemental sulfur instead of pyrite. Also i 1920, the plant began manufacturing normal superphosphate fertilizer. Superphosphate was produced through the diges of the source rock with sulfuric acid and water. The reaction produced anhydrite (calcium sulfate) and fluoride as by prod The anhydrite was sold with the superphosphate. From 1972 to 1975 the facility manufactured monoammonium phospha addition to superphosphate. In later years, the plant began adding micronutrients (zinc and magnesium) to the monoammonium phosphate.

Wastes and Waste Management Practices

Industrial wastewater was discharged to low-lying areas in the vicinity of the former process buildings. The wastewater ponded in four areas. The wastewater contained process products and by-products and was likely characteri by low pH levels and greater than background concentrations of sulfate, calcium, fluoride, silica, phosphate, sodium, chlo and a relatively high total dissolved solids content.

Extent of Contamination

By early 1957, Pensacola City officials noted declining pH levels, increasing lime requirements, and increasing concentrations of sulfate and fluoride in a public water supply well. Phase I field work was conducted from mid-1990 and completed by October 1990. The Phase I Report was presented to EPA on March 13, 1992. The results of the Phase I r suggested that additional sampling activities were necessary to adequately characterize the site.

Phase II sampling and analyses conducted in February 1992 consisted of more than 100 soil borings and the sampling of 34 existing and recently installed groundwater monitoring wells. The Phase II Remedial Investigation more fu identified the nature and extent of contamination associated with former site processes. Soil and groundwater contamina have resulted from wastewater discharge. Sludge has accumulated in previous wastewater discharge areas and infiltratio wastewater has caused a plume in the upper aquifer.

The table provided below shows that aluminum, chloride, fluoride, iron, manganese, nitrite/nitrate, and sulfate are above EPA's maximum contaminant level. In addition to the monitoring results presented below, the groundwater has be tested for EPA's Target Compound List and Hazardous Substance List, cyanide, PCBs, semi-volatiles, and pesticides. Groundwater pH levels have ranged from 3.35 to 10.7. Several nearby sources may have contributed to the existing groundwater contamination, therefore, not all the constituents identified below may be attributed to the Agrico site.

GROUNDWATER CONTAMINANTS COMPARED TO FLORIDA OR FEDERAL DRINKING WATER STANDARDS

Contaminant	Highest Detected Level (mg/l)	FL Standard (mg/l)	MCL (mg/l)	SMCL (mg/l)
Aluminum	110	0.2	--	0.05 to 0.2
Arsenic	0.164		0.05	--
Barium	0.069	2.0	2	--

Benzene	0.0015	0.001	0.005	--
Calcium	130	--	--	--
Chloride	270	250	--	250
Chromium (total)	0.038	0.1	0.1	--
Copper	0.031	1.0	1.3*	--
Fluoride	98	4.0	4	2
Iron	1.9	0.3	--	0.3
Lead	0.0066	0.015*	0.015*	0.05
Magnesium	11	--	--	--
Manganese	0.33	0.050	--	0.05
Mercury	0.00071	0.002	0.002	--
Nickel	0.055	0.1	0.1	--
Nitrite/nitrate	47	10	10	--
Phenol	0.02	0.01	--	--
Potassium	38	--	--	--
Radium-226 (pCi/l)	8.4	5**	--	--
Radium-228 (pCi/l)	12.4	--	--	--
Sodium	180	160	--	--
Sulfate	680	250	500	250
Xylenes	0.013	10	10	0.02
Zinc	0.026	5.0	--	5
2,4-Dinitrotoluene	0.025	0.002	--	--
Gross-alpha (pCi/l)	1.3	15	15	--
Gross-beta (pCi/l)	29.6	--	4 mrem	--

*Action level

**Combined level for Radium 226 and 228

In addition to the groundwater sampling results presented above, the soil has been tested for volatile- and semi-volatile organics, pesticides, gross alpha- and beta-activity, radium 226, and uranium 238.

SOIL CONTAMINANT LEVELS	
Contaminant	**Highest Detected Level (mg/kg)**
Fluoride	300,000
Nitrate	12
Sulfate	9,100

Corrective Actions/Regulatory Actions

In 1989, EPA listed the site on the CERCLA National Priority List. Conoco Inc. and Freeport McMoRan R P Ltd., former operators of the plant, entered into an Administrative Consent Order on September 29, 1989 to conduct a remedia investigation/feasibility study. A Consent Decree was signed in June 1993 for soil cleanup. Remediation of Operable Uni addresses the principal threat at the site by treating the most highly contaminated soils and wastes. Stabilized waste materials and soils contaminated at low levels will be consolidated on-site under a RCRA cap. Components of the on-site remediation have included:

1. Excavation and solidification/stabilization of approximately 125,000 cubic yards of contaminated sludge and s from the four ponds;
2. Consolidation of all stabilized sludge and soil into one containment area;
3. Construction of a slurry wall;
4. Installation of a RCRA cap over the containment area; and
5. Implementation of institutional controls to include security fencing access and deed restrictions.

Operable Unit 2 addresses groundwater concerns. The groundwater plume is discharging to Bayou Texar locate one mile from the site. There are no active water supply wells between the site and the groundwater discharge point, therefore, the contamination does not pose a risk as a current drinking water source. The groundwater remedy selected consists of monitoring groundwater conditions as natural attenuation, flushing, and dispersion occur since contaminant loadings to the groundwater have been eliminated. Selected components of the groundwater remedy include:

1. Groundwater monitoring of the sand and gravel aquifer;
2. Groundwater monitoring of Bayou Texar;
3. Door-to-door survey of irrigation wells;
4. Request access from private landowners to plug and abandon impacted irrigation wells;
5. Utilization of institutional controls to restrict new wells; and
6. Advisory program.

Sources of Information

Draft Phase II Remedial Investigation; Agrico Chemical Site, Pensacola, Florida, Volume I of III. Geraghty & Miller, Inc. fo Conoco Inc. and Freeport-McMoRan, April 29, 1992.

EPA Region IV Superfund Proposed Plan Fact Sheet, Agrico Chemical Site, prepared by U.S. EPA Region IV, February 1

Final Phase II Remedial Investigation; Agrico Chemical Site, Pensacola, Florida, Volume II of IV. Geraghty and Miller, In November 1993.

Final Phase II Remedial Investigation; Agrico Chemical Site, Pensacola, Florida, Volume III of IV. Geraghty and Miller, In Appendix F, November 1993.

Record of Decision: Operable Unit 1; Agrico Chemical NPL Site, Pensacola, Escambia County, Florida. EPA Region 4, September 29, 1992.

Written correspondence submitted by facility and/or State on draft version of release descriptions, October 1996

ARIZONA CHEMICAL FLORIDA

Facility Overview

Facility Name:	Arizona Chemical Company
Location:	Panama City, Florida
Waste Stream:	Process wastewater
Media Affected:	Groundwater

The facility was established in 1936 to process International Paper mill by-products into useable chemicals. The first operation established was a crude sulfate turpentine unit to process terpene chemicals that can be found in household cleaners, solvents, flavorings, and fragrances. In 1945, the plant moved into a second area of paper mill by-products recovery, the conversion of black liquor soap from the pulping process into crude tall oil. The crude tall oil is further refined into high purity fatty acids and rosins used in printing inks, adhesives, protective coatings, and synthetic rubber. A polyterpene resin production unit was added in 1971, raising facility employment to approximatel 280. Limonene, a citrus by-product, was later added to the raw material base. Three Florida Class III surface water bodi exist within a one-half mile radius of the site, and are designated to be managed for recreation and propagation of healthy and wildlife.

Wastes and Waste Management Practices

Prior to December 1990, a rosin sump received wastewater from the plant and discharged to an unlined industria wastewater holding pond. No information was available in the State files on the pond other than a map showing it to be approximately 200 feet by 100 feet, with depths ranging from 3 to 10 feet.

Extent of Contamination

Groundwater samples collected from four monitoring wells around the pond were analyzed pursuant to the 1990 Consent Order and are summarized below. Concentrations of benzene, iron, manganese, sodium, and total dissolved so (TDS) exceeded Florida guidance standards. Pond sludge and sediment samples revealed elevated concentrations of inorganics, ethylbenzene, xylenes, and chlorinated pesticides. The Preliminary Contamination Assessment Report (PCA states that a comparison of the material in the pond with the adjacent groundwater quality suggests that the pond is not a source of contamination because ethylbenzene and xylenes were not detected in the groundwater. The suspected sourc these purgeable compounds in the semi-solid material is a result of accidental releases of process water entering the stormwater system from the resin sump. Chlorinated pesticides found in bottom layer sediments of the pond could not be traced to any historical usage of DDT at the site. Concentrations of metals found in the sludge are believed to be due to t adsorption concentration effect of organic material on metal concentrations in the incoming wastewater. The metals are believed to be from two major sources, cooling water flows into the pond containing corrosives from the heat exchangers stormwater runoff from roads and parking lots.

GROUNDWATER CONTAMINANTS COMPARED TO FLORIDA OR FEDERAL DRINKING WATER STANDARDS

Contaminant	Highest Detected Level (mg/l)	FL Standard (mg/l)	MCL (mg/l)	SMCL (mg/l)
Benzene	0.0043	0.001	0.005	--
Iron	48	0.3	--	0.3
Manganese	0.068	0.05	--	0.05
Sodium	260	160	--	--
TDS	910	500	--	500

Corrective Actions/Regulatory Actions

The resin sump, which received wastewater from the resin plant, was taken out of service on December 1, 1990. Wastewater from the resin plant is now treated within a permitted treatment system. A January 8, 1990 Consent Order required that Arizona Chemical Company implement a groundwater study at the industrial wastewater holding pond. The facility continues in a remedial phase of the Consent Order.

Sources of Information

Preliminary Contamination Assessment Report, 1990.

FDEP Northwest District Site Summary Memorandum, September 20, 1995.

Written correspondence submitted by facility and/or State on draft version of release descriptions, October 1996.

CENTRAL PACKING FLORIDA

Facility Overview

Facility Name: Central Packing
Location: Sumter County, Florida
Waste Stream: Slaughterhouse wastewaters

Central Packing Company is a meat packing plant. No major surface water bodies exist near the site. Several isolated, wet weather ponds in the vicinity contain soils with low infiltration potential.

Wastes and Waste Management Practices

The plant generates wastewater from washing and rinsing slaughtered animals. All drains in processing areas are routed to the wastewater treatment plant. One drain in th animal holding pen area is designated for washdown; it sends wastewater directly to the retention pond. The process wastewater is filtered through a rotary drum filter, recycled in concrete vats, chlorinated, discharged to a polishing pond, a pumped to a sprayfield for land application. The sprayfield has a berm around the Southern and Eastern sides to preven surface runoff to low lying adjacent lands. The polishing pond is sealed with clay, and polishing pond sludge is either disposed of in an approved landfill or sold. Solid wastes such as bones, cartilage, and fat are collected and sold.

Extent of Contamination

Wastewater characteristics are monitored at six different locations along the treatment process. The results are submitted monthly to the Florida Department of Environmental Protection. Constituent concentrations of samples taken f treatment plant effluent, as it was applied to the sprayfield, are listed below. Concentrations of chloride, iron, manganese sodium, and sulfate exceeded Florida guidance standards.

GROUND WATER CONTAMINANTS COMPARED TO FLORIDA OR FEDERAL DRINKING WATER STANDARDS

Contaminant	Highest Detected Level (mg/l)	FL Standard (mg/l)	MCL (mg/l)	SMCL (mg/l)
Barium	0.28	2.0	2	--
Cadmium	0.0011	0.005	0.005	--
Calcium	121	--	--	--
Chloride	446.5	250	--	250
Chromium	0.001	0.1	0.1	--
Copper	0.062	1.0	1.3*	1.0
Fluoride	0.32	primary = 4.0, secondary = 2.0	4	2
Iron	0.38	0.3	--	0.3
Lead	0.008	0.015	0.015*	--
Magnesium	12.7	--	--	--
Manganese	0.23	0.05	--	0.05
Nitrate	0.197	10	10	--
Silver	0.002	0.1	--	0.1
Sodium	500	160	--	--
Sulfate	291	250	500	250
Sulfide	3.27	--	--	--
Zinc	0.38	5	--	5

*Action levels

Corrective Actions/Regulatory Actions

Several site investigations (4/92, 10/92, 6/94, and 11/95) noted that wastewater from the holding pens was being sent directly to the retention pond without treatment. The wastewater treatment plant was in disrepair according to the 6/9 inspection, and the 11/95 inspection noted that the retention pond was filled with manure.

Sources of Information

Central Packing Groundwater Monitoring Plan, June 20, 1984.

FDER Site Inspection Reports: April 1992, October 1992, June 1994, and November 1995.

FLORIDA INDUSTRIAL MACHINERY FLORIDA

Facility Overview

Facility Name: Florida Industrial Machinery
Location: Fort Walton Beach, Florida
Waste Stream: Process wastewater
Media Affected: Groundwater

Florida Industrial Machinery (FIM) rebuilds heavy engines. Several small surface water bodies exist on the site, including a small storm water pond and a filled gravel pit from former mining operations. A stocked fishing pond is also located near the site. Wetlands to the northeast, north, and south of the site are near the eastern margin of East Bay Swamp. The on-site man-made ponds and the off-site wetlands qualify for protection as Class III (Fresh) Surface Waters to be managed for “Recreation and for Propagation and Maintenance of a Healthy, Well-Balanced Population of Fish and Wildlife.”

Wastes and Waste Management Practices

The principal wastewater stream is discharge water from the engine teardown and washrack facility. All process wastewaters including engine test stand cooling water and waste oils formerly were discharged to the septic tank disposa system. The facility now uses a wastewater treatment and recycling system with an oil sump and skimmer to remove was oils for recycling. Waste oil is collected by a used oil recycling contractor. The system also contains a treatment facility to remove other impurities from the wastewater stream.

Extent of Contamination

Sampling of the former septic disposal area, considered the source of groundwater contamination, revealed elevated levels of lead and carbon tetrachloride, and low pH. No carbon tetrachloride concentration data were available i Florida files, however.

GROUNDWATER CONTAMINANTS COMPARED TO FLORIDA OR FEDERAL DRINKING WATER STANDARDS

Contaminant	Highest Detected Level (mg/l)	FL Standard (mg/l)	MCL (mg/l)	SMCL (mg/l)
Arsenic	0.032	0.05	0.05	--
Cadmium	0.0091	0.005	0.005	--
Chromium	0.04	0.1	0.1	--
Lead	0.060	0.015	0.015*	--
pH	4.9	6.5 - 8.5	--	6.5-8.5
Total phenols	0.013	0.01	--	--
Zinc	0.19	5	--	5

*Action level

Corrective Actions/Regulatory Actions

In March 1989, a representative of FDER inspected the FIM facility for compliance with FDER industrial wastewat standards. Following that inspection, FDER issued a Warning Notice notifying FIM that (1) the facility was operating improperly without a permit, and (2) the groundwater contamination violated Chapter 403, Florida Statutes, and the Rules FDER. Subsequently, FIM and FDER reached an agreement and a Consent Order was signed in August 1989 requiring Preliminary Contamination Assessment, which was completed in 1990. Soon after, FIM installed a closed-loop recycling system for cooling water, replacing the old septic tank disposal system. Cleanup is complete at the site, except for remed of petroleum-contaminated soil which is being land farmed.

Sources of Information

Contamination Assessment Report for Florida Industrial Machinery, Inc. Nassef Engineering & Company, Inc., Pensacola, Florida, June 1991.

FDEP Northwest District Site Summary Memorandum, September 20, 1995.

FLORIDA WIRE AND NAIL FLORIDA

Facility Overview

Facility Name:	Florida Wire and Nail
Location:	Quincy, Florida
Waste Stream:	Process wastewater
Media Affected:	Groundwater

Florida Wire and Nail (FWN) produced nails from 1978 to 1989. The nail manufacturing process consisted of purchasing rolled wire in bulk, cold drawing of the rod for sizing, cold cutting, and shaping the wire into nails. Prior to 1989, a portion of the nails were zinc galvanized using one of two processes. From 1978 until 1986, nails to be galvanized were “hot dipped,” a process which heated a combination of nails, zinc powder, and an ammonium chloride flux in a gas fired furnace. The zinc coated nails were then quenched in a water solution to solidify the coating. The “hot dip” process was removed and replaced with mechanical cold galvanizing in 1986.

FWN ceased its nail production and galvanizing operations in 1989. At this time the nail manufacturing and zinc galvanizing equipment were removed and weaving looms were installed in the former nail production area. Since 1989, t facility has only manufactured woven fabric for the paper industry.

Five private wells are within one mile of the site, two of which are located in the direction of the zinc plume, which described below. These wells have not been confirmed as active or drinking water wells. The City of Quincy provides po water service to this area. FWN monitors the groundwater between the source area and the well area on a quarterly basi

Wastes and Waste Management Practices

From 1978 to October 1980, effluent from the galvanizing process was released out the back of the plant onto company land. No treatment occurred before release into the environment. From October 1980 until 1983, effluent was directed to a Florida Department of Environmental Regulation (FDER) permitted on-site holding pond. A sludge settling t a 10,000 gallon underground settling tank, and a 150,000 gallon retention pond were operated under this permit. On Apr 1983, the pond was closed, and pond sludge was stored in a lined landfill. In December 1992, FWN removed the buried sludge containing zinc and nitrate and disposed of this waste in a permitted landfill. From 1983 to 1986, the wastewater w recycled through a filter press without discharge. When the “hot dip” process was replaced, a permitted water treatment system was incorporated to treat all water prior to discharge into the city sewer system. A sludge settling tank and a 10,0 gallon underground settling tank operated under this permit.

Extent of Contamination

In 1983, unacceptable levels of zinc, nitrates, and chlorides were found in the unlined pond perimeter monitoring wells. Groundwater contamination was traced to waste disposal of zinc galvanizing sludge and wastewater between 197 1983, during the use of the “hot dip” process.

GROUNDWATER CONTAMINANTS COMPARED TO FLORIDA OR FEDERAL DRINKING WATER STANDARDS				
Contaminant	**Highest Detected Level (mg/l)**	**FL Standard (mg/l)**	**MCL (mg/l)**	**SMCL (mg/l)**
Chloride	1170	250	--	250
Nitrate	33.1	10.0	10	--
Zinc	83.9	5.0	--	5

Corrective Actions/Regulatory Actions

Two effluent and sludge disposal practices have caused violations of Florida regulations due to excessive amour of zinc and chlorides leaching into the groundwater. Consent Order 89-0614, signed in 1989, required FWN to complete Preliminary Contamination Assessment Plan for groundwater contamination at the site. FDEP has required quarterly monitoring of groundwater at this site since 1990.

Sources of Information

Preliminary Contamination Assessment Plan, 1989.

Site Rehabilitation Completion Report, December 20, 1992.

FDEP Northwest District Site Summary Memorandum, September 20, 1995.

Written correspondence submitted by facility and/or State on draft version of release descriptions, October 1996

STONE CONTAINER FLORIDA

Facility Overview

The Stone paper mill has been in operation since 1931. Prior to that time a lumber mill was located at the site. Southern Kraft Company owned the paper mill when it was constructed. International Paper purchased it some time later, and then sold it to Southwest Forest Industries in 1979. Stone purchased the mill from Southwest Forest Industries in 1987. The mill produces Kraft liner board and bleached market pulp. Chemicals used in the paper manufacturing process since the mill was constructed include aluminum sulfate, calcium carbonate, calcium oxide, chlorine, chlorine dioxide, elemental oxygen, hydrogen peroxide, rosinsize, so
carbonate, sodium chlorate, sodium hydroxide, sodium hypochlorite, sodium sulfate, sodium sulfide, and sulfuric acid.

Facility Name:	Stone Container Corporation
Location:	Panama City, Florida
Waste Stream:	Process wastewater

Wastes and Waste Management Practices

In 1955, primary clarification to remove settleable solids from the mill's effluent began. The treated effluent was discharged to St. Andrews Bay. Over the years, a small bayou in the area of the pretreatment pond was reclaimed using
materials. A permit issued December 31, 1986 expired June 1, 1988. A timely operating permit renewal application was
prior to the expiration of the 1986 operating permit. The facility operated without a permit until May 1990, when a Conse
Order was signed.

The facility now operates an industrial wastewater pretreatment system associated with pulp and paper manufacturing. It consists of a lime pond, emergency clarifier, primary clarifier, pump station holding pond, ash sluice po
stormwater ditch, and a primary clarifier ditch which conveys industrial wastewater and stormwater to the primary clarifier
treatment. Primary treated effluent from the facility is discharged to Bay County Regional WWTF for additional treatment
to discharge into St. Andrews Bay.

Extent of Contamination

Pits, ponds, and lagoons are in contact with groundwater. Groundwater sampling indicates plumes of contamina
from the facility affecting the intermediate aquifer. The sampling revealed concentrations of several contaminants above
Florida guidance standards including chloride, iron, manganese, sodium, and sulfate.

GROUNDWATER CONTAMINANTS COMPARED TO FLORIDA OR FEDERAL DRINKING WATER STANDARDS

Contaminant	Highest Detected Level (mg/l)	FL Standard (mg/l)	MCL (mg/l)	SMCL (mg/l)
Arsenic	0.962	0.05	0.05	0.05
Chloride	9150	250	--	250
Chromium	3.3	0.1	0.1	--
Iron	26.6	0.3	--	0.3
Lead	0.051	0.015	0.015*	--
Manganese	0.23	0.05	--	0.05
Nickel	0.84	0.10	0.10	0.10
Sodium	5600	160	--	--
Sulfate	1140	250	500	250
Zinc	0.08	5	--	5

*Action level

Corrective Actions/Regulatory Actions

The facility received a Notice of Violation in November 1988 for direct discharges of wastewater from the facility t the groundwater. Stone currently operates under a Consent Order requiring sampling every 90 days, implementation of corrective actions if sampling reveals continuing contamination, and reimbursement to FDEP for expenses.

Sources of Information

Stone Container Corporation Industrial Wastewater Pretreatment Facility Groundwater Investigation Report, Volume I, undated.

FDEP Northwest District Site Summary Memorandum, September 20, 1995.

Written correspondence submitted by facility and/or State on draft version of release descriptions, October 1996.

ZELLWOOD FARMS FLORIDA

Facility Overview

Facility Name:	Zellwood Farms
Location:	Zellwood, Florida
Waste Stream:	Process wastewater
Media Affected:	Groundwater

Zellwood Farms is a water-intensive mushroom growing, processing and packaging industry producing fresh mushrooms for human consumption. The farm has conscientiously reduced raw water usage and improved wastewater management over the past five years.

Wastes and Waste Management Practices

The mushroom growing and processing operation generates varying flows and a high strength organic wastewater as a result of the growing process and the raw materials at the farm. Before the current wastewater treatment system was constructed, these process wastewaters were discharg the groundwater through four infiltration cells. In the current industrial wastewater treatment and disposal system, upgrad 1992, process wastewater is pumped and screened and some fresh water added before the mixture is stored in two 12,0 gallon tanks for reuse. The remaining wastewater is conveyed to a 1.5 acre, clay-lined, constructed wetlands treatment system (CWTS). Treated effluent is discharged to groundwater through two of the existing high-rate infiltration cells. Imp on local groundwater associated with past use of the infiltration basins for wastewater treatment and disposal resulted in Zellwood Farms' constructing the CWTS and implementing water conservation and reuse practices.

Extent of Contamination

Nitrate levels in the groundwater, as determined through sampling of the monitoring wells, have fluctuated widely over the last several years. In November 1989, the highest level was detected in MW-10 on the western portion of the sit This level (431.5 mg/l) is believed to be an "outlier." Three months later, the well detected nitrate at 11.75 mg/l supportin outlier conclusion. The state and federal drinking water standard for nitrate is 10 mg/l.

Corrective Actions/Regulatory Actions

Through implementation of water-conservation and wastewater recycling practices, the farm has reduced water u by about 33 percent. Zellwood installed a water recycling system in 1987 to reduce water use and the volume of water entering the wastewater treatment system. Concrete curbs were constructed around the perimeter of the wharf area to prevent runoff from leaving the wharf and directly entering the groundwater system prior to any treatment. Runoff is now routed with process wastewater to the CWTS and some is used in the recycling system. In October 1994, Zellwood Farm (Terry Farms) was awarded a 1994 Florida Environmental Award in the Environmental Program Achievement Category, based on the success of their continuing Water Conservation and Wastewater Management Improvement Program.

Sources of Information

FDER Permit for Zellwood Farms, Inc., November 30 , 1982.

Zellwood Farms Industrial Wastewater Treatment Facility Study, Dames and Moore, 1992.

Written correspondence submitted by facility and/or State on draft version of release descriptions, October 1996

Facility Overview

Facility Name: Atlas Processing Company

Location: Shreveport, Louisiana

Waste Stream: Refinery sludge and process wastewater

Media Affected: Groundwater and soil

Atlas Processing Company operates an oil refinery in Shreveport, Louisiana. The refinery has operated since 1923.

Wastes and Waste Management Practices

The facility disposes of wastewater and sludges from the process of refining oil from crude. The facility treats process water in a series of wastewater surface impoundments and discharges the effluent through a permitted NPDES outfall. The surface impoundments have been in existence for approximately 16 years. Past waste management practices have utilized an area adjacent to the surface impoundments known as the South Dirt Pile Area as temporary waste storage area for the storage of non-hazardous waste generated from the cleaning of the surface impoundments. In addition, impacted soils resulting from spills and leaks in the facility have also been temporarily stored the South Dirt Pile Area in the past. The wastes in the South Dirt Pile Area as well as the wastewater in the adjacent surf impoundments were tested and were determined not to be hazardous under TCLP. Sludges generated from the surface impoundments are disposed of off-site at a permitted facility. Prior to the existence of the wastewater impoundments and South Dirt Pile Area, this area was used as a process wastewater pond up until the 1970's. Presumably, the majority of t contamination to the soil and groundwater is related to the former wastewater pond. However, the South Dirt Pile Area m have also contributed volatile and semi-volatile organic compounds in the soil and groundwater.

In 1987, six (6) groundwater monitor wells were installed around the wastewater treatment impoundments. Four these wells are up-gradient and two are down-gradient of the surface impoundments. In 1995, four (4) permanent groundwater monitor wells were installed in the vicinity of the South Dirt Pile Area and down gradient of the surface impoundments. One of the wells was located in the middle of the South Dirt Pile Area and the other 3 were located down gradient of the South Dirt Pile Area.

In August 1995, soil samples were continuously collected from the ground surface to the termination depth of eac borehole. Groundwater monitoring wells were installed in each of the four soil boring holes. Groundwater is sampled quarterly.

Extent of Contamination

Groundwater - In 1995, groundwater samples were analyzed for metals and volatile and semi-volatile organics. T of eight metals were detected above the method detection limit. Volatile and semi-volatile organics were also detected, however, none of the samples exceeded the MCL. A thin layer of phase-separated hydrocarbons (PSH) equal to 0.01 fo was found in one monitoring well.

Since installation of the groundwater monitor wells around the impoundments, the facility has been sampling groundwater for chlorides, sulfate, pH, phenols, and BTEX quarterly and the results continuously reported to LaDEQ. Spe conductance and MEK were added to this list in 1993 and 1994, respectively. Sample results from 1996 indicated that chloride and sulfate exceeded the SMCL and specific conductance exceeded the SMCL and specific conductance excee the MCL in some of the wells. However, it should be noted that the detected values have not changed significantly from t first sampling event in 1987.

The table below presents groundwater monitoring data from the 1995 sampling of the wells in the South Dirt Pile Area and the 1996 sampling of the wastewater impoundments groundwater monitor wells.
All wells are down gradient of the wastewater treatment impoundments except the well indicating high chlorides and spe conductance which were from an up-gradient well.

GROUNDWATER CONTAMINANTS COMPARED TO FEDERAL DRINKING WATER STANDARDS

Contaminant	Highest Detected Level (mg/l)	MCL (mg/l)	SMCL (mg/l)

2-Methylnaphthalene	0.011	--	--
Acenaphthene	0.010	--	--
Barium	0.39	2.0	--
Carbon disulfide	0.024	--	--
Chlorides	1,350	--	250
Di-n-butylphthalate	0.006**	--	--
Fluorene	0.007	--	--
Lead	0.052	0.015	--
Naphthalene	0.006	--	--
Specific conductance (umhos/cm)	4,480	3,000	--
Sulfate	1,234	500	250
Xylene	0.016	10	--

*Also detected in laboratory blank
**Action level

Currently, the facility is sampling groundwater for chlorides, sulfate, specific conductance, phenols, BTEX, and MEK.

The following table presents sampling results from the free-floating PSH found in monitoring well 95-2. There are established SMCLs for the following constituents.

PHASE SEPARATED HYDROCARBON LEVELS

Contaminant	Highest Detected Level (µg/l)	MCL (mg/l)
1,3-Dithiolane, 2-methyl-2-	250	--
2-Butanone	140,000	--
2-Chloroethane	180,000	--
2-Methylnaphthalene	1,500,000	--
Acetone	1,100,000	--
Anthracene	210,000	--
Benzo(a)anthracene	210,000	0.0001
Benzo(a)pyrene	110,000	0.002
Benzo(g,h,i)perylene	80,000	--
Chrysene	300,000	0.0002
Fluorene	280,000	--
Indeno(1,2,3-cd)pyrene	70,000	0.0004
Methylene chloride	52,000	--
Naphthalene, 1 methyl-	4,800	--
Naphthalene, 1,5 dimethyl-	3,200	--
Naphthalene, 2 methyl-	4,000	--
Phenanthrene	1,300,000	--
Propanoic acid, 2-methyl	84	--
Pyrene	560,000	--
Thiophene, tetrahydro-2-methyl-	130	--
Unknown hydrocarbon	5,300	--

Please note that the laboratory report filed with LaDEQ indicated that 1,3 Dithiolane, 2-methyl-2-, naphthalene, 1-methyl-, naphthalene, 1,5-dimethyl-, naphthalene, 2-methyl-, and propanoic acid, 2-methyl-, were tentatively identified and that the identification and concentration of these compounds was based on the spectroscopists opinion due to presumptive evide only. Further, the concentration of unknown hydrocarbons identified from this analysis was also based on presumptive evidence.

A product identification analysis conducted on the PSH sample indicated the sample resembles a combination of diesel ra organics and motor oil.

Soil - In 1995, during the installation of the 4 monitoring wells in the South Dirt Pile Area soil samples were continuously collected from the ground surface to the termination depth of each borehole. The samples were analyzed fo Skinner List Metals and copper, silver, tin, and zinc. Detectable concentrations were reported for 11 of the 16 metals analyzed: arsenic, barium, chromium, cobalt, copper, lead, nickel, selenium, tin, vanadium, and zinc. Numerous volatile semi-volatile organic compounds were also detected in the soil samples. In addition, total petroleum hydrocarbons were detected.

SOIL CONTAMINANT LEVELS	
Contaminant	**Highest Detected Level (µg/kg)**
Arsenic	*
Barium	*
Benzo(a)anthracene	5,500
2-Butanone	28
Carbon disulfide	12
Chromium	*
Chrysene	9,100
Cobalt	*
Copper	*
Ethylbenzene	22
Lead	*
1-Methylnaphthalene	44,200
Naphthalene	4,500
Nickel	*
Phenanthrene	42,000
Pyrene	18,000
Selenium	*
Tin	*
TPH-Gasoline	560(mg/kg)
TPH-Lube Oil	22,000(mg/kg)
TPH-Diesel	9,600(mg/kg)
TPH-Kerosene	1,400(mg/kg)
Vanadium	*
Xylene	1,200
m,p-Xylene	720
o-Xylene	74
Zinc	*

*Detected at levels above the detection limit, no specific concentrations were provided in the LDEQ records

Corrective Actions/Regulatory Actions

The LDEQ Office of Solid Waste ordered Atlas to close the South Dirt Pile Area. The facility conducted a subsurface investigation down gradient of the South Dirt Pile Area in early 1996. The results of this investigation indicate that there is no apparent off-site migration from either the surface impoundments or the South Dirt Pile Area. LDEQ is allowing the site to conduct a comprehensive groundwater investigation to determine the facility-wide groundwater flow, s geology, and other factors. This investigation will required the installation of additional groundwater monitor wells throug the facility. Facility perimeter groundwater monitor wells will be installed at the conclusion of these additional studies. Th LDEQ will reassess the closure order upon reviewing the investigation findings.

Sources of Information

Louisiana Department of Environmental Quality, Solid Waste Division files, June 1996.

Personal communication with Groundwater Protection Division, Louisiana Department of Environmental Quality, August 1

Written correspondence submitted by facility and/or State on draft version of release descriptions, October 1996

BEAIRD INDUSTRIES LOUISIANA

Facility Overview

Beaird Industries manufactures steel vessels for the nuclear power industry at its Shreveport, Louisiana facility. As part of this manufacturing process, the facility sandblasts only non-painted, virgin metal surfaces. It does not reline, resurface, or repaint any metal surfaces. Historically, blasting sand has accumulated in and around the sand blasting building.

Facility Name:	Beaird Industries
Location:	Shreveport, Louisiana
Waste Stream:	Spent blasting sand and steel grit dust
Media Affected:	Groundwater

Wastes and Waste Management Practices

The accumulated spent blasting sand and steel grit dust were placed in an on-site waste pile. Previously, the fac used its spend blasting sand as fill-in on roads and low areas within the plant boundaries. This practice has ceased as a result of a compliance order from the Louisiana Department of Environmental Quality (LDEQ). Currently, the site operate under an exemption from the Louisiana solid waste regulations. LDEQ granted an exemption because the site develope environmentally sound method of recycling the blasting sand. Beaird now incorporates the waste in concrete or asphalt, disposes of the waste in a permitted off-site C & D landfill.

Extent of Contamination

The facility maintains that lead is a naturally occurring constituent in the sand. The site samples groundwater annually at 8 shallow wells and 4 deep wells. The groundwater data presented below from the January 1990 sampling ev show high levels of chromium and lead. 1993 test results indicate that chromium is below regulatory standards.

GROUNDWATER CONTAMINANTS COMPARED TO FEDERAL DRINKING WATER STANDARDS

Contaminant	Highest Detected Level (mg/l)	MCL (mg/l)	SMCL (mg/l)
Chromium	0.41	0.1	--
Lead	0.14	0.015*	--
Barium	0.37	2	--

*Action level

Corrective Actions/Regulatory Actions

LDEQ requires continued groundwater monitoring at the site, but does not plan to require remediation of groundwater.

Sources of Information

Louisiana Department of Environmental Quality, Solid Waste Division files, June 1996.

Personal communication with Solid Waste Division, Louisiana Department of Environmental Quality, August 1996.

Written correspondence submitted by facility and/or State on draft version of release descriptions, October 1996

CITGO PETROLEUM CORPORATION - LOUISIANA REFINERY LOUISIANA

Facility Overview

Facility Name:	Citgo Petroleum Corp. Louisiana Refinery
Location:	Lake Charles, Louisiana
Waste Stream:	Refinery wastes
Media Affected:	Soil and groundwater

Citgo Petroleum Corporation owns and operates a crude oil refinery. The plant's operations are separated into two functional areas: the Lube Plant and the Refinery. The Refinery is the nation's sixth largest. It was built in 1944 to produce aviation fuel. Through the years, new process units and unit upgrades have enabled the Refinery to increase its capacity from 70,000 barrels to the present 320,000 barrels per day. The refinery processes a high-sulfate crude from Venezuela. The site is located near the Calcasieu River and the Indian Marais Bayou runs through the site boundaries.

Wastes and Waste Management Practices

The Citgo facility has six separate non-hazardous waste management areas:

1. Refinery Secondary Wastewater Treatment Surface Impoundments (P-0275). This area consists of four soli waste surface impoundments. The impoundments include a settling basin, polishing pond, aerobic sludge digester, and aerobic sludge settling basin. Semi-annual sampling occurs at four monitoring wells.

2. Lube Plant Clay Pond No. 3 (P-0277) operates under a standard permit issued on March 9, 1992.

3. Lube Plant Clay Ponds No. 1, 2, and 4 (OC-0091) completed final closure on September 23, 1992 and a closure certification was issued by LDEQ on October 2, 1995. Semi-annual groundwater sampling occurs at monitoring wells.

4. Lube Plant Secondary Wastewater Treatment Surface Impoundments (P-0276). The facility was allowed to operate under an interim operational plan while they comply with a Louisiana Department of Environmental Quality (LDEQ) Upgrade Order. A Standard Permit was issued for these facilities on March 9, 1992, which superseded the order to upgrade.

5. Refinery Land Treatment Plots No. 1, 2, and 3 (OU-0120). Semi-annual groundwater sampling is conducted four monitoring wells.

6. Refinery Cooling Tower Sludge Basin (OC-0185). The closure plan for the Lake Charles facility was submitte on November 11, 1991. A Notice of Deficiencies (NOD) was issued on March 1, 1996. CITGO responded to these NOD's on April 2, 1996. Semi-annual groundwater sampling is conducted at two monitoring wells.

In 1990, two Lube Plant wastewater treatment surface impoundments were reclassified from non-hazardous to hazardous. This reclassification was based on the promulgation of the Primary Sludge Rule.

Extent of Contamination

Widespread groundwater contamination has been detected at the facility. Several areas of groundwater contamination have been attributed to the non-hazardous waste management practices at the facility. Groundwater samp at the facility's monitoring wells analyzes pH, specific conductance, total dissolved solids, total organic carbon, total orga halogens, sulfate, chloride, sodium, phenols, iron, and manganese. Total organic carbon levels in the downgradient wells the Lube Plant Clay Pond Nos. 1, 2, 3, and 4, the Lube Plant Secondary Wastewater Treatment Surface Impoundments, the Refinery Cooling Tower Sludge Basin have been higher than in the upgradient wells at each area. The tables provide below indicate the highest detected levels of several groundwater monitoring constituents in downgradient wells. The dat presented below represent semi-annual sampling events from 1992 through mid-1995.

REFINERY SECONDARY WASTEWATER TREATMENT SURFACE IMPOUNDMENTS
GROUNDWATER CONTAMINANTS COMPARED TO

FEDERAL DRINKING WATER STANDARDS

Constituent	Highest Detected Level (mg/l)	MCL (mg/l)	SMCL (mg/l)
Chloride	2,829	--	250
Iron	55.5	--	0.3
Manganese	6.74	--	0.05
Naphthalene	14.2	--	--
pH	4.71	--	6.5-8.5
Phenols	0.415	--	--
Sodium	1,270	--	--
Specific conductance (umhos/cm)	8,230	--	--
Sulfate	366	500	250
TOC	132.25	--	--
Total dissolved solids	7,712	--	500
Total organic halogens	0.52	--	--

LUBE PLANT CLAY POND NO. 3
GROUNDWATER CONTAMINANTS COMPARED TO
FEDERAL DRINKING WATER STANDARDS

Constituent	Highest Detected Level (mg/l)	MCL (mg/l)	SMCL (mg/l)
Chloride	390	--	250
Iron	21.1	--	0.3
Manganese	7.07	--	0.05
pH	4.92	--	6.5-8.5
Phenols	0.011	--	--
Sodium	419	--	--
Specific conductance (umhos/cm)	2,500	--	--
Sulfate	73*	500	250
Total dissolved solids	2,004	--	500
TOC	202.75	--	--
Total organic halogens	0.295	--	--

*Higher concentrations were found in upgradient well

Several constituents were detected in groundwater monitoring wells associated with Lube Plant Clay Ponds Nos. 1,2, and 4 (see table below). A brine pipeline lies adjacent to the southern border of these facilities. The constituents detected in the monitoring wells on the southern boundary of the Lake Charles facility are consistent with a release of brin LDEQ has not investigated the claim at this writing.

LUBE PLANT CLAY PONDS NO. 1, 2, AND 4
GROUNDWATER CONTAMINANTS COMPARED TO
FEDERAL DRINKING WATER STANDARDS

Constituent	Highest Detected Level (mg/l)	MCL (mg/l)	SMCL (mg/l)
Chloride	26,242	--	250
Iron	85	--	0.3
Manganese	21.9	--	0.05
pH	4.92	--	6.5-8.5
Phenols	0.693	--	--
Sodium	15,600	--	--
Specific conductance (umhos/cm)	57,900	--	--
Sulfate	575	500	250

TOC	247.25	--	--
Total dissolved solids	98,164	--	500
Total organic halogens	2.74	--	--

REFINERY LAND TREATMENT PLOTS NO. 1, 2, AND 3 GROUNDWATER CONTAMINANTS COMPARED TO FEDERAL DRINKING WATER STANDARDS			
Constituent	**Highest Detected Level (mg/l)**	**MCL (mg/l)**	**SMCL (mg/l)**
Chloride	5,060	--	250
Iron	69.80	--	0.3
Manganese	1.95	--	0.05
pH	5.97	--	6.5-8.5
Phenols	0.004	--	--
Sodium	3,520	--	--
Specific conductance (umhos/cm)	20,800	--	--
Sulfate	6,205	500	250
TOC	83	--	--
Total dissolved solids	25,236	--	500
Total organic halogens	0.084	--	--

REFINERY COOLING TOWER SLUDGE BASIN GROUNDWATER CONTAMINANTS COMPARED TO FEDERAL DRINKING WATER STANDARDS			
Constituent	**Highest Detected Level (mg/l)**	**MCL (mg/l)**	**SMCL (mg/l)**
Chloride	574	--	250
Iron	2.79*	--	0.3
Manganese	1.11*	--	0.05
pH	4.98	--	6.5-8.5
Phenols	0.009	--	--
Sodium	409	--	--
Specific conductance (umhos/cm)	2,148	--	--
Sulfate	91	500	250
TOC	166.5	--	--
Total dissolved solids	1,694	--	500
Total organic halogens	0.16*	--	--

*Higher concentrations were found in upgradient well

Corrective Actions/Regulatory Actions

A closure plan was submitted and approved by LDEQ. The closure for this Lake Charles facility has been completed on September 23, 1992, and a closure certification by LDEQ was issued on October 2, 1995. LDEQ also issu an Order to Close for the Refinery Cooling Tower Sludge Basin on September 11, 1991.

Sources of Information

Louisiana Department of Environmental Quality, Solid Waste Division files, June, 1996.

Semi-Annual Groundwater Report - Solid Waste Facilities. Citgo Petroleum Corporation, January 1995-June 1995.

Personal communication with Groundwater Protection Division, Louisiana Department of Environmental Quality, August 1

Written correspondence submitted by facility and/or State on draft version of release descriptions, October 1996.

DUPONT BURNSIDE PLANT LOUISIANA

Facility Overview

The Burnside Plant is owned by E.I. DuPont de Nemours & Company, Inc. The plant produces sulfuric acid from processes involving sulfur and spent sulfuric acid.

Wastes and Waste Management Practices

DuPont maintains two permitted industrial non-hazardous waste surface impoundments to contain and treat process wastewater. Seven groundwater monitoring wells located around the two impoundments are sampled on a semi-annual basis. Three of the wells are located upgradient.

Facility Name: DuPont Burnside Plant

Location: Darrow, Louisiana

Waste Stream: Sulfuric acid production wastewater

Media Affected: Groundwater

Extent of Contamination

The table below presents data from the semi-annual sampling events from 1986 to 1995. Sampling has revealed concentrations of sulfate and total dissolved solids above Federal standards.

GROUNDWATER CONTAMINANTS COMPARED TO FEDERAL DRINKING WATER STANDARDS

Contaminant	Highest Detected Level (mg/l)	MCL (mg/l)	SMCL (mg/l)
TDS	1,750	--	500
Chromium	0.061*	0.1	--
pH	6.75-7.19	--	6.5-8.5
Specific conductance (umhos/cm)	1,785	--	--
Sulfate	1,018	500	250
TOC	138	--	--

* Higher concentrations of chromium were found in one upgradient well. LDEQ is not certain that the chromium levels i groundwater can be attributed to the two surface impoundments.

Corrective Actions/Regulatory Actions

LDEQ is considering requiring the site to remediate groundwater due to continued sulfate exceedances.

Sources of Information

Louisiana Department of Environmental Quality, Solid Waste Division files, June 1996.

Second Semi-Annual Groundwater Monitoring Report. E.I. Du Pont de Nemours and Company, Inc. Burnside Facility, January 20, 1996.

Personal communication with Groundwater Protection Division, Louisiana Department of Environmental Quality, August 1

Facility Overview

Georgia Gulf operates a 170-acre landfarm with 130 acres useable for disposal. The landfarm is located a little over 1 mile from the Mississippi River. The landfarm was formerly used for sugar cane farming. The site is in a recharge zone of the Mississippi River. As a result, the groundwater flow varies seasonably. The groundwater table is very shallow (7 feet to 9 feet depth). There is no known potential source of contamination to groundwater in the vicinity, other than the landfarm.

Facility Name:	Georgia Gulf Landfarm
Location:	Iberville Parish, Louisiana
Waste Stream:	Process wastes, including biosludge, brine solids, lime

Wastes and Waste Management Practices

The following wastes were disposed of in the landfarm in 1994:

Biosludge	578.3 tons (dry sludge basis)
Brine solids	2,386.0 tons (dry sludge basis)
Lime solids	5,262.1 tons (dry sludge basis)
Desiccant	1.0 tons

The facility samples the groundwater semiannually from five monitoring wells installed in 1985 and at an additiona three wells installed in 1986. The soil is sampled semi-annually. The permitted capacity of the landfarm is 1,020,000 wet weight tons. Approximately 63.28 dry tons/acre were applied in 1994.

Extent of Contamination

Soil and groundwater contamination has been detected at the facility. Contaminants of concern include chlorides and sodium. In general, LDEQ believes that the impact to soil and groundwater can be attributed to the landfarm. Fluctuations in the groundwater flow direction can, however, affect sampling results. The table below presents groundwa monitoring data from January to June 1996.

GROUNDWATER CONTAMINANTS COMPARED TO FEDERAL DRINKING WATER STANDARDS

Contaminant	Highest Detected Level (mg/l)	MCL (mg/l)	SMCL (mg/l)
Chlorides	590	--	250
pH	6.2-6.6	--	6.5-8.5
Sodium	160	--	--
Specific conductance (umhos/cm)	2330	--	--
TDS	1,660	--	500
Total hardness	1020	--	--
Total Kjeldahl nitrogen	2.73	--	--
TOC	6.3	--	--
Zinc	0.147	--	5

The table below presents soil sampling data from 1994.

SOIL CONTAMINANT LEVELS (1994)

Constituent	Highest Detected Level (mg/kg)
Cadmium	2.0
Calcium	180,000

Chromium	28
Copper	23.6
Magnesium	14,000
Mercury	0.106
pH	9.3
Sodium	5,590
Total Kjeldahl nitrogen	1,010
TOC	508

Corrective Actions/Regulatory Actions

LDEQ requires continued sampling of groundwater and soil. No remedial action is currently planned.

Sources of Information

Louisiana Department of Environmental Quality, Solid Waste Division files, June 1996.

Personal communication with Groundwater Protection Division, Louisiana Department of Environmental Quality, August 1

Written correspondence submitted by facility and/or State on draft version of release descriptions, October 1996

Facility Overview

Facility Name: Gretna Machine and Iron Works

Location: Harvey, Louisiana

Waste Stream: Washwater from production of heavy metal products

The Gretna Machine and Iron Works facility is owned by Trinity Industries. Gretna reconditions barges at the Harvey, Louisiana site.

Wastes and Waste Management Practices

Gretna generated paint wastes and burned waste oils in two boilers. A 1.5 acre surface impoundment had been used as a dewatering/evaporation pit since before 1957. The impoundment contains oily solid residues from past waste management activities. Wastes were generated during the degassing and cleaning of barges. The unlined pi received washwater from gas-freeing and barge-cleaning operations. Historically, it has been a repository for wastes fro barges such as gasoline, diesel, #6 oil, and creosote.

In 1986, the site was required to characterize the wastewater in the impoundment. The analysis indicated the presence of hazardous constituents, but not at levels to be considered hazardous waste. The Louisiana Department of Environmental Quality (LDEQ) could not successfully document that the site was receiving hazardous wastes from barge Gretna claims to have received only oil and gas products, no listed hazardous waste. Gretna also states that the impoundment never received washwater that tested positive for hazardous characteristics. The site was deactivated in 1 before the Toxicity Characteristic Leaching Procedure Test became effective, and remains under the jurisdiction of the Louisiana State Office of Solid Waste.

Extent of Contamination

The table below presents 1994 ground water sampling data from downgradient wells. Benzene and pentachlorophenol were both above Federal drinking water standards.

GROUNDWATER CONTAMINANTS COMPARED TO FEDERAL DRINKING WATER STANDARDS

Contaminant	Highest Detected Level (mg/l)	MCL (mg/l)	SMCL (mg/l)
2-Methyl-4,6-dinitrophenol	0.0736	--	--
2,4-Dichlorophenol	0.0089	--	--
2,4-Dimethylphenol	0.0575	--	--
2,4-Dinitrophenol	0.010	--	--
2,4,6-Trichlorophenol	0.0036	--	--
4-Nitrophenol	0.0552	--	--
Benzene	0.157	0.005	--
Pentachlorophenol	0.0083	0.001	--
pH	6.1-7.3	--	6.5-8.5
Phenol	0.0024	--	--
Specific conductance (umhos/cm)	17,030	--	--
TOC	37.5	--	--
TOX	0.224	--	--

Corrective Actions/Regulatory Actions

The impoundment was capped in 1993. A 1994 State inspection noted artesian conditions in the monitoring well which were attributed to the capping of the impoundment. No remediation of the groundwater or upgrade of the monitorin wells is planned. LDEQ plans to continue requiring post- closure groundwater monitoring.

Sources of Information

Louisiana Department of Environmental Quality, Solid Waste Division files, June 1996.

Personal communication with Groundwater Protection Division, Louisiana Department of Environmental Quality, August 1

Facility Overview

The International Paper, Louisiana Mill plant in Bastrop, Louisiana is a pulp and paper mill. Manufacturing unit operations include wood processing, pulping, bleaching, power and steam generation, chemical recovery, paper machine operation, roll finishing, sheet finishing, and shipping. The nearest surface water body is Stalkinghead Creek. The groundwater table ranges from 30 to 80 feet in depth in Bastrop.

Facility Name: International Paper - Louisiana Mill

Location: Bastrop, Louisiana

Waste Stream: Inorganic light metal salts
Inorganic liquids
Lime kiln slake

Wastes and Waste Management Practices

The facility disposed of the following wastes in two inorganic settling basins: inorganic light metal salts, inorganic liquids, lime kiln slake, solid waste from a digester, bark, and other wood waste. These settling basins were operated for approximately 18 years before closing in 1989.

Extent of Contamination

Eight groundwater monitoring wells are sampled quarterly by International Paper personnel using LDEQ approve sampling methods. Data are reported semi-annually. Levels of arsenic, chromium, manganese, iron, selenium, and sulfa were above Federal drinking water standards. In the table below, data are presented from quarterly groundwater samplin results from 1990-1995.

GROUNDWATER CONTAMINANTS COMPARED TO FEDERAL DRINKING WATER STANDARDS

Contaminant	Highest Detected Level (mg/l)*	MCL (mg/l)	SMCL (mg/l)
Arsenic	0.148	0.05	--
Barium	0.371	2	--
Calcium	186	--	--
Chlorides	207	--	250
Chromium	0.115	0.1	--
Iron	8.6	--	0.3
Magnesium	57.1	--	--
Manganese	34.4	--	0.05
pH	5.3 - 10.7	--	6.5 - 8.5
Potassium	3.62	--	--
Selenium	0.08	0.05	--
Sodium	796	--	--
Sulfates	1,081	500	250
TDS	2,396	--	500

*Some of the maximum detected levels were found in upgradient wells, however, the LDEQ indicated that the upgradie wells were installed too close to the impoundment. The exceedances presented in this table are generally attributed t inorganic settling basins, according to the LDEQ.

An alum plant owned by a third party is located upgradient to International Paper's facility. Reports on file with th Louisiana DEQ from that facility show an apparent mounding and release from their solid waste impoundment which flow toward International Paper's monitoring system. International Paper believes that parameters such as sulfates, TDS and sodium are contributed to by the off-site plant.

Corrective Actions/Regulatory Actions

The mill closed two inorganic settling basins on August 15, 1989. Pond closure involved the drainage and remov of sludge from the south pond followed by removal of 6,000 cubic yards of soil. The site installed a concrete vault where wastewater is now disposed. The LDEQ is currently evaluating statistical analyses provided by the site to determine whe any remedial action will be required.

Sources of Information

Louisiana Department of Environmental Quality, Solid Waste Division files, June 1996.

Personal communication with Groundwater Protection Division, Louisiana Department of Environmental Quality, August 1

Written correspondence submitted by facility and/or State on draft version of release descriptions, October 1996

DEAN FOODS - PILGRIM FARMS SITE MICHIGAN

Facility Overview

Facility Name:	Dean Foods - Pilgrim Farms Site
Location:	Bentheim, Michigan
Waste Stream:	Pickle brine wastewater
Media Affected:	Groundwater

Dean Foods-Pilgrim Farms Site was originally a pickle processing facility; however, its operations have gradually been downsized to include only pickle washing and handling. On May 26, 1989, the facility ceased its treated process wastewater spray irrigation operations; on January 18, 1991, the facility ceased its relishing operations; and in 1993, the facility ceased its pickling operations. Dean Food's Inc. bought the site in 1990.

Located downgradient from the site, approximately 75 feet away from the seepage lagoons, is Black Creek, a tributary of Rabbit River. The top of the uppermost aquifer is 3 20 feet below surface. Groundwater flows east and southeast from the lagoons toward Black Creek. A localized mound occurs beneath the seepage lagoons with groundwater flowing radially away from the lagoons. The soils underlying the s consist of fine to medium-grained yellow-brown sand with thin clay and silt layers to depths ranging from 17 to 41 feet. C underlies the sand beneath most of the site.

Wastes and Waste Management Practices

Wastewater consisting of pickle brine from the pickling vats (until 1993) and then washwater from pickle washing operations (to present) was treated on-site in settling and groundwater seepage lagoons. The facility had a Michigan groundwater discharge permit and currently has a permit for washwaters without additives.

Extent of Contamination

Results from sampling conducted in 1994 showed that chloride from the seepage lagoons was contaminating groundwater east of the facility. This contaminated groundwater was migrating toward Black Creek. Water samples take from Black Creek in 1994 showed that levels of chloride were not exceeding State water quality standards. In fact, sampl revealed that a significant portion of the brine constituents were actually migrating beneath Black Creek, not into it. Samp results from previous years, however, showed levels of total dissolved solids in Black Creek to be exceeding water qualit standards. The impact to the aquifer was found to extend to the clay layer.

GROUNDWATER CONTAMINANTS COMPARED TO MICHIGAN OR FEDERAL DRINKING WATER STANDARDS

Contaminant	Highest Detected Level (mg/l)	MI Standard (mg/l)	MCL (mg/l)	SMCL (mg/l)
Bicarbonate, alkalinity	984	--	--	--
Calcium	291	--	--	--
Chloride	6,950	--	--	250
Iron, dissolved	31.1	--	--	0.3
Magnesium, dissolved	70	420*	--	--
Nitrogen, ammonia	49	--	--	--
Nitrogen, nitrate	33	10*	10	--
Nitrogen, nitrite	0.17	1*	1	--
pH	7.68	--	--	6.5-8.5
Phosphorus, total	5.4	--	--	-
Potassium, dissolved	140	--	--	--
Sodium, dissolved	4520	160*	--	--
Specific conductance (umhos/cm)	17.192	--	--	--
Sulfate	894	--	500	250

* Generic State drinking water standards, which should be reevaluated if conditions at a particular site do not meet the cri used to set the generic standards

In addition, residents near the site have complained of a serious mosquito biting problem. The Michigan Department of Public Health investigated the problem and determined that the species *Aedes Dorsalis*, which breeds in a salt water environment, was found in large populations at nearby residences. It was determined that the wall of one of th site's pickle brine seepage lagoons was leaking salt water to a nearby wetland, creating the breeding environment for the mosquitoes.

Corrective Actions/Regulatory Actions

Fiberglass tanks were installed to replace the leaking wooden vats that previously stored the pickles and brine. I November 1987, Pilgrim Farms was placed on Michigan's Act 307 Priority List with a rating of 31 (on a scale of 0-48, with being the most severe). No treatment of contaminated groundwater has been proposed.

As a temporary corrective action for the mosquito problem, Pilgrim Farms applied larvicide to the wetland that wa serving as the mosquitoes' breeding habitat. A suggested long-term treatment was draining the wetland.

Sources of Information

Letter from the Michigan Department of Public Health to the Director of Environmental Health, Allegan County Health Department, May 20, 1985.

Site Description/Executive Summary for Pilgrim Farms Pickle Plant; Groundwater Quality Division of the Michigan Depart of Natural Resources, October 22, 1985.

Letter from the Permits Section of the Waste Management Division to Pilgrim Farms, November 24, 1987.

Pilgrim Farms' Proposal for Bentheim Permit Renewal, August 15, 1989.

Act 307 Master Data Form and attached Site Scoring Documentation Sheet; Environmental Response Division, Decembe 1990.

Department of Natural Resources Waste Management Division Staff Report, January 15, 1991.

Letter from Pilgrim Farms, Inc. to the Michigan Department of Natural Resources and attached sampling data, April 25, 1

Attached sampling data letter from WW Operation Services to Dean Foods, November 15, 1991.

Map included in letter from WW Operation Services to the Michigan Department of Natural Resources, Waste Manageme Division, September 3, 1992.

Sampling data from the Hydrogeological Investigation Report for the Pilgrim Farms Site, Bentheim, Michigan; WW Engineering & Science, November 1993.

Letter from Dean Foods to the Michigan Department of Natural Resources, November 18, 1993.

Letter from WW Operation Services to the Michigan Department of Natural Resources, December 21, 1993.

Letter from Earth Tech to the Permits Section of the Michigan Department of Natural Resources regarding NPDES permi application, August 10, 1994.

Written correspondence submitted by facility and/or State on draft version of release descriptions, October 1996

FLAMM PICKLE AND PACKING COMPANY

Facility Overview

Facility Name: Flamm Pickle Company
Location: Eau Claire, Berrien County, Michigan
Waste Stream: Pickle process wastewater (brine)
Media Affected: Vegetation

Flamm Pickle and Packing Company is located in Eau Claire, Berrien Co., Michigan. The facility has been producing pickles and relishes for institutional and wholesale distribution since 1922, and its ownership has not changed in that time. Cucumbers are trucked to the plant where they are washed, sorted, and stored in tanks containing brine. They are subsequently washed and desalted, flavored, packed, and shipped. Usable aquifers are believed to be located in the vicinity of the plant, which is also located in close proximity to both the St. Joseph River and its tributary, Love Creek.

Wastes and Waste Management Practices

Wastewater is derived from the heavy usage of water in most stages of the pickle-production process. Cucumbe arrive at the plant, are washed, and are placed into brine tanks to cure for a period varying from ten days to over one yea When they are removed, they are washed and desalted, which requires steam, fresh water, and the addition of alum. So the brine from processing is used as starter brine for fresh cucumbers. Wastewater is also produced as a result of the va processes to flavor, prepare, and pack the whole or sliced pickles, and relishes. These processes may include the use o sugar, additional salt, and/or vinegar. Wastewater that is not to be reused is strained to remove solids which are hauled a and is stored in a collection tank. Seepage from the brine tanks is also pumped to this collection tank.

From approximately 1978 to approximately 1990, the wastewater flowed from the tank by gravity to the two-cell seepage lagoon area located along the St. Joseph River bottom land. Waste Management Division experts of the Plainw Michigan District believe the lagoons provided inadequate treatment and did not protect the groundwater.

Extent of Contamination

The Department of Natural Resources (DNR) inspected the seepage lagoons on August 16, 1984. Inspectors fou the first of the two lagoons to be turbid blue in color. This pond flowed into the second lagoon which was a muddy pink c Both ponds had an odor and were full to capacity with evidence of overflow at lower edges and salt crystallized in nearby An overflow was observed in progress by the inspectors, who noted wet ground for about ten feet from the pond. They fu noted that this discharge was the likely cause of death for many trees in a nearby marsh.

DNR's August 16, 1984, inspection, and a subsequent January 3, 1985, inspection of the seepage lagoons led to issuance of a letter on January 23, 1985, from a Water Quality Specialist in the Plainwell District. In this letter, DNR point continued evidence of repeated overflow as an apparent violation of the facility's groundwater discharge permit.

Corrective Actions/Regulatory Actions

Efforts continue on the part of the State to work with the facility to establish a new system of proper treatment, bu of April, 1996 the issue had yet to be resolved.

Sources of Information

Report of Wastewater Survey, Michigan Water Resources Commission (WRC), May 8, 1968.

Briefing Memo, Michigan WRC, October 3, 1974.

Report of an Industrial Wastewater Survey, Michigan DNR, November 24-25, 1975.

Letter from Township of Sodus, Michigan to Michigan DNR, July 28, 1984.

Michigan WRC Facility Inspection Report, August 16, 1984.

Michigan DNR Interoffice Communication, September 4, 1984.

Letter from Plainwell DNR to Flamm Pickle, January 23, 1985.

Diagram of wastewater flow through facility and map of facility and surrounding area from permit application, undated.

Letter from Michigan DNR to Flamm Pickle, June 29, 1990.

Michigan DNR Interoffice Communication, April 25, 1996.

MURCO, INC. MICHIGAN

Facility Overview

Facility Name: Murco, Inc.

Location: Plainwell, Allegan County, Michigan

Waste Stream: Paunch, animal manure solid waste, and process wastewater from meat packaging and rendering

Murco has operated in Plainwell, Michigan for over 70 years. Facility operations include on-site kill, processing, and packaging of beef for human consumption and rendering facilities for the processing of meat scraps, bones, viscera, and blood for the animal food and cosmetics industries. The Chart Drain and its East Branch tributary merge on-site and have associated wetlands. The Chart Drain merges with the Kalamazoo River one-fourth mile east of the property. A confined aquifer is beneath the clay till that underlies the site (except in the immediate vicinity of the Chart Drain). This aquifer serves as the major water source for most domestic wells in the immediate area. Solid wastes the raising of animals, including animal manures, are not hazardous wastes when returned to the soils as fertilizer (40 CF 261.4(b)(2)(ii)).

Wastes and Waste Management Practices

The on-site waste stream includes approximately 1,000,000 gallons per day of process wastewater, paunch (undigested food materials remaining in the rumen of the cattle's stomach at the time of slaughter), animal manure solid waste, and settleable solids from the initial collection stages of the wastewater treatment system. Wastewater is treated through a series of clarifiers; one anaerobic and four subsequent aerobic ponds. Treated wastewater is currently applied agricultural fields owned by Murco using spray irrigation under a discharge permit issued by the State in 1976. Solid was are also applied to the land using soil injection.

Extent of Contamination

The land application of liquid and solid waste has elevated concentrations of constituents in the groundwater, surface water, and soil at the site.

Groundwater - All groundwater constituents sampled for were found regularly to exceed background concentratio for groundwater in the area. In addition, iron, nitrate, nitrite, sodium, and total dissolved solids (TDS) were found to excee State or Federal drinking water standards as specified below.

GROUNDWATER CONTAMINANTS COMPARED TO MICHIGAN OR FEDERAL DRINKING WATER STANDARDS

Contaminant	Highest Detected Level (mg/l)	MI Standard (mg/l)	MCL (mg/l)	SMCL (mg/l)
Ammonia	142	--	--	--
Bicarbonate	1420	--	--	--
Chloride	148	--	--	250
COD	210	--	--	--
Dissolved calcium	205	--	--	--
Iron	5.31	--	--	0.3
Magnesium	57.8	420	--	--
Nitrate	104	10	10	--
Nitrite	1.4	--	1	--
pH	7.8	--	--	6.5-8.5
Sodium	163	160	--	--
TDS	2700	--	--	500
Total phosphorus	7.08	--	--	--

Surface Water - Nitrate levels in two of the five samples taken along the Chart Drain were found to exceed both groundwater background levels for the site as well as State and Federal drinking water standards. Nitrate is reduced as t

Chart Drain flows east prior to discharge to the Kalamazoo River. This decline may be caused by uptake of the nitrogen the wetland vegetation.

SURFACE WATER CONTAMINANTS COMPARED TO MICHIGAN OR FEDERAL DRINKING WATER STANDARDS				
Contaminant	**Highest Detected Level (mg/l)**	**MI Standard (mg/l)**	**MCL (mg/l)**	**SMCL (mg/l)**
Ammonia	10.0	--	--	--
COD	127.0	--	--	--
Nitrate	45.7	10	10	--
Nitrite	0.02	--	1	--
TDS	3092.0	--	--	500
Toluene	<.005	1.0	1.0	--

<u>Soil</u> - The constituents of concern at Murco's agricultural fields that received treated wastewater via spray irrigatic and solid wastes via soil injection are phosphorous, nitrates, and ammonia. As shown in the table below, all three were f in concentrations exceeding background levels at the site; however, calcium, magnesium, and potassium were considera lower than background levels.

SOIL CONTAMINANTS COMPARED TO BACKGROUND CONCENTRATIONS		
Contaminant	**Average Detected Level (mg/kg)**	**Average Background Concentration (mg/kg)**
Ammonia	5.47	0.25
Calcium	337.1	18,008
Magnesium	53.5	6,025
Nitrates	5.43	0.58
Phosphorous	283.4	173
Potassium	65.0	108

Corrective Actions/Regulatory Actions

Murco has been phasing out the current wastewater treatment system since August 1995. Ponds 1 through 4 are undergoing closure and are being replaced by a new 9.9 million gallon anaerobic pond that has been constructed and is i use. As of May 1996, one aerobic pond remained in use. A new treatment system is expected to be constructed by Janu 1997, operational by July 1997, and will eliminate the land application of wastewater.

Sources of Information

Remedial Investigation Report, STS Consultants Ltd. for Murco, Inc., May 6, 1996.

Facility Overview

Facility Name:	Wexford Sand Company, Yuma Site
Location:	Slagle Township, Wexford County, Michigan
Waste Stream:	Wastewater from sand washing

Wexford Sand Company's Yuma site in Slagle Township, Michigan is primarily a surface sand mining and washing operation. The Yuma site was once used as a waste disposal area for spent core sand from Ford Motor Company's Cleveland casting plant. The site is currently used to dispose of the fine sands removed via the beneficiation process.

The site is located in a sparsely populated area with almost level topography. The land one-quarter mile west (downgradient) of the site is part of the Manistee National Forest. The Manistee River is located approximately 3.5 r northwest of the site and Slagle Creek is located 1.5 miles southwest of the site.

The soil underlying the site consists of sorted and stratified sands and gravels. The aquifer at the disposal site appears to be homogeneous and unconfined. The water table is estimated to be 30 to 40 feet below the ground surface. nearest potable wells lie 0.25 miles northwest and north of the site. Other wells lie 1.0 to 1.5 miles to the north in the towr Yuma. Groundwater migrates in a westerly direction. The average groundwater gradient is about 0.3 to 0.5 percent in th vicinity of the disposal site.

Wastes and Waste Management Practices

The site is considered an unlicensed type III landfill, which has never been properly capped and closed. Approximately 800,000 tons of the spent foundry sand was dumped at the Yuma site between 1977 and 1982. The wastewater generated from the sand beneficiation process is treated to remove conditioning reagents, namely Pamak-4 a Pine Oil. Pamak-4 consists of oil derived fatty acids and small amounts (4-12%) of resin (rosin) acids. Many of the fatty a found in this product are common components of the human diet. Approximately 90% of the Pine Oil or terpineol consists mixed terpene alcohols.

The wastewater treatment system for the sand beneficiation process consists of three linked ponds, representing area of 1.86 million square feet or approximately 42.7 acres. Pond No. 1 is the largest of the three ponds; it is used as a sedimentation/seepage lagoon. Outfall consisting of fine sand waste material from the sand clarification process and fror sand purification process enter this pond through a pipe and drainage ditch, respectively. Outfall from the drying operatio enters this pond via a pipe. The combined wastewater flow into the lagoon is 3.176 million gallons per day.

Pond No. 2 functions as a stabilization lagoon for wastewater from Pond No. 1. The wastewater is allowed to furt biodegrade prior to discharge to Pond No. 3.

Pond No. 3 serves as a holding pond for the treated wastewater. Approximately 24 percent of the treated wastewater is recycled from Pond No. 3 to the processing plant. The calculated wastewater removal rates by evaporatior infiltration are 0.129 million gallons per day and 2.32 million gallons per day, respectively.

Groundwater monitoring wells are sampled quarterly.

Extent of Contamination

A 1986 hydrogeological report for the years 1980 through 1986 showed levels of ammonia-N, calcium, chloride, conductivity, iron, magnesium, nitrate-N, phenol, sodium, and sulfate present in the groundwater above background level These elevated levels are attributable to the disposal of spent core sand from Ford Motor Company's Cleveland casting p The levels of these parameters, except that of iron, are all now within drinking water quality limits. Although levels of iron groundwater are elevated, they are lower than in the 1986 report because the company has ceased disposing of spent co sand on the site.

Groundwater sampling results in 1990 indicate that current sand washing operations are degrading groundwater quality beyond the sand mining property. Downgradient wells on Federal forest land showed that PAMAK and elevated le of manganese are present in the aquifer. The PAMAK is not biodegrading as the company had thought it would. The sar washing operation has never held a permit to discharge as is required under the Water Resources Commission Act.

An isochemical contour of Pamak-4 from the July 1988 analytical results indicates that contamination is present i the groundwater. According to a May 1989 hydrogeological report by ASI, these levels of Pamak-4 in the groundwater do pose a significant impact to the environment based on its low toxicity levels.

A September 28, 1994, memo from the Michigan Department of Natural Resources states that sampling results o site show levels of manganese and arsenic to be above permittable limits.

GROUNDWATER CONTAMINANTS COMPARED TO MICHIGAN OR FEDERAL DRINKING WATER STANDARDS

Contaminant	Highest Detected Level (mg/l)	MI Standard (mg/l)	MCL (mg/l)	SMCL (mg/l)
Ammonia-N	0.15	ID	--	--
Arsenic	0.05	0.05	0.05	--
Bicarbonate (mg $CaCO_3$/l)	449	--	--	--
COD	19	--	--	--
Conductivity (umhos/cm)	786	--	--	--
Iron	9.6	ID	--	0.3
Lead	0.31	0.004	--	0.3
Manganese	0.89	0.18	--	0.05
Nitrate-N	3.1	10	10	--
Pamak-4	2.3	1.0*	--	--
pH	8.4	--	--	6.5-8.5
Total alkalinity (mg $CaCO_3$/l)	449	--	--	--
TOC	13	--	--	--

*A May 1989 Hydrogeologic Investigation Report conducted by ASI states that the “anticipated allowable level of Pamal is 1 mg/l.”

ID = Inadequate data to develop criterion.

Corrective Actions/Regulatory Actions

No corrective or regulatory actions have been taken.

Sources of Information

Hydrogeologic Investigation Report; May 1989, ASI.
Sampling results from ANATECH Laboratories, November 7, 1994.

Michigan Department of Natural Resources, Waste Management Division, memorandum to Wexford Sand, October 22, 1

Michigan Department of Natural Resources, Hydrogeologic Review Unit, Waste Management Division, memorandum to Wexford Sand, September 28, 1994.

BAKER COMMODITIES, INC. NEW MEXICO

Facility Overview

Baker Commodities, Inc. operates a slaughterhouse in Albuquerque, New Mexico. The depth to groundwater is approximately 10 feet.

Wastes and Waste Management Practices

Approximately 4,320 gallons per day of wastewater was discharged to the unlined lagoon until the plant closed in 1990.

Facility Name: Baker Commodities, Inc.

Location: Albuquerque, New Mexico

Waste Stream: Slaughterhouse wastewater

Media Affected: Groundwater

Extent of Contamination

The table below identifies the highest level of each constituent detected in downgradient wells. Groundwater is monitored at four wells. Nitrate and total dissolved solids were found to be above New Mexico or Federal standards.

GROUNDWATER CONTAMINANTS EXCEEDING NEW MEXICO OR FEDERAL DRINKING WATER STANDARDS

Contaminant	Highest Detected Level (mg/l)	NM Standard (mg/l)	MCL (mg/l)	SMCL (mg/l)
Ammonia	46.9	--	--	--
Kjeldahl nitrogen	57.6	--	--	--
Nitrate	10.4	10	10	--
Total dissolved solids	3104	1000	--	500

Corrective Actions/Regulatory Actions

All operating wells are currently in compliance with state requirements. After the plant closed in 1990, the facility filled in their lagoons. The New Mexico Environment Department requires the plant to monitor groundwater quarterly.

Sources of Information

New Mexico Environment Department, Groundwater Section, Database printout and corresponding files, 1995.

BIAD CHILE PROCESSING PLANT - GARFIELD NEW MEXICO

Facility Overview

Biad Chile Processing Plant - Garfield is located in Garfield, New Mexico, in Dona Ana County. The facility washes red chiles, which are then dehydrated and powdered on-site. The wastestream produced from this process is chile wastewater.

Facility Name:	Biad Chile Processing Plant - Garfield
Location:	Garfield, New Mexico
Waste Stream:	Food processing wastewater
Media Affected:	Groundwater

Wastes and Waste Management Practices

Up to 90,000 gallons per day of chile wastewater is screened for solids and discharged via concrete irrigation ditches to a minimum of 16 acres of farmland. The discharge occurs during fall and winter months, September through January.

Extent of Contamination

The table below identifies the highest level of each constituent detected in downgradient wells. Groundwater is monitored tri-annually at three wells. Nitrate/nitrite and total dissolved solids were found to be above New Mexico or Fed standards.

GROUNDWATER CONTAMINANTS EXCEEDING NEW MEXICO OR FEDERAL DRINKING WATER STANDARDS

Contaminant	Highest Detected Level (mg/l)	NM Standard (mg/l)	MCL (mg/l)	SMCL (mg/l)
Nitrate/nitrite as N	29	10	10	--
pH	7.19-8.01	6.5-8.5	--	6.5-8.5
Total dissolved solids	2,400	1,000	--	500
Total filterable residue	2366	--	--	--
Water Kjeldahl nitrogen	2.0	--	--	--

Corrective Actions/Regulatory Actions

The New Mexico Environment Department requires the site to continue monitoring groundwater three times a yea The facility is planning to close its plant this year.

Sources of Information

New Mexico Environment Department, Groundwater Section, database printout and corresponding files, 1995.

BIAD CHILE PROCESSING PLANT - LEASBURG NEW MEXICO

Facility Overview

Facility Name:	Biad Chile Processing Plant - Leasburg
Location:	Leasburg, New Mexico
Waste Stream:	Food processing wastewater
Media Affected:	Groundwater

Biad Chile Processing Plant - Leasburg is located in Leasburg, New Mexico, in Dona Ana County. The depth to groundwater is approximately 8 feet. The facility washes red chiles, which are then dehydrated and powdered on-site. The wastestream produced from this process is chile wastewater.

Wastes and Waste Management Practices

Up to 90,000 gallons per day of chile wastewater is screened for solids and discharged via concrete irrigation ditches to a minimum of 16 acres of farmland. The discharge occurs during fall and winter months of September through January. No more than 200 pounds of total nitrogen per year acre are allowed to be land applied.

Extent of Contamination

The table below identifies the highest level of each constituent detected in downgradient wells. Groundwater is monitored tri-annually at three wells. Nitrate/nitrite and total dissolved solids were found to be above New Mexico or Fede standards.

GROUNDWATER CONTAMINANTS EXCEEDING NEW MEXICO OR FEDERAL DRINKING WATER STANDARDS

Contaminant	Highest Detected Level (mg/l)	NM Standard (mg/l)	MCL (mg/l)	SMCL (mg/l)
Nitrate/nitrite as N	25	10	10	--
pH	7.19-7.58	6.5-8.5	--	6.5-8.5
Total dissolved solids	900	1,000	--	500
Total filterable residue	2366	--	--	--
Water Kjeldahl nitrogen	2.0	--	--	--

Corrective Actions/Regulatory Actions

The New Mexico Environment Department requires the site to continue monitoring groundwater three times a yea

Sources of Information

New Mexico Environment Department, Groundwater Section, database printout and corresponding files, 1995.

BIAD CHILE PROCESSING PLANT - MESILLA NEW MEXICO

Facility Overview

Biad Chile Processing Plant - Mesilla is located in Mesilla, New Mexico. The facility washes red chiles, which are then dehydrated and powdered on-site. The wastestream produced from this process is chile wastewater. The depth to groundwater is approximately 20 feet.

Facility Name:	Biad Chile Processing Plant - Mesilla
Location:	Mesilla, New Mexico
Waste Stream:	Food processing wastewater
Media Affected:	Groundwater

Wastes and Waste Management Practices

Up to 90,000 gallons per day of chile wastewater is screened for solids and discharged via concrete irrigation ditches to a minimum of 16 acres of farmland. The discharge occurs during fall and winter months of September through January.

Extent of Contamination

The table below identifies the highest level of each constituent detected in downgradient wells. Groundwater is monitored tri-annually at three wells. Nitrate/nitrite was found to be above New Mexico or Federal standards.

GROUNDWATER CONTAMINANTS EXCEEDING NEW MEXICO OR FEDERAL DRINKING WATER STANDARDS

Contaminant	Highest Detected Level (mg/l)	NM Standard (mg/l)	MCL (mg/l)	SMCL (mg/l)
Kjeldahl nitrogen	1.5	--	--	--
Nitrate/nitrite as N	16	10	10	--
pH	7.20-7.84	6.5-8.5	--	6.5-8.5
Total filterable residue	1059	--	--	--

Corrective Actions/Regulatory Actions

The New Mexico Environment Department requires the site to continue monitoring groundwater three times a yea

Sources of Information

New Mexico Environment Department, Groundwater Section, database printout and corresponding files, 1995.

KOCH MATERIALS COMPANY NEW MEXICO

Facility Overview

Facility Name: Koch Materials Company

Location: Eddy County, New Mexico

Waste Stream: Process wastewater

Koch Materials Company is an asphalt plant located in Eddy County, New Mexico. The facility was operated by Elf management until April 1993 and has been under Koch management since then. The approximate depth to groundwater at the plant is 50 feet.

Wastes and Waste Management Practices

Koch Materials Company produces water softener back wash, small amounts of boiler blowdown, and laboratory water from asphalt emulsion. The company operates a synthetically-lined pond for evaporation. The pond receives 1,000 gallons per day of wastewater. The facility's water management permit permits flow up to 2,000 gallons/day. The flow is non-contact waste waters, except for very minor quantities of laboratory waste water from asphalt emulsion road paving material testing.

Extent of Contamination

The table below identifies the highest level of each constituent detected in downgradient wells. Methylene chlori and total dissolved solids were found to be above New Mexico or Federal standards. However, of note, the groundwater resource in question is brine and non-potable; and the State of New Mexico has said that purgeable organics (*e.g.,* methylene chloride, Method 8240) are within state standards.

GROUNDWATER CONTAMINANTS EXCEEDING NEW MEXICO OR FEDERAL DRINKING WATER STANDARDS

Contaminant	Highest Detected Level (mg/l)	NM Standard (mg/l)	MCL (mg/l)	SMCL (mg/l)
Chloride	47.9	250	--	250
Chloromethane	1.4	--	--	--
Di-n-butylphthalate	19	--	--	--
Methylene chloride	4	0.1	0.005	--
Total dissolved solids	1,248	1,000*	--	500

* The facility indicated that the State of New Mexico has determined that background for TDS in the groundwater media in question is ~3,200 mg/l.

Corrective Actions/Regulatory Actions

The New Mexico Environment Department requires the site to continue monitoring groundwater semi-annually. T facility has stopped using the lagoon and are only using evaporation. The facility will continue to monitor for two years for closure.

Sources of Information

New Mexico Environment Department, Groundwater Section, database printout and corresponding files, 1995.

Written correspondence submitted by facility and/or State on draft version of release descriptions, October 1996

LEPRINO FOODS CHEESE PLANT NEW MEXICO

Facility Name: Leprino Foods Cheese Plant

Location: Roswell, New Mexico

Waste Stream: Food processing wastewater

Facility Overview

Leprino Foods Cheese Plant is located in Roswell, New Mexico. The depth to ground water is approximately 33 feet. The groundwater is monitored quarterly at 15 monitoring wells located in a sandstone formation which is connected the artesian groundwater aquifer.

Wastes and Waste Management Practices

Leprino Foods Cheese Plant produces an average of 750,000 gallons per day of food processing wastewater. A maximum of 6,000 gallons of domestic wastewater is chlorinated, combined with process wastewater, and directed to a fl equalization tank. Wastewater from the flow equilization tank is treated in an extended-aeration activated sludge system consisting of two aeration basins and clarifiers. Treated effluent is stored in a newly constructed 42 million gallon synthetically-lined lagoon and the two existing synthetically lined lagoons. Treated effluent is used to irrigate 450 acres o cropland Sludge is processed by aerobic digesters and stored in a 9 million gallon synthetically lined lagoon.

Extent of Contamination

The table below identifies the highest level of each constituent detected in downgradient wells. Nitrate and total dissolved solids were found to be above New Mexico or Federal standards.

GROUNDWATER CONTAMINANTS EXCEEDING NEW MEXICO OR FEDERAL DRINKING WATER STANDARDS

Contaminant	Highest Detected Level (mg/l)	NM Standard (mg/l)	MCL (mg/l)	SMCL (mg/l)
Ammonia	0.5	--	--	--
Chemical oxygen demand	20	--	--	--
Conductivity	5,640	--	--	--
Nitrate	30	10	10	--
Total dissolved solids	4,320	1,000	--	500
Total Kjeldahl nitrogen	1.0	--	--	--

Corrective Actions/Regulatory Actions

The New Mexico Environment Department requires the site to continue monitoring groundwater quarterly.

Sources of Information

New Mexico Environment Department, Groundwater Section, database printout and corresponding files, 1995.

Written correspondence submitted by facility and/or State on draft version of release descriptions, October 1996

SANTA FE INGREDIENTS COMPANY, INC. NEW MEXICO

Facility Overview

Facility Name:	Santa Fe Ingredients Company, Inc.
Location:	Hidalgo County, New Mexico
Waste Stream:	Food processing wastewater
Media Affected:	Groundwater

Santa Fe Ingredients Company, Inc. is located in McCormack County, New Mexico. The facility washes red chiles, which are then dehydrated and powdered on-site. The wastestream produced from this process is chile wastewater. The depth to groundwater is approximately 150 feet.

Wastes and Waste Management Practices

Up to 750,000 gallons per day of washwater is discharged to a tar-lined concrete sump, then pumped through a solids separator screen and through a gated distribution to a land application area of approximately 120 acres. This area is bermed to prevent surface runoff. The facility is not allowed to land apply more than 200 pounds of total nitrogen per acre per year.

Extent of Contamination

The table below identifies the highest level of each constituent detected in downgradient wells. Fluoride and nitrate/nitrite were found to be above New Mexico or Federal standards.

GROUNDWATER CONTAMINANTS EXCEEDING NEW MEXICO OR FEDERAL DRINKING WATER STANDARDS

Contaminant	Highest Detected Level (mg/l)	NM Standard (mg/l)	MCL (mg/l)	SMCL (mg/l)
Alkalinity (as CaCO$_3$)	158.5	--	--	--
Bicarbonate	2.83	--	--	--
Bicarbonate alkalinity	172.7	--	--	--
Calcium	111.3	--	--	--
Carbonate	0.34	--	--	--
Carbonate alkalinity	10.2	--	--	--
Chloride	60	250	--	250
Fluoride	2.41	1.6	4	2
Magnesium	11.9	--	--	--
Nitrate/nitrite as N	12.9	10	10	--
Potassium	5.5	--	--	--
Sodium	100.4	--	--	--
Sulfate	165.3	600	500	250
Total dissolved solids	500	1,000	--	500
Total filterable residue	601	--	--	--
Water Kjeldahl nitrogen	0.4	--	--	--

Corrective Actions/Regulatory Actions

The New Mexico Environment Department requires the site to continue monitoring groundwater semi-annually.

Sources of Information

New Mexico Environment Department, Groundwater Section, database printout and corresponding files, 1995.

GEORGIA-PACIFIC CORPORATION NEW YORK

Facility Overview

Georgia-Pacific Corporation operates a paper finishing plant in the town of Warwick, Orange County, New York. An unnamed tributary approximately 300 feet from Wawayanda Creek is the nearest surface water body.

Facility Name:	Georgia-Pacific Corporation
Location:	Warwick, New York
Waste Stream:	Process wastewater from paper finishing
Media Affected:	Groundwater and surface water

Wastes and Waste Management Practices

The facility discharges process wastewater into their adjacent lagoon. Process wastewater from the operation of Georgia Pacific Corp.'s paper finishing plant is discharged into an adjacent clay-lined lagoon.

Extent of Contamination

Groundwater - The table below identifies the constituents analyzed and detected in the 1992 groundwater sampli and the highest detected level of each constituent in downgradient wells. Arsenic, chromium, lead, manganese, and zinc levels were found to be consistently above New York or Federal standards.

GROUNDWATER CONTAMINANTS EXCEEDING NEW YORK OR FEDERAL DRINKING WATER STANDARDS

Contaminant	Highest Detected Level (mg/l)	NY Standard (mg/l)	MCL (mg/l)	SMCL (mg/l)
Arsenic	0.027	0.025	0.05	--
Chromium	0.088	0.05	0.1	--
Lead	0.041	0.025	0.015*	--
Manganese	10.8	0.3	--	0.05
Zinc	0.5	0.3	--	5.0

*Action level

Surface water - The table below identifies the constituents analyzed and detected in the 1992 surface water sampling and the highest detected level of each constituent in downstream samples. Lead levels were found to be above Federal standards.

SURFACE WATER CONTAMINANTS EXCEEDING NEW YORK OR FEDERAL DRINKING WATER STANDARDS

Contaminant	Highest Detected Level (mg/l)	NY Standard (mg/l)	MCL (mg/l)	SMCL (mg/l)
Alkalinity (as $CaCO_3$)	74	--	--	--
Cadmium	0.00005	0.01	0.005	0.001
Calcium	30.4	--	--	--
Chloride	28.5	250	--	250
Copper	0.0023	0.2	1.0*	1.0
Fluoride	0.09	1.5	4.0	2.0
Hardness (as $CaCO_3$)	105	--	--	--
Lead	0.0010	0.025	0.015*	--
Magnesium	7.0	35	--	--
Nickel	0.0008	--	0.1	--
Nitrogen, ammonia, as N	0.012	--	--	--
Nitrogen, Kjeldahl, as N	0.27	--	--	--

Contaminant	Highest Detected Level (mg/l)	NY Standard (mg/l)	MCL (mg/l)	SMCL (mg/l)
Nitrogen, nitrate (+NO_2) as N	0.56	10	10	--
pH	8.0	6.5-8.5	--	6.5-8.5
Phosphate	0.074	--	--	--
Potassium	1.4	--	--	--
Sodium	15.5	20	--	--
Sulfate	27.8	250	500	250
TDS	201	500	--	500
Turbidity	4.3 NTU	5 NTU	--	--
Zinc	0.005	0.3	--	5.0

*Action level

Corrective Actions/Regulatory Actions

A 1992 Order on Consent requires Georgia-Pacific to conduct groundwater sampling of the existing monitoring w for all metals. The samples shall be both filtered and unfiltered. Georgia-Pacific may, at their discretion, install new wells near the existing wells and sample the new wells in addition to the existing wells. After an evaluation of the sample, the Department shall determine if Georgia-Pacific will be required to submit and implement an Approved Investigative Report groundwater study addressing the need to protect the water supply of the town of Warwick was required to be prepared a the Department planned to review the soil sample results for the stream sediment, the clay liner of the lagoons, the residu material that may still be in the lagoons, and/or tanks at the site. No information was readily available on the implementa of this Order.

Sources of Information

Order on Consent, 1992.

Letter from Georgia-Pacific Corporation to New York State Department of Environmental Conservation, March 19, 1984.

Report on Preliminary Soil and Foundation Investigation, Proposed Paper Finishing Plant, 1992 surface water sampling data.

Letter from New York State Department of Environmental Conservation to Georgia-Pacific Corp., February 7, 1992.

Written correspondence submitted by facility and/or State on draft version of release descriptions, October 1996.

HOLLINGSWORTH AND VOSE COMPANY NEW YORK

Facility Overview

Facility Name:	Hollingsworth and Vose Company
Location:	Easton, New York
Waste Stream:	Paper mill sludge
Media Affected:	Groundwater

Hollingsworth and Vose Company is headquartered in East Walpole, Massachusetts and has two paper mills located in the towns of Easton and Greenwich, New York. The mills manufacture miscellaneous specialty papers, specifically, papers for oil, water, and air filter products. The Greenwich mill has been in operation since 1880 and produces approximately 18 tons of paper per day. The Easton mill produces approximately 44 tons of paper per day. Hollingsworth and Vose has owned the mills for over 40 years. The landfill was constructed in 1974 and is situated adjacent to the Batten Kill River.

Wastes and Waste Management Practices

Approximately 2,625 tons of paper sludge with 15-20% solids is disposed of per year. The sludge is dewatered o time in drying beds. When the drying beds fill and dewatering has been maximized, the sludge is excavated and hauled t landfill. Leachate from the drying beds is collected in an underdrain system and pumped to a clarifier. Under standard operating procedures, sludge disposal in the landfill occurs once a year. The sludge disposal landfill is devoid of liners ar leachate collection capabilities.

Extent of Contamination

Groundwater sampling downgradient from the landfill was conducted monthly. Sampling has detected phenol lev consistently above New York State standards. Phenols additionally are found to meet or exceed the NYS drinking water standards in 75% of upgradient samples.

GROUNDWATER CONTAMINANTS EXCEEDING NEW YORK OR FEDERAL DRINKING WATER STANDARDS

Contaminant	Highest Detected Level (mg/l)	NY Standard (mg/l)	MCL (mg/l)	SMCL (mg/l)
pH	6.87-8.09	6.5-8.5	--	6.5-8.5
Phenol	0.022	0.001	--	--

Corrective Actions/Regulatory Actions

No information was readily available on any remediation of the contaminated groundwater.

Sources of Information

Hollingsworth and Vose Company Multi-Media Inspection, June 16, 1993.

New York State Department of Environmental Conservation, Memorandum, “Program Summary for Hollingsworth and Vo Inspection,” August 17, 1993.

Hollingsworth & Vose, Annual/Quarterly Report, 1995.

Personal Communication, Al Majors, Tennessee Department of Environment and Conservation, Division of Solid Waste Management, August 28, 1996.

Written correspondence submitted by facility and/or State on draft version of release descriptions, October 1996

Facility Overview

Facility Name:	International Environmelting Corp.
Location:	Dunkirk, Chautauqua County, New York
Waste Stream:	Spent casting sand and construction wastes

The International Environmelting Corp. facility is located in an industrial area where two foundries operated for eighty or more years. The two foundries, Skeleton Shovel Company and True Temper Corporation, manufactured metal items, such as steam radiators and shovels. Manufacturing operations continued at the site from at least 1915 to 1985. An environmental investigation was conducted at the site, including soil and groundwater sampling in 1989. A second investigation including soil and groundwater sampling was conducted in 1993 and submitted to the New York State Department of Environmental Conservation (DEC).

Wastes and Waste Management Practices

Both of the foundries formerly located on the site used spent casting sand and construction wastes to fill in the lo lying areas near their plants. Excavations on site before 1975 provided a major source of fill for the parking lot on the nor side of the facility. In addition, construction waste and truck fleet maintenance waste was added to the fill material. This waste stream included copper pipe, solder, galvanized ferrous metals, and brass filings. The fill area varies from grade t depths of eight feet. In later years, parking lots and buildings were built on most of the property.

Extent of Contamination

The facility conducted an environmental investigation in 1993 and submitted the soil and groundwater sampling results to the DEC. These results are presented in the following tables.

Groundwater - The table below presents the results of the groundwater analysis. Arsenic, chromium, lead, and nickel were all detected above State or Federal standards.

GROUNDWATER CONTAMINANTS COMPARED TO NEW YORK OR FEDERAL DRINKING WATER STANDARDS

Contaminant	Highest Detected Level (µg/l)	NY Standard (µg/l)	MCL (µg/l)	SMCL (µg/l)
Arsenic	200	50	50	--
Cadmium	1.5	10	10	--
Chromium	65.0	50	50	--
Lead	345	50	50	--
Mercury	.5	2	2	--
Nickel	278	76.8	--	--
Zinc	1,180	5,000	--	5,000
TPH	3,600,000	--	--	--
Tetrachoroethene	1,450	--	--	--
Xylenes	40	--	10,000	--

Soil - The soil samples generally were taken from boring holes through the overlying concrete. Some surface soi samples were taken from unpaved ground. Arsenic, benzene, copper, mercury, nickel, and zinc were all detected in soil boring samples at levels higher than those set by DEC. The table below presents the results of the soil sampling.

SOIL CONTAMINANTS COMPARED TO NEW YORK STATE STANDARDS

Contaminant	Surface Soil Samples Highest Detected Level (mg/kg)	Soil Boring Samples Highest Detected Level (mg/kg)	Proposed DEC* Soil Cleanup Objectives For Inactive Hazardous

			Waste Sites (mg/kg)
Arsenic	29.7	35.60	7.0
Chromium	16.4	16.60	50
Copper	--	2250	25
Lead	2930	1070	--
Mercury	--	0.26	0.1
Nickel	--	28.8	13
Thallium	--	--	150
Zinc	--	1770	20
Benzene	--	0.03	0.06
Toluene	--	0.027	1.5
TPH	3,600	170	--
Tetrachoroethene	1.45	--	1.4
p-Xylene/m-Xylene	0.04	--	1.2

*Telephone conversation with the Technology Section, DEC.

Corrective Actions/Regulatory Actions

Most of the property is covered by asphalt paving or buildings. The facility plans to pave additional areas to provi new parking. In addition, the groundwater underlying the property is perched and is <u>not</u> used as a drinking water source. view of this site's unique characteristics, DEC chose not to list this site on the Registry of Inactive Hazardous Waste Dispo Sites. DEC, however, recommended that the facility "clean up those few areas that show elevated total metals" and prov "letter report on such action" to DEC.

Sources of Information

Letter from DEC addressed to International Environmelting Corporation.

DEC internal memorandum, dated April 13, 1993.

Hazardous Substance Waste Disposal Nomination Form, May 3, 1994.

<u>Results of the Soil and Groundwater Sampling at the Prospective Enviromelting Facility in Dunkirk, NY</u>. Groundwater Technology for the DEC, April 2, 1993.

Written correspondence submitted by facility and/or State on draft version of release descriptions, October 1996.

INTERNATIONAL PAPER COMPANY, TICONDEROGA MILL NEW YORK

Facility Overview

Facility Name:	International Paper Company, Ticonderoga Mill
Location:	Ticonderoga, New York
Waste Stream:	Paper mill sludge
Media Affected:	Groundwater

International Paper Company's (IPCo.) Ticonderoga Mill facility has two paper making machines which have the combined capacity to produce 840 tons per day of fine alkaline printing quality papers. Up to 700 tons of pulp per day is also produced. IPCo. operates a paper sludge landfill in the town of Ticonderoga, in Essex County, New York. The landfill is underlain in most areas by three distinct geologic units: a varved clay zone, a silty sand zone, and a bedrock formation. The silty sand zone is absent in localized areas on the western portion of the landfill. Groundwater in the three geologic zones generally flows to the east-northeast. The shallow groundwater also flo the southeast in the southeast region of the landfill. The facility is located one-half mile west of Lake Champlain.

Wastes and Waste Management Practices

In 1982, IPCo. filed a permit application to expand its landfill into areas located immediately north (33 acres) and south (27 acres) of the existing facility. A permit to construct both expansion areas was issued in August 1983, and to op the northern expansion in April 1984. The southern portion of the expansion has not been constructed, although the facil has recently notified the State of their intent to develop this section of the landfill. In March 1989, IPCo. submitted an application for renewal of their existing permit. Processing of this permit was suspended pending resolution of issues rela to groundwater contamination. IPCo. has continued to operate under the conditions of the 1984 permit in accordance wit Section 401.2 of the State Administrative Procedures Act. Presently, surface water runoff and leachate are collected arou the landfill perimeter and conveyed to a collection sump in the northeast landfill corner. Leachate is then pumped to the treatment plant. Material permitted for disposal in the landfill includes primary, secondary, and tertiary treatment sludge, a well as miscellaneous non-hazardous waste associated with operation of the facility.

Extent of Contamination

The table below identifies the constituents analyzed for and detected in the December 1992 groundwater samplin of the landfill and the highest detected level of each constituent in downgradient wells. Iron, magnesium, sodium, sulfate, TDS levels were found to be above New York or Federal standards.

GROUND WATER CONTAMINANTS EXCEEDING NEW YORK OR FEDERAL DRINKING WATER STANDARDS

Contaminant	Highest Detected Level (mg/l)	NY Class GA GW Standards (mg/l)	MCL (mg/l)	SMCL (mg/l)
Alkalinity	746	--	--	--
Chloride	47.7	250	--	250
Iron	20.4	0.3	--	0.3
Magnesium	1,495	35	--	--
pH	6.7	6.5-8.5	--	6.5-8.5
Sodium	282	20	--	--
Sulfate	5430	250	500	250
TDS	10,800	500	--	500
TOC	12.2	--	--	--

Corrective Actions/Regulatory Actions

In accordance with an Order on Consent with NYSDEC, a draft Remedial Action Plan has been submitted by the facility and is currently under review.

Sources of Information

Summary prepared by New York Department of Environmental Conservation, July 1996.

Environmental Monitoring Plan, May 1996, Rust Environment and Infrastructure, Inc.

Hydrogeologic Assessment of the International Paper Ticonderoga Mill Landfill, January 1994, Eder Associates.

New York Department of Environmental Conservation, Solid Waste Division files, July 1996.

Written correspondence submitted by facility and/or State on draft version of release descriptions, October 1996

INTERNATIONAL PAPER, HUDSON RIVER NEW YORK

Facility Name:	International Paper, Hudson River
Location:	Corinth, New York
Waste Stream:	Paper mill sludge
Media Affected:	Groundwater

Facility Overview

The International Paper, Hudson River facility is located in the town of Corinth, Saratoga County, New York. The facility is a paper mill.

Wastes and Waste Management Practices

International Paper owns and operates a solid waste landfill for the disposal of paper mill sludge produced by their paper manufacturing facility. Landfilling activities were initiated in the summer of 1995. Approximately 6,728 tons of paper mill sludge is disposed of in the landfill per year.

Extent of Contamination

The table below identifies the highest level of each constituent detected in downgradient wells. Aluminum, bariu iron, manganese, pH, and turbidity levels were found to be above New York or Federal standards.

GROUNDWATER CONTAMINANTS EXCEEDING NEW YORK OR FEDERAL DRINKING WATER STANDARDS

Contaminant	Highest Detected Level (mg/l)	NY Standard (mg/l)	MCL (mg/l)	SMCL (mg/l)
Alkalinity	445	--	--	--
Aluminum	3.3	0.1	--	0.05 to 0.2
Ammonia	0.09	2.0	--	--
Arsenic	0.002	0.025	0.05	--
Barium	0.034	0.001	2.0	--
Bromide	1.74	--	--	--
Cadmium	0.0034	0.01	0.005	--
Calcium	84.3	--	--	--
Chloride	19.2	250	--	250
Chromium	0.0039	0.05	0.1	--
Cobalt	0.0015	--	--	--
Copper	0.007	0.2	1.0*	1.0
Iron	2.64	0.3		0.3
Lead	0.0141	0.025	0.015*	--
Magnesium	25.2	35	--	--
Manganese	20.7	0.3	--	0.05
Nickel	0.0016	--	0.1	--
Nitrate-nitrite	3.2	10	10	--
pH	4.2-11.4	6.5-8.5	--	6.5-8.5
Phenols	0.00012	0.001	--	--
Potassium	2.8	--	--	--
Selenium	0.0076	0.01	0.05	--
Sodium	10.9	20	--	--
Sulfate	110	250	500	250
Turbidity	1050 NTU	5 NTU	--	--
TDS	328	500	--	500
Vanadium	0.0049	0.014	--	--
Zinc	0.109	0.3	--	5.0

*Action level

Corrective Actions/Regulatory Actions

Information was not readily available.

Sources of Information

Annual/Quarterly Report, 1995.

Sampling Data, 1995.

Written correspondence submitted by facility and/or State on draft version of release descriptions, October 1996

RED HOOK PAPER, INC. NEW YORK

Facility Overview

Facility Name: Red Hook Paper, Inc.

Location: Red Hook, New York

Waste Stream: Paper slurry

The Red Hook Paper, Inc., located in the town of Red Hook, Dutchess County, New York is engaged in the business of paper recycling.

Wastes and Waste Management Practices

Paper slurry, a byproduct of paper recycling, is discharged into a wastewater treatment plant comprised of seven lagoons in a series, a small, and a large pond. The smaller pond has a flow of about 5 gallons per minute, escaping through an earthen dam to a drainage ditch. This flow e a swampy area adjacent to a small stream exiting Spring Lakes. This treatment plant is required to monitor flow, BOD, suspended solids, settleable solids, pH, temperature, toluene, acetone, and zinc. Under normal operations, 300 gallons o process and cooling water are discharged per minute, 24 hours a day, producing a total daily flow of 432,000 gallons.

Extent of Contamination

On March 17, 1992, the New York State Department of Environmental Conservation (DEC) investigated a compla at Red Hook Paper. The investigator noted that a dead swan and dead fish were in the treatment lagoon. On April 15, 1 the Dutchess County Health Department conducted a site visit. The investigator noted that “Many dead fish were observe They appeared to have been dead for a long time.” The dead fish were located on the south side of the larger, propeller- shaped lake (indicated as the large pond on the permit). Dead fish were also observed in the very small pond on the sou side of Spring Lake Road. In these areas about one to three dead fish per square foot were observed and there appeare be a mild, musty, paper waste odor around the ponds.

On March 30, 1992, the DEC took a water sample from the treatment lagoon. The results indicated a level of toluene of 0.02 mg/l. Since the lagoons are not lined, DEC has assumed that the toluene has entered the groundwater. State health standard for toluene in groundwater is 0.005 mg/l. No groundwater sampling data were available.

Corrective Actions/Regulatory Actions

The settling lagoons have been dredged. Regular maintenance of the settling lagoons will prevent mats of sludg from collecting in the large pond. A hydrasieve was installed on March 9, 1994. The hydrasieve filters the wastewater th reducing the amount of waste paper fiber entering the lagoons. Efforts have been made to reclaim and recycle paper slu which has been stored on site in the past. Plans to install groundwater monitoring wells are underway.

Sources of Information

Memorandum to New York State Department of Environmental Conservation, “Case Report -- Red Hook Paper, Inc. Wastewater,” June 16, 1995.

Letter from New York State Department of Environmental Conservation to Red Hook Paper Inc., June 22, 1993.

Letter from Red Hook Paper to New York State Department of Environmental Conservation, May 11, 1993.
Letter from New York State Department of Environmental Conservation to Red Hook Paper Inc., July 29, 1992.

Letter from Red Hook Paper Inc. to New York State Department of Environmental Conservation, March 19, 1994.

Letter from Red Hook Paper Inc. to New York State Department of Environmental Conservation, April 4, 1995.

State Pollutant Discharge Elimination System Discharge Permit, April 1, 1993.

New York State Department of Environmental Conservation Complaint Investigation Report, March 24, 1992.

Letter from New York Department of Environmental Conservation to Red Hook Paper Inc., May 7, 1993.

New York State Department of Environmental Conservation Complaint Investigation Report, April 21, 1993.

Memorandum from Dutchess County Health Department to New York State Department of Environmental Conservation, 22, 1993.

Facility Overview

Facility Name: Sherwood Medical Company

Location: Argyle, New York

Waste Stream: Cooling water discharge for medical device manufacturing facility

Media Affected: Groundwater

Sherwood Medical Company owns and operates a PVC medical catheters and devices manufacturing facility located in the town of Argyle, Washington County, New York. The geology at the Sherwood Medical site consists of a thin layer of unconsolidated sand, gravel, silt, and weathered shale fragments which overly the interbedded shale and sandstone bedrock. Groundwater occurs within and its flow is controlled by fractures and joints in the shale/sandstone bedrock. Following an evaluation of the shallow and deep flow aquifers at the site, groundwater divides were identified by topographic ridges which separate surface water drainage basins. Shallow groundwater in the immediate vicinity of the facility appears to be discharged to nearby Hook Brook which crosses the site from east to west through the southwest corner of the property.

Wastes and Waste Management Practices

From 1986 until July 1989, Sherwood Medical discharged cooling water to two septic tanks and leach fields. The cooling water was used to solidify extruded catheters.

Extent of Contamination

Two new groundwater monitoring wells were installed in the downgradient direction from each leachfield. Sampl
were collected from each of these wells and from the three in-service plant water production wells. In addition, soil sampl
were collected at six locations and analyzed for the same parameters as the groundwater samples in order to determine whether any residual soil contamination may be affecting groundwater quality. Phenol levels in the groundwater were fou
be consistently above New York standards. Grease and oil contamination also was detected.

GROUNDWATER CONTAMINANTS EXCEEDING NEW YORK OR FEDERAL DRINKING WATER STANDARDS				
Contaminant	**Highest Detected Level (mg/l)**	**NY Standard (mg/l)**	**MCL (mg/l)**	**SMCL (mg/l)**
Grease and oil	3	--	--	--
Phenols	0.003	0.001	--	--

Corrective Actions/Regulatory Actions

The New York State Department of Environmental Conservation issued an Order on Consent requesting that discharge of industrial wastewater be ceased for any outfall or point source at the site and that a groundwater monitoring assessment be implemented to determine the impact, if any, on the local groundwater. Groundwater sampling was requi
quarterly for one year to identify any observable trends in groundwater quality. In addition to quarterly sampling, monthly
level readings were required in all four plant production wells and the two monitoring wells for one year during periods of regular operation. The daily volume of water also was required to be recorded to determine the effects of pumping on wat
flow directions in the vicinity of the Sherwood plant. A risk assessment for phenolic compounds was performed to study hypothetical groundwater use by area residents. The assessment concluded a low potential for adverse health effects du
phenolic compounds. No additional action was thus deemed warranted at this time.

Sources of Information

Executive Summary, Sherwood Medical Company, undated.

1990 Groundwater Sample Analysis, Sherwood Medical Company.

New York Department of Environmental Conservation, Solid Waste Division files, July 1996.

Written correspondence submitted by facility and/or State on draft version of release descriptions, October 1996

ALAMAC KNIT FABRICS, INC. — NORTH CAROLINA

Facility Name:	Alamac Knit Fabrics, Inc.
Location:	Hamilton, North Carolina
Waste Stream:	Processing sludge and wastewater
Media Affected:	Groundwater

Facility Overview

Alamac Knit Fabrics, Inc. is an apparel fabric manufacturing plant located in Hamilton, North Carolina, in Martin County. The approximate depth to groundwater is greater than 6 feet and the predominant soil texture is sand.

Wastes and Waste Management Practices

Sludge is land applied to a 38 acre area by spray irrigation. Management practices apply solids at agronomic rates, or less, while maintaining a cover crop capable of uptaking all of the plant available nitrogen (PAN), which includes nitrates. An annual report required by permit is prepare each year and tracks closely the PAN and metals loading. In addition, an independent certified soil scientist visits the site each year, collects soil samples, and provides his assessment of the operation. No waste is discharged to surface water.

Extent of Contamination

The table below identifies the constituents detected in groundwater sampling and the highest detected level of ea constituent in downgradient wells. Groundwater is monitored tri-annually at 6 wells, three upgradient and three downgrad Nitrate and total organic carbon were found to be above North Carolina or Federal standards.

GROUNDWATER CONTAMINANTS EXCEEDING NORTH CAROLINA OR FEDERAL DRINKING WATER STANDARDS

Contaminant	Highest Detected Level (mg/l)	NC Standard (mg/l)	MCL (mg/l)	SMCL (mg/l)
Cadmium	0.01	0.005	0.005	--
Nitrate	27.4	10	10	--
TOC	5.44	0	--	--

Alamac has not been able to identify the source of nitrates. Elevated cadmium and nitrate levels are found in an upgradient well which monitors groundwater moving onto the site.

Corrective Actions/Regulatory Actions

Information was not readily available.

Sources of Information

North Carolina Department of Environmental Management, Groundwater Section, Permits and Compliance Database Printout, August 18, 1995.

Written correspondence submitted by facility and/or State on draft version of release descriptions, October 1996

BALL-FOSTER GLASS CONTAINER CO., L.L.C. NORTH CAROLINA

Facility Overview

Ball-Foster Glass Container Co. is located in Henderson, North Carolina, in Vance County. The nearest surface water body is Martin Creek which is within 100 feet.

Facility Name:	Ball-Foster Glass Container Co.
Location:	Henderson, North Carolina
Waste Stream:	Process sludges
Media Affected:	Groundwater

Wastes and Waste Management Practices

Ball-Foster Glass Container Co. operated an industrial wastewater lagoon. According to the facility, wastewater containing vegetable oils and animal fats were discharged into the lagoon. North Carolina Department of Environmental Management suspects that the lagoon also received “direct discharges of hydraulic oils, and other petroleu oils from plant equipment maintenance operations” in the lagoon.

Extent of Contamination

The table below identifies the constituents detected in groundwater sampling and the highest detected level of ea constituent in downgradient wells. Groundwater is monitored semi-annually with a monitoring well network which include upgradient and seven downgradient wells. Benzene, oil and grease, and total petroleum hydrocarbons were found to be above North Carolina standards.

GROUNDWATER CONTAMINANTS EXCEEDING NORTH CAROLINA OR FEDERAL DRINKING WATER STANDARDS

Contaminant	Highest Detected Level (mg/l)	NC Standard (mg/l)	MCL (mg/l)	SMCL (mg/l)
Benzene	0.0059	0.001	0.005	--
Oil and grease	1,600	0	--	--
Total petroleum hydrocarbons	540	10	--	--

Corrective Actions/Regulatory Actions

The industrial lagoon was closed in 1994. Sludge and soil from the lagoon were stabilized with lime, excavated, a transported off-site to a sanitary landfill. The lagoon was back-filled with clean material, compacted, and seeded. The lag wastewater was treated with a portable treatment system and discharged to a publicly owned treatment works. Monitorin continue, but removal of the waste source is anticipated to enhance groundwater remediation. Remedial activities will continue during the fall of 1996.

Sources of Information

North Carolina Department of Environmental Management, Groundwater Section, Permits and Compliance Database Printout, August 18, 1995.

Corrective Action Plan, Former Lagoon Area, O’Brien & Gere Engineers, Inc., June 1995.

Written correspondence submitted by facility and/or State on draft version of release descriptions, October 1996

BORDEN CHEMICAL INC. NORTH CAROLINA

Facility Overview

Borden Chemical Inc. is located in Fayetteville, Cumberland County, North Carolina. The facility is situated on predominantly loamy sands. There are no drinking water wells within 1/4 mile of the Borden plant site. There are, however, drinking water wells adjacent to the land application farm sites. For this reason, their permit requires that biomass land application activities be kept at least 400 feet from these homes and their associated drinking water wells.

Facility Name:	Borden Chemical Inc.
Location:	Fayetteville, North Carolina
Waste Stream:	Biomass from biological treatment of thermoset resin wastewater

Wastes and Waste Management Practices

Borden Chemical operates a biological wastewater treatment facility which treats wastewater generated during thermorest resin manufacture. Approximately 79 dry tons/yr. of biomass from wastewater treatment is land applied on farmlands as a nutrient supplement. Biomass is land applied with sufficient buffer zones established to prevent runoff to surface water.

Extent of Contamination

The sludge analysis indicates the presence of several compounds of concern: formaldehyde, several halogenate organics, phenols, and toluene. The concentrations of these compounds do not preclude land application, but the North Carolina Department of Environmental Management issued the permit with contingencies requiring groundwater monitori for related contaminants. Groundwater is monitored tri-annually at 6 wells. The table below identifies the constituents detected in groundwater sampling and the highest detected level of each constituent in downgradient wells. Ammonia-nitrogen, arsenic, chromium, formaldehyde (methanol), lead, nitrate, and total organic carbon were found to be above No Carolina or Federal standards.

GROUNDWATER CONTAMINANTS EXCEEDING NORTH CAROLINA OR FEDERAL DRINKING WATER STANDARDS

Contaminant	Highest Detected Level (mg/l)	NC Standard (mg/l)	MCL (mg/l)	SMCL (mg/l)
Ammonia-nitrogen	0.05	0	--	--
Arsenic	0.012	0	0.05	--
Chromium	0.11	0.05	0.1	--
Formaldehyde (Methanol)	0.25	0	--	--
Lead	0.27	0.015	0.015*	--
Nitrate	10.4	10	10	--
TOC	9.9	0	--	--

*Action level

Arsenic, chromium, formaldehyde (methanol), lead, and TOC were determined to be inherent in the soil and artificially elevated by the well purging and sampling procedure which captured high amounts of sediment in the sample. the sampling procedure was changed to allow the sediment to settle, the contaminant values dropped below detectable li The ammonia-nitrogen value is a single result from a single sampling event. All other samples were non detectable, suggesting a temporary aberration or sample contamination. The nitrate value, however, is not inconsistent with subsequ sampling events. However, it must be noted that biomass is land applied on each field once every one to two years. Oth sources of nitrogen (and trace contaminants) are also land applied by the farmer. These include commercial fertilizers ar residuals from clean-out of turkey houses. It should also be noted that septic tanks are contributing to the contaminate le of the wells since coliform bacteria are detected.

Corrective Actions/Regulatory Actions

None pending.

Sources of Information

North Carolina Department of Environmental Management, Groundwater Section, Permits and Compliance Database Printout, August 18, 1995.

Written correspondence submitted by facility and/or State on draft version of release descriptions, October 1996.

Facility Overview

Carolina Turkeys, a turkey processing facility, is located in Duplin County, North Carolina. The nearest surface water body to our location for monitoring procedures is an estuary which feeds the Northeast Cape Fear River and is located approximately 1500 - 2000 feet in distance away. The surficial aquifer is predominantly sands with medium to high infiltration capacities.

Facility Name:	Carolina Turkeys
Location:	Duplin County, North Carolina
Waste Stream:	Turkey processing and rendering waste
Media Affected:	Groundwater

Wastes and Waste Management Practices

Carolina Turkeys has two waste water lagoons, one aerated 15 million gallon lagoon and one 41 million gallon holding lagoon. The water which is treated and aerated in the smaller lagoon feeds the larger holding lagoon until ready t applied to the permitted spray fields. Primary and secondary screened effluent comes to a 1-million gallon flow equalizati tank. Through dissolved air flotation units, oil and grease is then removed. This treated wastewater is then sent to the 15 million gallon aerated lagoon. The waste from these lagoons is then applied to approximately 560 (440 for water spray ar 120 for sludge) acres of permitted spray irrigation disposal fields.

Extent of Contamination

The table below identifies the constituents detected in groundwater sampling and the highest detected level of ea constituent in downgradient wells. There are currently 15 monitoring wells, 8 of which are sampled on a quarterly basis. Nitrate and oil and grease were found to be above North Carolina or Federal standards.

GROUNDWATER CONTAMINANTS EXCEEDING NORTH CAROLINA OR FEDERAL DRINKING WATER STANDARDS

Contaminant	Highest Detected Level (mg/l)	NC Standard (mg/l)	MCL (mg/l)	SMCL (mg/l)
Copper	0.230	1	1.3*	1
Nitrate	14.2	10	10	--
Nitrite	<0.1	1	1	--
Oil and grease	1.1	0	--	--

*Action level

Corrective Actions/Regulatory Actions

Information was not readily available.

Sources of Information

North Carolina Department of Environmental Management, Groundwater Section, Permits and Compliance Database Printout, August 18, 1995.

Written correspondence submitted by facility and/or State on draft version of release descriptions, October 1996.

Facility Overview

Frit Car and Equipment Company is located in Bridgeton, North Carolina in Craven County.

Facility Name: Frit Car and Equipment Company

Location: Bridgeton, North Carolina

Waste Stream: Process washwater

Media Affected: Groundwater

Wastes and Waste Management Practices

Frit Car and Equipment Company has two sludge drying beds, a 45,000 gallon aerated storage tank, and a 1.5 acre sprayfield. No wastes are discharged to surface water.

Extent of Contamination

The table below identifies the constituents detected in groundwater sampling and the highest detected level of ea constituent in downgradient wells. Groundwater is monitored tri-annually at four wells. Ammonia, chromium, phenol, phosphorous, and total organic carbon were found to be above North Carolina or Federal standards.

GROUNDWATER CONTAMINANTS EXCEEDING NORTH CAROLINA OR FEDERAL DRINKING WATER STANDARDS

Contaminant	Highest Detected Level (mg/l)	NC Standard (mg/l)	MCL (mg/l)	SMCL (mg/l)
Ammonia-nitrogen	0.5	0	--	--
Chromium	1.19	0.05	0.1	--
Phenol	0.018	0	--	--
Phosphorous (total)	2.4	0	--	--
TOC	43.6	0	--	--

Corrective Actions/Regulatory Actions

Information was not readily available.

Sources of Information

North Carolina Department of Environmental Management, Groundwater Section, Permits and Compliance Database Printout, August 18, 1995.

Written correspondence submitted by facility and/or State on draft version of release descriptions, October 1996.

Facility Overview

Hoechst Celanese Corporation (HCC), a chemical manufacturer, owns the closed Needmore Road Landfill in Salisbury, North Carolina, in Rowan County. The nearest surface water body is the South Yadkin River and the depth to groundwater ranges from 5 feet to 40 feet below land surface.

Facility Name:	Hoechst Celanese Corporation
Location:	Salisbury, North Carolina
Waste Stream:	Chemical process waste
Media Affected:	Groundwater

Wastes and Waste Management Practices

Hoechst Celanese Corporation's Needmore Road Landfill received waste from 1966 until 1990 when the Corporation began to send its wastes off-site to a commercial facil

Extent of Contamination

The table below identifies the constituents analyzed for and detected in groundwater sampling and the highest detected level of each constituent in downgradient wells. The groundwater has been monitored since 1980. There are 6 monitoring wells and 27 groundwater extraction wells on the site. Many of the following contaminants listed below were f to exceed North Carolina or Federal standards.

GROUNDWATER CONTAMINANTS EXCEEDING NORTH CAROLINA OR FEDERAL DRINKING WATER STANDARDS

Contaminant	Highest Detected Level (mg/l)	NC Standard (mg/l)	MCL (mg/l)	SMCL (mg/l)
1,1-Biphenyl	0.2	0	--	--
1,1-Dichloroethane	0.54	0.7	--	--
1,1-Dichloroethylene	0.296	0.007	0.007	--
1,1,1-Trichloroethane	0.056	0.2	0.2	--
1,1,2,2-Tetrachloroethane	0.001	0	--	--
1,2-Dichlorobenzene	0.002	0	--	--
1,2-Dichloroethene	0.046	0	--	--
1,4-Dioxane	45	0.007	--	--
2,4-Dimethylphenol	0.731	0	--	--
2-Butanone	1.57	0.17	--	--
2-Methylphenol	0.15	0	--	--
4-Methyl-2-pentanone	0.056	0	--	--
4-Methylphenol	0.434	0	--	--
Acetone	10.6	0.7	--	--
Barium	2.55	1	2	--
Benzene	0.006	0.001	0.005	--
Benzoic acid	11.3	0	--	--
Benzyl alcohol	1.204	0	--	--
Biochemical oxygen demand	13,400	0	--	--
Biphenyl ether	10	0	--	--
Bis(2-ethylhexyl)phthalate	2.608	0.003	--	--
Cadmium	0.0125	0.005	0.005	--
Chemical oxygen demand	15,500	0	--	--
Chloride	118	250	--	250
Chlorobenzene	0.042	0.05	--	--
Chloroethane	0.023	0	--	--
Chromium	0.062	0	0.1	--
Copper	0.772	1	1.3	1

Contaminant	Highest Detected Level (mg/l)	NC Standard (mg/l)	MCL (mg/l)	SMCL (mg/l)
Di-n-butylphthalate	1.16	0.7	--	--
Diethylphthalate	0.388	5.0	--	--
Ethylene glycol	3700	7.0	--	--
Fluoride	0.4	2	4	2
Iron	333	0.3	--	0.3
Lead	3.21	0	0.015	--
Manganese	96.8	0.05	--	0.05
Methylene chloride	0.068	0.005	0.005	--
Nitrate	4.36	10	10	--
pH	5.6	6.5-8.5	--	6.5-8.5
Phenol	15.8	0.3	--	--
Specific conductance (umhos/cm)	2,990	--	--	--
Sulfate	88	250	500	250
Toluene	0.038	1.0	1.0	--
Total dissolved solids	7,040	1,000	--	500
TOC	5,500	0	--	--
TOX	2.5	0	--	--
Trichloroethene	0.14	0.0028	0.005	--
Zinc	262	5	--	5

Corrective Actions/Regulatory Actions

Hoechst Celanese Corporation has completed the Phase VI investigation to evaluate the nature and extent of groundwater degradation, and is currently implementing corrective measures to contain and treat affected groundwater. UV/peroxide system is operating at the site to remove 1,4-dioxane from extracted groundwater, and an additional biologic treatment system will be installed to treat high-COD effluent streams from source area wells. In addition, the facility completed the installation of a RCRA-type composite cap over each of the fill areas during the first quarter of 1996.

Sources of Information

North Carolina Department of Environmental Management, Solid Waste Division, files, undated.

Written correspondence submitted by facility and/or State on draft version of release descriptions, October 1996

Facility Overview

Appleton Papers Inc. operates an integrated fine paper mill at its Spring Mill in Roaring Spring, Blair Co., Pennsylvania. They manufacture coated paper for conversion into NCR Paper brand of carbonless paper, utilizing the Kraft pulping process. The nearest surface water body is Halter Creek.

Facility Name:	Appleton Papers Inc.
Location:	Roaring Springs, Pennsylvania
Waste Stream:	Paper mill manufacturing wastewater
Media Affected:	Groundwater

Wastes and Waste Management Practices

Waste products of bark and wood fines from wood operations are burned in a power boiler. Wash-up water, overflows at the recausticizing plant, bleach plant materials, an stock and coating preparations are processed through the waste treatment plant. Power boilers burn coal and natural ga some of these wastes are processed through the waste treatment plant. The waste treatment plant treats all of the mill's waste streams by primary sedimentation and secondary activated sludge. Liquid waste streams include bleach plant filtra and washes, as well as washes from the boiler house machine room, and No. 2 paper machine coater. Solid waste mate include green liquor dregs and slake grit which are impurities from chemical recovery. These, as well as washed and dewatered lime sludge and dust, are disposed of in an on-site landfill. Residual wastes generated at the mill are dispose in a lined surface impoundment, the No. 1 Lagoon, which has a State solid waste permit.

Extent of Contamination

Groundwater has been contaminated at the site of the No. 1 Lagoon because the lagoon is leaking. Monitoring w conducted with upgradient and downgradient wells. Results of the monitoring show excess levels of chlorides and sulfate

GROUNDWATER CONTAMINANTS COMPARED TO FEDERAL DRINKING WATER STANDARDS

Contaminant	Highest Detected Level (mg/l)	MCL (mg/l)	SMCL (mg/l)
TDS	1,933	--	500
Sulfate	595	--	500-250
Chloride	630	--	250

Corrective Actions/Regulatory Actions

In February 1987, the Department of Environmental Resources in Pennsylvania modified Appleton's solid waste permit covering the No. 1 Lagoon. Condition 3 of the permit modification stated that the company must submit a Phase II application for a new site due to groundwater contamination at the existing site. In response to the permit modification, Appleton filed an appeal to the Environmental Hearing Board (EHB Docket No. 87-085-W). The Department informed Appleton that continued use of the No. 1 Lagoon was unacceptable, so the company filed another appeal (EHB Docket N 88-074-W). The appeals were solved in March 1990 when the Department removed the permit condition. No additional information on the remediation of the contaminated groundwater was available.

Sources of Information

Proposal to Appleton Papers, Inc. from the Harrisburg Regional Office of the Department of Environmental Resources, October 1987.

Appleton Papers, Inc. PPC Plan, undated.

Consent Adjudication between the Commonwealth of Pennsylvania, Department of Environmental Resources, and Apple Papers, Inc. March 1990.

Facility Overview

Facility Name:	Allied-Signal, Inc.
Location:	Cleveland, Tennessee
Waste Stream:	Manufacturing scrap and pelletized waste
Media Affected:	Groundwater

Since 1964, automotive brake friction materials have been manufactured at Allied-Signal Inc.'s Friction Materials Division in Cleveland, Tennessee. This 285,000 square foot plant facility, situated on 22 acres, employs approximately 550 personnel. The facility uses a permitted 24-acre landfill near the plant operation for disposal of process wastes from the facility. This landfill has been operated by Allied-Signal and the former Bendix Corporation since 1964. The landfill is divided into four phases. Phase I, consisting of 1.3 acres, was constructed in 1964 and closed in 1981. Phases II and III, consisting of 4.1 acres, were constructed in 1980 and closed in 1994. Phase IV, consisting of acres, was constructed in August, 1993 and is currently in use. As noted, the only portion of this landfill currently in use is Phase IV 4 acre portion. In August , 1992 the facility was permitted to construct this final 4-acre phase of the active landf according to the sub-title D requirements for a leachate collection system and waste area liner system, which consists of t feet of recompacted clay to meet the rule design specifications. In August of 1993, construction of the first section (IV-A) completed. In April of 1994 a variance from the rule requirements to upgrade class II landfills from clay liners to composit fabric and clay liners was received for the unconstructed IV-B section due to the need for design compatibility with the IV- section. The construction of the final section, IV-B, is scheduled for 1997. The remaining life of this landfill is approximat 10 years at present fill rates. The landfill is characterized by bedrock-controlled, northeast to southeast trending ridges ar valleys.

Wastes and Waste Management Practices

Approximately 7,000 tons of manufacturing scrap and pelletized waste are disposed of annually at the landfill. Sc waste includes friction materials, dust from process operations, floor sweepings, off-specification batches, and reject proc Dust collected from process operations are pelletized with a mixture of cement and water prior to disposal at the landfill. Generally, pelletized friction material wastes and baghouse dust collector contents comprise 80% of the waste stream an reject materials and floor sweepings make up the remaining 20%.

The landfill consists of a trench fill operation in which each trench is filled with individual cells of waste that are covered with soil. Phases II and III are being filled in five foot lifts that consist of four feet of waste and one foot of intermediate earthen cover. Both the waste and cover are compacted prior to the placement of additional waste. The wa covered each day following filling activities to minimize erosion and airborne transport of the waste. Grading of the waste performed after placement to enhance surface water runoff and to prevent ponding. The landfill was permitted in 1983, p to the promulgation of the Tennessee Solid Waste Processing and Disposal Amendments of 1990 and therefore, the land not equipped with a subterranean leachate collection system. The portions of the landfill that were in use during the 1991 time period have been capped and closed. A new state-of-the-art landfill has been installed that contains both a leachate collection system and waste area liner system which complies with the federal standards for the management and siting land-based units set forth at 40 CFR Part 257. The leachate is collected and discharged to the local Cleveland POTW.

Extent of Contamination

Nine groundwater wells are monitored quarterly. Five piezometers characterize groundwater flow. High concentrations of BEHP, total dissolved solids, and total phenols have been detected in the groundwater samples. Healt may be present when phenolic compound concentrations are above 21.0 mg/l for adults and 9.6 mg/l for children. The ta below identifies the constituents analyzed and detected in the 1990-1991 groundwater sampling (the only years for which were readily available) and the highest detected level of each constituent in downgradient wells.

GROUNDWATER CONTAMINANTS COMPARED TO TENNESSEE OR FEDERAL DRINKING WATER STANDARDS

Contaminant	Highest Detected Level (mg/l)	TN Standard (mg/l)	MCL (mg/l)	SMCL (mg/l)	U.S. EPA Health-Based Criteria

					(mg/l)
Barium	<0.05	2.0	2.0	--	--
BEHP	0.039	--	--	--	0.0042
Chloride	31	--	--	250	--
Hardness	150	--	--	--	--
Nitrogen, nitrate	1.8	10	10	--	--
pH	3.9-10.6	6.0-9.0	--	6.5-8.5	--
Phenols	22.0	--	--	--	21.0
Specific conduct-ance (umhos/cm)	305	--	--	--	--
TDS	29,000	500	--	500	--
TOC	130	--	--	--	--
Turbidity	41,500 NTU	--	--	--	--

Some of the reported data may be from a monitoring well suspected to be improperly installed. However, the fac continues to sample that well and monitoring data is provided to the State of Tennessee.

Since September of 1993, solid waste from the plant facility has been disposed of in Phase IV-A of the landfill. Since the new landfill was placed into use and Phases II and III were capped and closed, levels of phenol and BEHP hav continued to steadily decline

Corrective Actions/Regulatory Actions

Phases II and III were capped and closed in 1994. Phase IV-A, a new state-of-the-art landfill, with a leachate collection and liner system has been in operation since September if 1993. The leachate from this phase of the landfill is collected and discharged to the local Cleveland POTW. In 1994, three additional monitoring wells were constructed due the expansion of the active waste area into Phase IV-A. Presently, twelve groundwater monitoring wells and four piezom wells are located at the landfill. These wells are currently sampled semi-annually in compliance with Tennessee Solid Wa regulations and analyzed for selected volatile and semi-volatile organic compounds, and for applicable inorganics. Analy results are submitted to the State of Tennessee following each monitoring event.

Sources of Information

RMT Laboratories Report, Allied Signal, INC./ Bendix, April 1991.

RMT Laboratories Report, Allied Signal, INC./ Bendix, July 1991.

RMT Laboratories Report, Allied Signal, INC./ Bendix, June 1992.

Written correspondence submitted by facility and/or State on draft version of release descriptions, October 1996

CYTEC INDUSTRIES INC. TENNESSEE

Facility Overview

Facility Name:	Cytec Industries Inc.
Location:	Chattanooga, Tennessee
Waste Stream:	Processed silica
Media Affected:	Groundwater

Cytec Industries Inc. (Cytec) is a vertically integrated, specialty chemicals company that serves a wide range of industries. Cytec manufactures liquid alum, which is an aqueous solution of hydrated aluminum sulfate. It is used primarily in paper making and as a precipitating agent in sewage treatment and water purification. The facility owner is Cytec Industries Inc. The Tennessee River runs adjacent to the western facility boundary. Although this area is termed floodplain, it is at an elevation of 660 feet which is above the 100-year flood level of 653.7 feet. Local groundwater moves towards the Tennessee River. There are no potable wells downgradient of the site prior to the Tenne River. The nearest potable well is reported to be over two miles from the site.

Wastes and Waste Management Practices

Cytec Industries Inc. operates a 10 acre permitted class II disposal facility. Processed silica is the byproduct of liquid alum manufacturing process. Processed silica slurry is pumped from the manufacturing process to one of two perm sand bed filters. While one sand bed is being filled, the other sand bed provides final dewatering and drying so that the processed silica can be excavated from the sand bed and transported to the landfill located on the same property. The processed silica is then placed, spread, compacted, graded, covered and stabilized. Water, including rainwater, is reclai from both sand bed filters continuously and is returned to the manufacturing process. Each sand bed has 4,000 cubic ya of capacity and is normally cleaned out once every six to eight months at the design rate of 15,000 cubic yards per year. landfill was constructed over a former processed silica impound and is now characterized by 12 feet of processed silica underlain by silty, sandy clay.

Extent of Contamination

The table below identifies the constituents analyzed in 1995 sampling and the highest detected level of each constituent in downgradient wells. Aluminum, lead, pH, and sulfate all exceeded regulatory groundwater standards. Groundwater sampling occurs quarterly.

GROUNDWATER CONTAMINANTS COMPARED TO TENNESSEE OR FEDERAL DRINKING WATER STANDARDS

Contaminant	Highest Detected Level (mg/l)	TN Standard (mg/l)	MCL (mg/l)	SMCL (mg/l)
Aluminum	0.75	--	--	0.05-0.2
Arsenic	0.012	0.05	0.05	--
Chromium	0.039	0.1	0.1	--
Lead	0.043	0.05	0.015*	--
pH	4.1	6.0-9.0	--	6.5-8.5
Sulfate	4000	--	500	250
TDS	396	500	--	500

*Action level

Corrective Actions/Regulatory Actions

Information was not readily available.

Sources of Information

American Cyanamid Company Operation Manual, undated.

Final Hydrogeologic Evaluation, Tennessee Department of Public Health, Office of Solid Waste Management, undated.

Application for State Operation Permit, Department of Environment and Conservation, Division of Water Pollution Control
1995.

Davies Engineering Company, Inc. Sampling Data. 1995.

Closure Plan for American Cyanamid Company, undated.

Public Notice of proposed alum mud disposal site, undated.

Written correspondence submitted by facility and/or State on draft version of release descriptions, October 1996

ASSOCIATED COMMODITIES CORPORATION TENNESSEE

Facility Overview

Associated Commodities Corporation's facility in Maury, Tennessee, processes aluminum smelting drosses/residues. The regional topography is typified by rolling hills which extend down to the flood plain of the Duck River. The rate of slope of the ground surface varies from virtually flat-lying to 25% with the average slope estimated to be 5%. The slope of the ground surface within the development is generally flat with surface water runoff flowing to the northwest and southeast. The property is crossed by five principal and several secondary eroded valleys.

Facility Name:	Associated Commodities Corp.
Location:	Maury, Tennessee
Waste Stream:	Aluminum slag and salt compound
Media Affected:	Groundwater

Wastes and Waste Management Practices

The 732 acre Associated Commodities landfill is situated along a ridge top, at an approximate average elevation 980 feet. Five active surface streams are present. The landfill accepted aluminum slag and salt compound. The landfill stopped receiving waste in September of 1993. Landfill closure was completed in 1994. Wastes are presently shipped o site.

Extent of Contamination

The table below identifies the constituents analyzed in 1995 groundwater sampling and the highest detected leve each constituent in downgradient wells. Iron, nickel, and TDS all were found to exceed Tennessee or Federal standards. Groundwater sampling occurs quarterly.

GROUNDWATER CONTAMINANTS EXCEEDING TENNESSEE OR FEDERAL DRINKING WATER STANDARDS

Contaminant	Highest Detected Level (mg/l)	TN Standard (mg/l)	MCL (mg/l)	SMCL (mg/l)
Aluminum	7.6	--	--	0.05-0.2
Antimony	<0.005	0.006	--	--
Arsenic	0.003	0.05	0.05	--
Barium	1.7	2.0	2.0	--
Beryllium	0.0006	0.004	0.004	--
Cadmium	0.0032	0.005	0.005	--
Chromium	0.006	0.1	0.1	--
Cobalt	0.15	--	--	--
Copper	0.12	--	1.3*	1.0
Iron	9.9	--	--	0.3
Lead	0.007	0.05	0.015*	--
Magnesium	153	--	--	--
Mercury	<0.0002	0.002	0.002	--
Nickel	0.18	0.1	0.1	--
Selenium	<0.01	0.05	0.05	--
Silver	<0.001	0.01	--	0.1
Sodium	5040	--	--	--
Thallium	<0.005	0.002	0.002	--
Vanadium	0.012	--	--	--
Zinc	0.06	--	--	5.0
Chloride	10	--	--	250

Contaminant	Highest Detected Level (mg/l)	TN Standard (mg/l)	MCL (mg/l)	SMCL (mg/l)
Specific conductance (umhos/cm)	908	--	--	--
Fluoride	0.13	4.0	4.0	2.0
Nitrogen	<0.1	--	--	--
TDS	595	500	--	500
Turbidity	47.3 NTU	--	--	--
Ethylene dibromide	<0.0002	0.00005	0.00005	--
pH	6.2	6.0-9.0	--	6.5-8.5

*Action level

Corrective Actions/Regulatory Actions

Closure activities included placement of a compacted clay cap over the fill area, construction of the cap of the for fill area, grading activities in the area downgradient of the fill area, seeding of grass of the landfill, and quarterly groundwa sampling.

Sources of Information

Memorandum from Tennessee Department of Environment and Conservation, September 12, 1994.

Letter from Resource Consultants Inc. to Tennessee Department of Environment and Conservation, August 19, 1994.

Letter from Associated Commodities Corp. Tennessee Department of Environment and Conservation, January 12, 1994

Subsurface Investigation for Proposed Recyclable Slag Storage Facility, Resource Consultants Inc., undated.

Corrective Action Activities, Resource Consultants, Inc., February 1993.

1995 Groundwater Sampling Data, Resource Consultants, Inc.

Personal communication with the Tennessee Department of Environment and Conservation, August 1996.

HOLSTON ARMY AMMUNITION PLANT TENNESSEE

Facility Overview

Facility Name:	Holston Army Ammunition Plant
Location:	Kingsport, Tennessee
Waste Stream:	Mixture of ammunition processing wastes
Media Affected:	Groundwater

Holston Army Ammunition Plant (HAAP) was constructed in 1942 to manufacture the high explosive RDX and formulations based on RDX. Holston AAP currently manufactures RDX and HMX (another high explosive) and formulations based on these two explosives. Holston AAP is located near Kingsport, in northeast Tennessee. The facility is underlain by two major rock units, the Mascot Dolomite and the Sevier Shale. The Mascot formation is highly fractured and jointed, and contains many solution channels. These solution channels often develop vertically and form sinkholes. Groundwater is found in the abundant fractures of the Sevier Shale. However, deeper fractures are usually se by calcium carbonate, and significant quantities of groundwater are generally not found below 300 feet. The facility is bis by the Holston Rivr, which flows generally from northeast to southwest. Holston AAP operates an Active Sanitary Landfil a Tar Pit.

Wastes and Waste Management Practices

The wastes disposed of at HAAP consist of a mixture of materials from the manufacture of explosives (ammunitic used by the Army. The Active Sanitary Landfill has seven associated sampling wells. The Tar Pit has four associated sampling wells.

Extent of Contamination

Manganese was found to be above Federal standards in third quarter 1995 sampling results for the active sanitar landfill. Groundwater sampling occurs quarterly.

Active Sanitary Landfill

GROUNDWATER CONTAMINANTS EXCEEDING TENNESSEE OR FEDERAL DRINKING WATER STANDARDS

Contaminant	Highest Detected Level (mg/l)	TN Standard (mg/l)	MCL (mg/l)	SMCL (mg/l)
Manganese	0.160	--	--	0.05

Manganese concentrations are naturally high in native soils in northeast Tennessee.

The table below identifies the constituents analyzed for in the third quarter 1995 sampling and the highest detecte level of each constituent in downgradient wells for the tar pit. The pH was found to be above Tennessee or Federal standards. Groundwater sampling occurs quarterly.

Tar Pit

**GROUNDWATER CONTAMINANTS EXCEEDING
TENNESSEE OR FEDERAL DRINKING WATER STANDARDS**

Contaminant	Highest Detected Level (mg/l)	TN Standard (mg/l)	MCL (mg/l)	SMCL (mg/l)
COD	20	--	--	--
pH	9.8	6.0-9.0	--	6.5-8.5
Phenol	0.78	--	--	--
TDS	378	500	--	500

Corrective Actions/Regulatory Actions

The tar pit consists of two Solid Waste Management Units, SWMUs 14 and 15. A RCRA Facility Investigation (R has been performed on the two SWMUs. A removal action has been funded for SWMU 15, and a Corrective Measure St has been funded for SWMU 14. Both actions are expected to be performed in 1997. The Sanitary Landfill will be closed late 1996/early 1997.

Sources of Information

Groundwater Data and Summary, Third Quarter, 1995.

Written correspondence submitted by facility and/or State on draft version of release descriptions, October 1996

MONSANTO CHEMICAL COMPANY TENNESSEE

Facility Overview

Facility Name: Monsanto Chemical Company
Location: Columbia, Tennessee
Waste Stream: Variety of solid industrial wastes
Media Affected: Groundwater

The Monsanto Chemical Company's Columbia Tennessee plant processed phosphate ore to extract elemental phosphorous for sale to customers and for use in other Monsanto operations external to the Columbia plant. The manufacturing facility operated almost 50 years prior to its shutdown in October 1986. Subsequently, elemental phosphorous produced at a sister plant was received in railroad tank cars, unloaded and repackaged into 55-gallon drums for sale. A local vendor crushed, sized, and shipped previously stockpiled furnace slag for sale. No solid waste streams were generated from the phosphorous repackaging or slag processing operations. In December 1995, the elem phosphorous repackaging operation was permanently shut down and the repackaging facility dismantled. Three addition plant facilities remain operational. They were installed in 1986/87 in preparation for plant closure and include a phosphor recovery distillation still, a phosphorous contaminated water treatment plant, and an on-site landfill.

Wastes and Waste Management Practices

The plant presently operates a solid industrial waste landfill. The wastes currently being accepted by the landfill a

- Phosphorus contaminated equipment components;
- Office waste;
- Building demolition waste;
- Industrial demolition waste from process equipment operation and equipment repair; including scrap metal, rubber, plastic, glass, paper, and cardboard that may contain trace amounts of elemental phosphorus but are non-RCRA hazardous wastes;
- Scrap metal, rubber, plastic, glass, paper, and cardboard from the on-site plant vehicle repair shop; and
- Scrap shipping materials including wooden pallets, cardboard, plastic, and metal strapping.

Extent of Contamination

The table below identifies all of the constituents analyzed in the 1994-1995 groundwater sampling of the landfill a and the highest detected level of each constituent in downgradient wells. Lead was found to be above State standards.

GROUNDWATER CONTAMINANTS EXCEEDING TENNESSEE OR FEDERAL DRINKING WATER STANDARDS

Contaminant	Highest Detected Level (mg/l)	TN Standard (mg/l)	MCL (mg/l)	SMCL (mg/l)
Acetone	<0.02	--	--	--
Acrylonitrile	<0.02	--	--	--
Antimony	<0.005	0.006	0.006	--
Arsenic	<0.05	0.05	0.05	--
Barium	<0.1	2.0	2.0	--
Benzene	<0.005	0.005	0.005	--
Beryllium	<0.001	0.004	0.004	--
Bromochloromethane	<0.005	--	--	--
Bromodichloromethane	<0.005	--	--	--
Bromoform	<0.005	--	0.1	--
Cadmium	<0.005	0.005	0.005	--
Carbon disulfide	<0.005	--	--	--
Carbon tetrachloride	<0.005	--	0.005	--

Contaminant	Highest Detected Level (mg/l)	TN Standard (mg/l)	MCL (mg/l)	SMCL (mg/l)
Chromium	<0.01	0.1	0.1	--
Cobalt	<0.05	--	--	--
Copper	<0.01	--	1.3*	1.0
Fluoride	0.36	4.0	4.0	2.0
Lead	0.014	0.05	0.015*	--
Mercury	<0.0002	0.002	0.002	--
Nickel	0.01	0.1	0.1	--
Selenium	<0.01	0.05	0.05	--
Silver	<0.01	0.01	0.01	0.1
Thallium	<0.01	0.002	0.002	--
Vanadium	0.017	--	--	--
Zinc	0.07	--	--	5

*Action levels

Corrective Actions/Regulatory Actions

Information was not readily available.

Sources of Information

Letter from Monsanto Chemical Company to Division of Solid Waste Management, Tennessee Department of Environme and Conservation, September 20, 1994.

Letter from Tennessee Department of Environment and Conservation to Monsanto Chemical Company, October 18, 199

Groundwater Monitoring Analysis for Monsanto Chemical Company, 1994-1995.

Written correspondence submitted by facility and/or State on draft version of release descriptions, October 1996

Facility Overview

Facility Name:	Occidental Chemical Corp.
Location:	Columbia, Tennessee
Waste Stream:	Solid waste from phosphate production

The Occidental Chemical Corporation is presently using an area known as the Gaskill Farm for the disposal of solid non-hazardous waste generated at the Columbia facility. Phosphates are produced at the facility.

Wastes and Waste Management Practices

The existing landfill covers approximately 19 acres in the northwest quadrant of the 724 acre plant site. Of the 19 acres, 15 are currently inactive. The landfill is used for the disposal of industrial waste. A current waste profile include coke fines, scrap metal and wood, empty crushed drums, and sludge from emission control scrubbers. No hazardous wa is disposed of in the landfill. The landfill operates 5 days per week, 12 months a year. As scrubber sludge and coke fines compose the largest portion of the waste, they are brought to the landfill three to four days per week. Sludge is deposited dump truck into the diked cell area. Nodule and slag fines are then used as cover as the cells are completed during the weekly operation.

Extent of Contamination

The table below identifies the constituents analyzed in 1994 groundwater sampling and the highest detected leve each constituent in downgradient wells. Benzene was found to be above Tennessee or Federal standards. Groundwater sampling occurs quarterly.

GROUNDWATER CONTAMINANTS EXCEEDING TENNESSEE OR FEDERAL DRINKING WATER STANDARDS

Contaminant	Highest Detected Level (mg/l)	TN Standard (mg/l)	MCL (mg/l)	SMCL (mg/l)
2-Butanone	0.370	--	--	--
2-Hexanone	0.028	--	--	--
Acetone	1.300	--	--	--
Antimony	0.00018	0.006	0.006	--
Arsenic	0.000003	0.05	0.05	--
Barium	0.000091	2.0	2.0	--
Benzene	0.009	0.005	0.005	--
Cadmium	0.0000012	0.005	0.005	--
Carbon disulfide	0.023	--	--	--
Chloride	0.200	--	--	250
Chromium	0.00003	0.1	0.1	--
Copper	0.000086	--	1.3*	1.0
Ethylbenzene	0.002	0.7	0.7	--
Fluoride	0.0034	4.0	4.0	2.0
Iron	0.0256	--	--	0.3
Lead	0.000674	0.05	0.015*	--
Manganese	0.0011	--	--	0.05
Nickel	0.00002	0.1	0.1	--
Nitrate	0.0023	10	10	--
Specific conductivity (umhos/cm)	3.560	--	--	--
TOC	0.032	--	--	--
Toluene	0.008	1.0	1.0	--
Vanadium	0.00001	--	--	--

Contaminant	Highest Detected Level (mg/l)	TN Standard (mg/l)	MCL (mg/l)	SMCL (mg/l)
Zinc	0.00008	0.001	--	5.0

*Action levels

Some of the reported data may be from a monitoring well initially installed at the request of the Tennessee Solid Waste division to be a downgradient test well, but was later determined to not be downgradient of the landfill. Monitoring this well did continue however.

Corrective Actions/Regulatory Actions

Information was not readily available.

Sources of Information

Occidental Chemical Corp., 1994 Groundwater Sampling Results, undated.

Consulting Engineers, Inc., Description of Operation, undated.

Personal communication with the Tennessee Department of Environment and Conservation, August 1996.

Written correspondence submitted by facility and/or State on draft version of release descriptions, October 1996

SCEPTER, INC. TENNESSEE

Facility Overview

Facility Name:	Scepter, Inc.
Location:	New Johnsonville, Tennessee
Waste Stream:	Slag
Media Affected:	Groundwater

Scepter, Inc. operates a commercial industrial non-hazardous waste landfill near New Johnsonville, Humphreys County, Tennessee. Slag from an aluminum smelter is disposed of at the landfill.

Wastes and Waste Management Practices

The landfill covers approximately 134 acres, and varies in elevation from approximately 400 feet to 620 feet.

Extent of Contamination

The table below identifies the constituents analyzed in 1992 sampling and the highest detected level of each constituent in downgradient wells. Iron and pH were found to be above Tennessee or Federal standards. Groundwater sampling occurs quarterly.

GROUNDWATER CONTAMINANTS EXCEEDING TENNESSEE OR FEDERAL DRINKING WATER STANDARDS

Contaminant	Highest Detected Level (mg/l)	TN Standard (mg/l)	MCL (mg/l)	SMCL (mg/l)
Ammonia (as N)	<0.1	--	--	--
Arsenic	0.002	0.05	0.05	--
Barium	<0.1	2.0	2.0	--
Cadmium	<0.0002	0.005	0.005	--
Calcium	9.36	--	--	--
Chloride	6.0	--	--	250
Chromium	0.036	0.1	0.1	--
COD	310	--	--	--
Cyanide	<0.01	--	0.2	--
Iron	15.7	--	--	0.3
Lead	0.026	0.05	0.015*	--
Magnesium	3.98	--	--	--
Mercury	<0.0002	0.002	0.002	--
Nitrate (as N)	3.40	10	10	--
pH	4.4	6.0-9.0	--	6.5-8.5
Potassium	2.9	--	--	--
Selenium	<0.01	0.05	0.05	--
Silver	<0.01	0.01	--	0.1
Sodium	5.9	--	--	--
Specific conductivity (umhos/cm)	85	--	--	--
Sulfate	12	--	500	250
TDS	304	500	--	500
TOC	6.0	--	--	--

*Action level

Corrective Actions/Regulatory Actions

Information was not readily available.

Sources of Information

Scepter, Inc. 1992 Quarterly Groundwater Monitoring Results.

Operating Manual, Industrial Landfill, Scepter, Inc., New Johnsonville, TN.

TENNESSEE ALUMINUM PROCESSORS, INC. TENNESSEE

Facility Overview

Facility Name: Tennessee Aluminum Processors, Inc.

Location: Mount Pleasant, Tennessee

Waste Stream: Aluminum dross furnace cake waste

Tennessee Aluminum Processors, Inc. is a secondary smelter of aluminum scrap and dross.

Wastes and Waste Management Practices

Tennessee Aluminum Processors stockpiles aluminum dross at its processing facility. The material is soluble in water and as a result has contaminated run-off from the property. This contaminated run-off has percolated down to underground waters and also has traveled overland into surface waters, specifically Quality Creek, which runs adjacent to the site. The groundwater at the site is classified fo domestic and industrial water supply, livestock watering and wildlife, surface water discharge, and irrigation uses. The wa of Quality Creek are classified for domestic and industrial water supply, fish and aquatic life, recreation, irrigation and live watering, and wildlife uses.

Extent of Contamination

Surface water - The table below identifies the constituents analyzed in 1990-1993 surface water sampling and the highest detected level of each constituent in downgradient samples. Aluminum, chloride, and lead were found to be abov Tennessee or Federal standards.

SURFACE WATER CONTAMINANTS EXCEEDING TENNESSEE OR FEDERAL DRINKING WATER STANDARDS

Contaminant	Highest Detected Level (mg/l)	TN Standard (mg/l)	MCL (mg/l)	SMCL (mg/l)
Aluminum	1.34	--	--	0.05 to 0.2
Chloride	697	--	--	250
Lead	0.05	0.05	0.015*	--
Manganese	1.01	--	--	0.05
Specific conductance (umhos/cm)	2,300	--	--	--

*Action level

Groundwater - The table below identifies the constituents analyzed in 1990-1993 groundwater sampling and the highest detected level of each constituent in downgradient wells. Aluminum, chloride, lead, and manganese were found t above Tennessee or Federal standards.

GROUNDWATER CONTAMINANTS EXCEEDING TENNESSEE OR FEDERAL DRINKING WATER STANDARDS

Contaminant	Highest Detected Level (mg/l)	TN Standard (mg/l)	MCL (mg/l)	SMCL (mg/l)
Aluminum	108.0	--	--	0.05-0.2
Chloride	37,200	--	--	250
Lead	0.16	0.05	0.015*	--
Manganese	8.03	--	--	0.05
Specific conductance (umhos/cm)	67,500	--	--	--

*Action level

The reported lead results may result in part from the natural presence of lead in the Bigby Cannon limestone formation.

Corrective Actions/Regulatory Actions

Crushing and screening processes have been added to aid in the reduction of the stockpile mass and allow more confined storage of material. Additionally, the stockpile area has been reduced in size and waste from the crusher has be stockpiled in a more contained, readily controlled area. Further, concrete walls have been constructed to assist in containment and maintenance. Planning is underway for the implementation of a total recovery process to recycle, sell, and/or permanently dispose of all materials generated by Tennessee Aluminum Processors.

Sources of Information

Letter from Tennessee Department of Health and Environment to Tennessee Aluminum Processors, Inc., May 27, 1987.

Letter from Caldwell and Associates to Tennessee Department of Health and Environment, June 29, 1988.

1990-1993 Sampling Data, Caldwell and Associates.

Written correspondence submitted by facility and/or State on draft version of release descriptions, October 1996.

UCAR CARBON COMPANY INC. TENNESSEE

Facility Overview

UCAR Carbon Company's facility in Lawrenceburg, Tennessee manufacturers carbon bricks.

Facility Name: UCAR Carbon Company Inc.

Location: Lawrenceburg, Tennessee

Waste Stream: Process waste from carbon brick manufacturing

Media Affected: Groundwater

Wastes and Waste Management Practices

UCAR Carbon Company Inc., operates one Class II industrial non-hazardous waste disposal unit at the Lawrenceburg, Tennessee facility to serve its carbon brick manufacturing process. The industrial landfill is designed to accept carbon and graphite, scrap metal, construction/demolition type material and other carbonaceous wastes.

Extent of Contamination

The table below identifies the highest detected level of constituents from June 1994 in downgradient wells. Cadmium, chromium, iron, lead, and nickel were found to be above Tennessee or Federal standards.

GROUNDWATER CONTAMINANTS EXCEEDING TENNESSEE OR FEDERAL DRINKING WATER STANDARDS

Contaminant	Highest Detected Level (mg/l)	TN Standard (mg/l)	MCL (mg/l)	SMCL (mg/l)
Ammonia nitrogen	<0.1	--	--	--
Arsenic	0.02	0.05	0.05	--
Barium	0.451	2.0	2.0	--
Beryllium	<0.005	0.004	0.004	--
Cadmium	0.005	0.005	0.005	--
Calcium	99.4	--	--	--
Carbon disulfide	0.18	--	--	--
Chloride	4.6	--	--	250
Chromium	0.176	0.1	0.1	--
Cobalt	0.163	--	--	--
Copper	0.099	--	1.3*	1.0
Cyanide	<0.01	--	0.2	--
Dissolved manganese	1.11	--	--	--
Iron	72.8	--	--	0.3
Lead	0.091	0.05	0.015*	--
Magnesium	29.2	--	--	--
Mercury	0.00052	0.002	0.002	--
Nickel	0.519	0.1	0.1	--
Nitrate-N	0.5	10	10	--
pH	6.1	6.0-9.0	--	6.5-8.5
Selenium	<0.005	0.05	--	--
Silver	<0.005	0.01	--	0.1
Sodium	4.78	--	--	--
Specific conductance (umhos/cm)	578	--	--	--
Sulfate	175	500	500	250
Thallium	<0.002	0.002	0.002	--
TOC	4.5	--	--	--
Vanadium	0.161	--	--	--

Contaminant	Highest Detected Level (mg/l)	TN Standard (mg/l)	MCL (mg/l)	SMCL (mg/l)
Zinc	0.743	--	--	5.0

*Action level

The concentrations for chromium, lead, nickel, and pH were detected at high concentrations in the facility background/upgradient well.

Measured sulfate, dissolved manganese and iron levels in the June 1994 sampling event exceeded only the Secondary Maximum Contaminant Levels (SMCL). It is important to note that the national secondary drinking water regulations (40 CFR 123) control contaminants in drinking water that primarily affect the aesthetic qualities relating to pub acceptance. Health implications may also exist at considerably higher concentrations of these contaminants. These regulations are only guidelines for States and are not federally enforceable.

It should be noted that during the analytical testing of the June 1994 event, antimony, beryllium, and thallium wer tested with a Limit of Quantification (LOQ) greater than the Maximum Contaminant Level (MCL). These discrepancies we corrected in later sampling events.

No turbidity readings were taken during the June 1994 sampling event. Therefore no correlation between sedime laden wells and relatively turbidity free wells within the groundwater monitoring network at the Lawrenceburg, Tennessee facility can be made. Turbidity measurments have been implemented in later sampling events.

Corrective Actions/Regulatory Actions

UCAR Carbon Company has adjusted sampling activities to address possible airborne contamination. In additio UCAR Carbon Company has initiated a correlation of the metals analysis in response tot he sedimentation loading within monitoring well network.

The Tennessee Division of Solid Waste Management, which regularly reviews the groundwater quality data, has presented regulatory concerns with the groundwater monitoring analytical results at the Lawrenceburg, Tennessee facilit

Sources of Information

Regional Geohydrologic System, Law Engineering Testing Company, February 12, 1982.

Registration Authorizing Solid Waste Disposal Activities in Tennessee, 1985.

Summary of Laboratory Analysis of Groundwater Samples, 1994.

Written correspondence submitted by facility and/or State on draft version of release descriptions, October 1996

Facility Overview

Facility Name: Anzon America, Inc.

Location: Laredo, Texas

Waste Stream: Antimony smelting slag

Media Affected: Groundwater and surface water

The Anzon America, Inc. facility in Laredo, Texas is currently owned and operated by Anzon Inc. and has been the site of metals refining operations since the Texas Mining and Smelting Company began operations in 1928. The property was sold to the United States government in 1947, who, in the same year sold it to National Lead Industries. National Lead operated the site until 1977, when it shut down for approximately 18 months. Anzon Inc. acquired the facility in 1978 and resumed operations. Las Manadas Creek is located approximately 100 to 200 feet from the site. According to the site groundwater investigation re the groundwater table ranges from two to 18.5 feet below the surface, and the upper water-bearing zone is highly saline.

Wastes and Waste Management Practices

Anzon is a large quantity generator of hazardous waste according to the Waste Registration Summary Report. T Phase II groundwater report indicates that the site used to store antimony ores on concrete surface pads, and allow stormwater run-off on the ground. Since the blast furnaces were removed from service in 1992, these outdoor storage practices have ceased. There are 17 water wells within one mile of the Anzon property, either upgradient or cross-gradie The Las Manadas Creek acts as a shallow groundwater divide.

Extent of Contamination

The following information, regarding the extent of contamination at the site, was extracted from the Phase II groundwater report. Groundwater monitoring wells sampled for the Phase II investigation in 1993 showed antimony level from 0.004 mg/l to 0.8 mg/l in the upper water-bearing zone. In the lower water-bearing zone, antimony levels ranged fro 0.003 mg/l to 0.008 mg/l in downgradient wells. The highest detected level of antimony (2.5 mg/l) in groundwater along th western plant boundary appears to be related to the temporary historic storage of ores at a former blast furnace operation upgradient of the impacted area. The site stopped accepting ores in 1991. Low levels of antimony were also detected in upgradient wells. The facility's Phase II groundwater report to the Texas Water Commission (TWC) states that it expects concentrations of antimony to decrease with time. Due to naturally elevated levels of total dissolved solids, the shallow, limited aquifer under the facility is not usable as a source of drinking water. Additionally, deep aquifers underlying the fac have been investigated and have not been impacted by antimony.

As shown in the table below, antimony exceeded Federal drinking water standards. However, Anzon Inc. mainta that the insoluble forms of antimony found at the facility are approximately an order of magnitude less soluble than the compound used to derive the federal drinking water standard, and thus the bioavailability and toxicity of antimony found a facility is significantly lower. Due to these differences, Anzon feels that the risk to human health and the environment usi the MCL as a basis of comparison at the facility is significantly overstated.

GROUNDWATER CONTAMINANTS COMPARED TO FEDERAL DRINKING WATER STANDARDS			
Contaminant	**Highest Detected Level (mg/l)**	**MCL (mg/l)**	**SMCL (mg/l)**
Antimony	2.5	0.006	--

Corrective Actions/Regulatory Actions

Anzon Inc. has been very active in investigating the facility and working with the TNRCC to ensure protection of human health and the environment. Anzon has been performing environmental investigations of all media at the site, beginning in 1991 and continuing into 1996. A Phase II groundwater investigation was conducted at Anzon in May 1993. investigation followed the Phase I investigation conducted in October and November 1991, and was designed to define a characterize groundwater quality at the Anzon facility. According to the Phase II groundwater report, ores or finished proc are no longer stored outdoors. Feedstock materials are currently shipped in supersaks and are stored and processed inc There have been two additional rounds of well installation and groundwater sampling following the Phase II Groundwater Investigation concluded in 1993. These continued groundwater investigations have defined the horizontal and vertical ex of groundwater impact from historical operations, and the impact is found to be limited to a very small area along the wes boundary of the facility.

Anzon has also conducted a human health and environment risk assessment in accordance with the Risk Reduct Rules promulgated by the TNRCC. Pursuant to these assessments, it has been determined that the antimony present in environment at the Anzon facility does not pose an unreasonable risk to human health or the environment. Anzon has received approval to close a substantial portion of its property in accordance with the Risk Reduction Standards with the understanding that no future action is necessary. While TNRCC has considered taking regulatory action at the facility, Ar has demonstrated that current management practices with regards to raw and other materials at the site are protective of human health and the environment. These management practices include the indoor storage of all raw materials with potential impact to the environment, control of stormwater runoff from the manufacturing area of the facility, reduction of a emissions, control of fugitive emissions, along with other best management practices and engineering controls which minimize the potential for release of contaminants to the environment. Anzon believes that the site is taking adequate precautions under existing regulatory programs to ensure that historical contamination from past practices is remedied ar that human health and the environment are being protected from current operations at the facility.

Sources of Information

Texas Natural Resource Conservation Commission Risk Reduction Rules, Chapter 335.

Phone conversation with Texas Natural Resource Conservation Commission, Enforcement Coordination and Litigation Division. September 14, 1995.

Texas Natural Resource Conservation Commission, Information Resources Division, Waste Registration Summary Repo database query. September 6, 1995.

Texas Natural Resource Conservation Commission, Industrial and Hazardous Waste Division, facility files. Retrieved September 18, 1995.

Phase II Groundwater Investigation Report, Anzon Incorporated, Laredo, Texas. September 17, 1993.

Written correspondence submitted by facility and/or State on draft version of release descriptions, October 1996.

ELF ATOCHEM TEXAS

Facility Overview

Facility Name: Elf Atochem

Location: Bryan, Texas

Waste Stream: Process wastewater

Media Affected: Groundwater and surface water

Elf Atochem, a French chemical company, bought this facility in 1989; the site has manufactured pesticides and insecticides for 50 years. A municipal lake and several streams are located near the site (exact distance unknown).

Wastes and Waste Management Practices

The facility is a large quantity generator of hazardous waste according to the Waste Registration Summary Report. This report also indicates that in addition to the sprinkler water collection lagoon, the facility had a was pile of arsenic-contaminated soil used for temporary storage before treatment. This waste pile was removed and closed i 1992. There are also two other surface impoundments, one closed in 1994 and the other remains active, but plans to clo a landfill.

There are 46 monitoring wells across the facility. The facility monitors quarterly or annually depending on the location of the wells.

Extent of Contamination

The following information regarding the extent of contamination at the site was extracted from the Status Report o the Groundwater Extraction System. As shown in the table below, arsenic, benzene, gamma-BHC, bis(2-ethylhexyl)phtha ethyl benzene, heptachlor, heptachlor epoxide, pentachlorophenol, and 1,1,2-trichloroethane exceeded Federal water standards.

GROUNDWATER CONTAMINANTS COMPARED TO FEDERAL DRINKING WATER STANDARDS

Contaminant	Highest Detected Level (mg/l)	MCL (mg/l)	SMCL (mg/l)
Arsenic	0.14	0.05	--
Benzene	0.012	0.005	--
alpha-BHC	0.00114	--	--
beta-BHC	0.00005	--	--
gamma-BHC	1.24	0.0002	--
Bis(2-ethylhexyl)phthalate	0.032	0.006	--
Chlorobenzene	0.0312	--	--
Chloroform	0.426	0.1	--
Diazinon	0.000426	--	--
1,2-Dichlorobenzene	0.0316	0.6	--
1,4-Dichlorobenzene	0.0346	0.075	--
Ethyl benzene	0.931	0.7	--
Ethyl parathion	0.00018	--	--
Heptachlor	0.0022	0.0004	--
Heptachlor epoxide	0.00096	0.0002	--
Methyl parathion	0.000142	--	--
4-Nitrophenol	36.8	--	--
n-Nitrosodimethylamine	1.97	--	--
Pentachlorophenol	0.063	0.001	--
1,2,4-Trichlorobenzene	0.0352	0.07	--
1,1,2-Trichloroethane	0.021	0.005	--
o,o,o-Triethylphosphorthioate	0.000125	--	--

Contaminant	Highest Detected Level (mg/l)	MCL (mg/l)	SMCL (mg/l)
Xylenes	4.78	10	--

Corrective Actions/Regulatory Actions

Information was not readily available.

Sources of Information

Texas Natural Resource Conservation Commission Risk Reduction Rules, Chapter 335.

Phone conversation with Texas Natural Resource Conservation Commission, Enforcement Coordination and Litigation Division. September 14, 1995.

Texas Natural Resource Conservation Commission, Information Resources Division, Waste Registration Summary Repo database query. September 6, 1995.

Texas Natural Resource Conservation Commission, Industrial and Hazardous Waste Division, facility files. Retrieved September 18, 1995.

Status Report on the Groundwater Extraction System, Elf Atochem North America, Inc., Bryan, Texas. Supplement to the Semi-Annual Report for July, 1994. Volume 1. Prepared by Geraghty & Miller, Inc.

ROBROY INDUSTRIES - TEXAS, INC. TEXAS

Facility Overview

The Robroy Industries site is a corrosion resistant electrical conduit and fitting manufacturer located near Gilmer, Texas. Prior to 1983, the facility employed zinc plating and galvanizing in its manufaturing process. Since 1983, the facility's manufacturing process has been primarily a coating operation, utilizing PVC and polyurethanes.

Facility Name: Robroy Industries - Texas, Inc.

Location: Gilmer, Texas

Waste Stream: Neutralized spent acid sludge

Media Affected: Groundwater

Wastes and Waste Management Practices

The facility is a large quantity generator of hazardous waste according to the Waste Registration Summary Repor The following information regarding the waste management practices at the facility was extracted from the Phase III/IV progress report. The facility, constructed in 1962, operated two landfills to dispose of neutralized spent acid sludge from former zinc plating and galvanizing operations. Both landfills are now closed. Immediately adjacent to the main landfill (S A) is a closed process water holding pond. In the 1960s the site disposed of spent acid in an evaporation/holding pond a with its rinse water and cooling water. In 1976 the site began neutralizing the acid then disposing of the resultant sludge i clay-lined landfill at Site B. In 1977, the acid holding pond was lined with clay and converted to the Site A landfill. Electroplating operations ceased in 1978, and galvanizing operations ceased in 1983. Both landfills remained open for fu use. In 1985, EPA sued Robroy for inadequate closure plans and RCRA violations at the landfills. The suit was dropped when Robroy demonstrated that the sludge in the Site A and Site B landfills is non-hazardous. A full groundwater investigation and closure plan was initiated.

Extent of Contamination

Data presented in the table below, were extracted from a 1989 groundwater monitoring data report. In addition to the parameters listed below, Site A has high specific conductance.

As shown in the table below, chloride, iron, manganese, pH, and sulfate exceeded Federal drinking water standards.

GROUNDWATER CONTAMINANTS COMPARED TO FEDERAL DRINKING WATER STANDARDS

Contaminant	Highest Detected Level (mg/l)	MCL (mg/l)	SMCL (mg/l)
Chloride	1,907	--	250
Iron	4,400	--	0.3
Manganese	22	--	0.05
pH	3.0	--	6.5-8.5
Phenolics	26	--	--
Sodium	2,400	--	--
Sulfate	19,800	500	250
TOC	120	--	--
Total organic halogens	1.18	--	--

Corrective Actions/Regulatory Actions

According to the Phase III/IV progress report, as part of the site's closure plan, eight new monitoring wells have b installed in addition to the twelve existing wells. In addition, engineering controls, primary waste stabilization, and impermeable caps were implemented at the closed landfills and holding pond. The facility completed a two year post-clo monitoring period in December 1995. Based on the results of the data collected, Robroy currently is requesting that the S landfill be closed under the Texas Risk Reduction Rules. By agreement with the TNRCC, the facility started an additiona

year groundwater monitoring period to gather the data to finally close the Site A landfill. The additional data will be submi
to the TNRCC to support the facility's desire for final closure under the Texas Risk Reduction Rules.

Sources of Information

Texas Natural Resource Conservation Commission Risk Reduction Rules, Chapter 335.

Texas Natural Resource Conservation Commission, Information Resources Division, Waste Registration Summary Repo
database query. September 6, 1995.

Texas Natural Resource Conservation Commission, Industrial and Hazardous Waste Division, facility files. Retrieved September 18, 1995.

Phase III/IV Progress Report Ground Water Investigation, Robroy Industries - Texas, Inc. Prepared by ERM-Southwest, September 17, 1992.

Written correspondence submitted by facility and/or State on draft verions of release descriptions, October 1996.

SOUTHWESTERN BARGE FLEET SERVICE, INC. TEXAS

Facility Overview

The Southwestern Barge Fleet Service facility is a chemical and petroleum barge cleaning and repair facility located in Highlands, Texas. The San Jacinto River is located near the site (exact distance unknown).

Facility Name:	Southwestern Barge Fleet Service, Inc.
Location:	Highlands, Texas
Waste Stream:	Washwaters, oil sludge, waste paper, and debris
Media Affected:	Groundwater

Wastes and Waste Management Practices

The facility is a large quantity hazardous waste generator according to the Waste Registration Summary Report. The following information regarding the waste management practices at the facility was extracted from the Site Assessment Plan. A storage impoundment was used to hold washwaters, crude oil, and No. 6 fuel oil recovered dur the cleaning of barges. This unit was backfilled with waste paper and construction debris from the site. In 1979 the impoundment was covered with one to two feet of cement kiln flue dust and capped with two to four feet of clayey soil; the the unit was covered with topsoil and vegetative cover.

Extent of Contamination

The following information regarding the extent of contamination at the facility was extracted from the Site Assessment Report. Subsequent to closure, oily liquids were found discharging at several locations adjacent to the impoundment. The chromium exceedances may be indicative of naturally occurring poor groundwater quality, and do not reflect contamination from the former impoundment.

As shown in the table below, aluminum, chromium, trans-1,2-dichloroethene, iron, manganese, selenium, and vin chloride exceeded Federal water standards.

GROUNDWATER CONTAMINANTS COMPARED TO FEDERAL DRINKING WATER STANDARDS

Contaminant	Highest Detected Level (mg/l)	MCL (mg/l)	SMCL (mg/l)
Aluminum	9.17	--	0.05-0.2
Antimony	<0.01	0.006	--
Arsenic	<0.01	0.05	--
Barium	0.626	2.0	--
Benzene	14.9	0.005	--
Beryllium	<0.005	0.004	--
Cadmium	<0.01	0.005	--
Calcium	597	--	--
Chromium	0.088	0.1	--
Cobalt	<0.05	--	--
Copper	<0.06	1.3	1.0
Cyanide	0.081	0.2	--
1,1-Dichloroethane	0.608	--	--
trans-1,2-Dichloroethene	1.56	0.005	--
2,4-Dimethylphenol	16.1	--	--
Iron	25.5	--	0.3
Magnesium	213	--	--
Manganese	5.58	--	0.05
Mercury	<0.0008	0.002	--
Naphthalene	2.24	--	--

Contaminant	Highest Detected Level (mg/l)	MCL (mg/l)	SMCL (mg/l)
Nickel	<0.06	0.1	--
Phenol	5.5	--	--
Potassium	49.7	--	--
Selenium	0.051	0.05	--
Silver	<0.008	--	0.1
Sodium	3,620	--	--
Thallium	<0.002	0.002	--
Vanadium	<0.06	--	--
Vinyl chloride	8.6	0.002	--
Zinc	0.126	--	5

Corrective Actions/Regulatory Actions

According to the Site Assessment Plan, three oil/water recovery sumps were installed within the limits of the form impoundment in order to prevent further discharges.

Sources of Information

Texas Natural Resource Conservation Commission Risk Reduction Rules, Chapter 335.

Phone conversation with Texas Natural Resource Conservation Commission, Enforcement Coordination and Litigation Division. September 14, 1995.

Texas Natural Resource Conservation Commission, Information Resources Division, Waste Registration Summary Repo database query. September 6, 1995.

Texas Natural Resource Conservation Commission, Industrial and Hazardous Waste Division, facility files. Retrieved September 18, 1995.

Site Assessment Plan, Southwestern Barge Fleet Service, Inc., Highlands, Texas. Prepared by Southwestern Laboratori Inc. October 19, 1992.

STAUFFER CHEMICAL TEXAS

Facility Overview

Facility Name: Stauffer Chemical
Location Stauffer, Texas
Waste Stream: Wastewater
Media Affected: Groundwater

Stauffer Chemical manufactured pesticides at its Stauffer, Texas facility. Buffalo Bayou is within one mile of the site.

Wastes and Waste Management Practices

The Stauffer Chemical plant is not a hazardous waste generator according to the Waste Registration Summary Report. The site monitors groundwater semi-annually and submits a comprehensive annual report. The following information regarding the waste management practi at the facility was extracted from the Barrier Well System Performance Report. As part of a compliance directive issued b State of Texas, Stauffer initiated closure activities at the site in 1980. The impoundment was capped and a barrier well system was installed to remove groundwater contaminants and prevent migration beyond the property boundaries.

Extent of Contamination

The following information regarding the extent of contamination at the facility was extracted from the Barrier Well Performance Report. As shown in the table below, atrazine, benzene, gamma-BHC, iron, manganese, and total dissolve solids exceeded Federal water standards. The data presented in the table below were from sampling events in 1993 and 1994 from four barrier wells and one cleanup well located within the property boundaries.

GROUNDWATER CONTAMINANTS COMPARED TO FEDERAL DRINKING WATER STANDARDS

Contaminant	Highest Detected Level (mg/l)	MCL (mg/l)	SMCL (mg/l)
Atrazine	0.024	0.003	--
Benzene	0.038	0.005	--
alpha-BHC	0.087	--	--
gamma-BHC	0.077	0.0002	--
Bicarbonate	528	--	--
Calcium	149	--	--
Calcium carbonate	464.3	--	--
Chloride	92.5	--	250
PP'-DDT	0.005	--	--
EPTC	0.096	--	--
Fluoride	0.43	4	2
Iron	0.67	--	0.3
Magnesium	24.45	--	--
Manganese	0.39	--	0.05
Methyl parathion	0.18	--	--
Molinate	0.36	--	--
Nitrate	4.27	10	--
Potassium	1.32	--	--
Sodium	56.2	--	--
Sulfate	42.4	*500**	250
TOC	540	--	500
Toluene	0.19	1	--
Total organic carbon	5.7	--	--
Total suspended solids	213	--	--

Contaminant	Highest Detected Level (mg/l)	MCL (mg/l)	SMCL (mg/l)
o-Xylene	3.8	10	--
m,p-Xylenes	6.7	10	--

* Sulfate MCL is under consideration by the Agency.

Corrective Actions/Regulatory Actions

Information was not readily available.

Sources of Information

Texas Natural Resource Conservation Commission Risk Reduction Rules, Chapter 335.

Phone conversation with Texas Natural Resource Conservation Commission, Enforcement Coordination and Litigation Division. September 14, 1995.

Texas Natural Resource Conservation Commission, Information Resources Division, Waste Registration Summary Repo database query. September 6, 1995.

Texas Natural Resource Conservation Commission, Industrial and Hazardous Waste Division, facility files. Retrieved September 18, 1995.

Barrier Well System Performance, August 1992 through June 1994, Stauffer Management Company Hempstead Road S Harris County, Texas. Prepared by Geraghty & Miller, Inc. August 11, 1994.

TEXAS INSTRUMENTS, INC.

Facility Overview

Texas Instruments in Dallas, Texas is currently a metal fabrication facility. Manufacturing operations at the plant include metal grinding, polishing, drilling, cutting, painting, and plating. No known surface water body exists on or near the site.

Facility Name: Texas Instruments, Inc.

Location: Dallas, Texas

Waste Stream: Wastewater

Media Affected: Groundwater

Wastes and Waste Management Practices

The facility is a large quantity generator of hazardous waste according to the Waste Registration Summary Report. The following information regarding the waste management practices at the facility was extracted from the Radio Tower Closure Plan. The machine shop adjacent to th Radio Tower Site at the facility had collection trenches used to collect metal shavings and to reprocess the cutting oil. Th trenches were located along the perimeter of the building and are now filled with concrete. The facility stopped using the trenches in the early 1980s. Now the plant has a cutting oil/fluid recycling system.

Extent of Contamination

The following information regarding the extent of contamination at the facility was extracted from the Radio Towe Closure Plan. The Radio Tower Site at the Texas Instruments facility is the primary area of contamination. Free floating petroleum product was found in some monitoring wells. The former trenches are a primary source of groundwater contamination near the Radio Tower. The cutting oil recycling system now being used is not believed to impact groundwa

From the 1960s to the early 1970s the site used carbon tetrachloride in its semi-conductor production and metals finishing processes.

The following contaminants were detected in groundwater sampling events: carbon tetrachloride, chloroform, tetrachloroethene, trichloroethene. All of these contaminants were used in the metals fabrication processes at some poin time. In addition, the following chemicals were also detected: 1,1-dichloroethane, methylene chloride, toluene. Specific levels were not readily obtainable in the facility files.

Corrective Actions/Regulatory Actions

Information was not readily available.

Sources of Information

Texas Natural Resource Conservation Commission Risk Reduction Rules, Chapter 335.

Phone conversation with Texas Natural Resource Conservation Commission, Enforcement Coordination and Litigation Division. September 14, 1995.

Texas Natural Resource Conservation Commission, Information Resources Division, Waste Registration Summary Repo database query. September 6, 1995.

Texas Natural Resource Conservation Commission, Industrial and Hazardous Waste Division, facility files. Retrieved September 18, 1995.

TI Lemmon Ave. Radio Tower Site, Closure Plan Amendment Report, Texas Instruments Incorporated, Dallas, Texas, Ap 1993. Prepared by Caldwell Engineering.

Texas Instruments Incorporated Lemmon Ave. Facility Radio Tower Site Closure Plan, Dallas, Texas, December 1992. Prepared by Caldwell Engineering.

CHESAPEAKE PAPER PRODUCT COMPANY VIRGINIA

Facility Overview

Facility Name:	Chesapeake Paper Product Company
Location:	King William, Virginia
Waste Stream:	Industrial non-hazardous solid waste

Chesapeake Paper Products Company (CPPC) owns and operates a captive industrial solid waste facility located in rural King William County, Virginia. The facility is located within a 275 acre site that is approximately 5 miles northwest of the Town of West Point on the west side of SR30. It is bounded by SR30 to the north, the Norfolk Southern Railroad to the south, land owned by the Pamunkey Game Club to the west, and other lands of CPPC and private owners to the east. The land between the Norfolk Southern Railroad right-of-way and the Pamunkey River is also owned by CPPC. Adjacent lands are either forested or used for agricultural purposes.

The facility consists of two permitted landfills identified as Mann #2 (permit #255) and Mann #3 (permit #543). Ma
#2 is an active landfill that covers 11 acres and began operation on or about September 25, 1978. It reached its capacity
June 1993 and is currently in post-closure care. The nearest surface body of water is the Pamunkey River which is 1400
to the south. Mann #3 is an active three phase landfill with a design capacity of approximately 50 years. Phase 1 covers
acres and began operation in May 1993 and is expected to reach its capacity in about 17 years. Phases 2 and 3 will cove
35.4 acres when constructed. The nearest surface body of water is the Pamunkey River which is 700 feet to the south.

Wastes and Waste Management Practices

All waste received at the facility is non-hazardous industrial waste generated by CPPC. Waste streams include a
from coal and wood-fired boilers, construction debris, secondary fiber and paper waste, occasional dewatered sludge fror
wastewater treatment operations, and other non-hazardous industrial wastes. Mann #2 groundwater is monitored by one
upgradient and four downgradient wells. Mann #3 is monitored by four upgradient and six downgradient wells.

Extent of Contamination

Groundwater is monitored at one upgradient and three downgradient wells. The table below identifies the highes
level of each constituent detected in downgradient wells. Iron and zinc were found to be above Virginia or Federal standa

GROUNDWATER CONTAMINANTS EXCEEDING VIRGINIA OR FEDERAL DRINKING WATER STANDARDS

Contaminant	Highest Detected Level (mg/l)	VA Standard (mg/l)	MCL (mg/l)	SMCL (mg/l)
Arsenic	0.0063	0.05	--	--
Barium	0.046	2	--	--
Iron	1.6	--	--	0.3
Magnesium	0.6	--	--	--
Sulfates	16.9	--	--	--
TDS	190	--	--	500
TOC	1.7	--	--	--
Zinc	0.057	0.05	--	5

Corrective Actions/Regulatory Actions

Mann #2 entered Virginia's Phase 2 monitoring program on February 19, 1993 and has continued with an approv
modified Phase 2 monitoring program to date as the result of one Phase 3 monitoring event in September 1994.

Sources of Information

Groundwater Monitoring Plan for the Chesapeake Corp. Mann # 2 Industrial Waste Landfill, May 1992.

Chesapeake Paper Products Company, Phase 2 Background Data, Mann # 2 Landfill, June 1994.

Chesapeake Paper Products Company, Phase 2 Background Data, Mann # 2 Landfill, September, 1994.

Virginia Solid Waste Management Facilities List - Industrial Waste Landfills in Phase 2 Monitoring Program, August 22, 1

Drinking Water Regulations and Health Advisories, US EPA, Office of Water, February 1996.

Virginia Solid Waste Management Facilities List - Industrial Waste Landfills, June 17, 1996.

Virginia Solid Waste Management Facilities List - Industrial Waste Landfills in Phase 2 GW Monitoring, June 17, 1996.

Written correspondence submitted by facility and/or State on draft version of release descriptions, October 1996.

Facility Overview

Georgia-Pacific is located in Bedford, Virginia.

Facility Name:	Georgia-Pacific
Location:	Bedford, Virginia
Waste Stream:	Industrial non-hazardous solid waste
Media Affected:	Groundwater

Wastes and Waste Management Practices

Georgia-Pacific operates an unlined, on-site, industrial waste landfill which began receiving waste in approximately 1976, ceased receiving waste by October 9, 1993, and was closed permanently by October 31, 1994. Only non-hazardous wastes (bark, fly ash, bottom ash, process wastewater sludge, papermill trash and garbage and asbestos containing material) were landfilled at the facility.

Extent of Contamination

Groundwater is monitored at one upgradient and three downgradient wells. The table below identifies the highes level of each constituent detected in downgradient wells. Beryllium, iron, and lead were found to be above Virginia or Fed standards.

GROUNDWATER CONTAMINANTS EXCEEDING
VIRGINIA OR FEDERAL DRINKING WATER STANDARDS

Contaminant	Highest Detected Level (mg/l)	VA Standard* (mg/l)	MCL (mg/l)	SMCL (mg/l)
Arsenic	0.024	0.05	--	--
Barium	1.010	2.0	2	--
Beryllium	0.005	0.004	0.004	--
Cadmium	0.003	0.005	--	--
Chloride	184	--	--	250
Chromium	0.047	0.1	0.1	--
Copper	0.05	1.3	1.3**	1.0
Cyanide	<0.02	0.2	0.2	--
Iron	37.1	--	--	0.3
Lead	0.19	0.015	0.015**	--
Selenium	0.006	0.05	0.05	--
Sodium	40.2	--	--	--
Zinc	0.5	4.7	--	5

*These Groundwater Protection Standards (GWPS) were developed with the Virginia Department of Environmental Quali and will become effective upon issuance of the Post Closure Permit for the facility in 1996 or 1997. The GWPS are base background levels, Federal MCL's, or risk-based alternate concentration limits. Since their establishment in 1995, no exceedances of these GWPS have occurred at the site. Likewise, no exceedances of Federal Drinking Water Standards have occurred in that time either.

**Action level

Many of the "high" data values were directly impacted by the relatively high level of turbidity in the groundwater w (one downgradient and one side gradient well). Additionally, the water samples were unfiltered.

Corrective Actions/Regulatory Actions

Georgia-Pacific installed a closure cap consisting of soil combined with a 30 mil. VLDPE synthetic geomembrane minimize stormwater infiltration into the waste and thereby minimize the potential for leachate generation. The facility has completed Phase II groundwater monitoring program requirements in 1995. In April 1996 a request was made to the VA

to modify the landfill permit for the post closure period. A Phase III groundwater monitoring plan, as required by the VSW
has been proposed in the permit modification.

Sources of Information

Georgia-Pacific Groundwater Sampling, June 24, 1992.

Georgia-Pacific Groundwater Sampling, October 28, 1992.

Phase 2 Monitoring, January 17, 1994.

Georgia-Pacific Corp. Industrial Waste Disposal Facility, Annual Groundwater Monitoring Report, February 28, 1994.

Georgia-Pacific Groundwater Sampling, September 28, 1994.

Georgia-Pacific Groundwater Sampling, January 23, 1995.

Virginia Solid Waste Management Facilities List - Industrial Waste Landfills in Phase 2 Monitoring Program, August 22, 1

Georgia-Pacific Groundwater Sampling, February 1996.

Drinking Water Regulations and Health Advisories, US EPA, Office of Water, February 1996.

Virginia Solid Waste Management Facilities List - Industrial Waste Landfills, June 17, 1996.

Virginia Solid Waste Management Facilities List - Industrial Waste Landfills in Phase 2 GW Monitoring, June 17, 1996.

Written correspondence submitted by facility and/or State on draft version of release descriptions, October 1996.

HERCULES INCORPORATED VIRGINIA

Facility Overview

Facility Name: Hercules Inc.
Location: Allegheny, Virginia
Waste Stream: Waste propylene and latex

Hercules Inc. is located in Allegheny, Virginia. The soils at the site are alluvial sediments consisting primarily of silts and fine sands which coarsen downwards into silty and clayey gravel and silty sand with gravel at the base above bedrock. The bedrock below these alluvial soils is a black shale of the Millboro Formation of the Devonian age. The shale is encountered at depths of 8.5 to 20 feet below grade.

Wastes and Waste Management Practices

Hercules Inc. has an on-site industrial landfill which began operating in 1965 and has been inactive since 1993. T facility was permitted in 1973 as a sanitary landfill, but was later designated as an industrial waste landfill in 1993. The la contains waste polypropylene and latex. The facility contains three distinct waste disposal areas: the mound, trench, and areas. The mound area received baled saran-coated polypropylene film; the trench area received saran latex solids; and pit area received baled, saran-coated polypropylene film.

Extent of Contamination

Groundwater is monitored at 4 wells. The table below identifies the highest level of each constituent detected in downgradient wells. Cadmium, iron, lead, and zinc were found to be above Virginia or Federal standards.

GROUNDWATER CONTAMINANTS EXCEEDING VIRGINIA OR FEDERAL DRINKING WATER STANDARDS

Contaminant	Highest Detected Level (mg/l)	VA Standard (mg/l)	MCL (mg/l)	SMCL (mg/l)
Cadmium	0.0099	--	0.005	--
Chloride	77	--	--	250
Chromium	0.014	--	--	--
Iron	788	--	--	0.3
Lead	0.376	0.050	0.015*	--
Selenium	0.002	--	0.05	--
Sodium	11.8	--	--	--
TOC	1.8	--	--	--
Zinc	0.385	0.05	--	5

*Action level.

Corrective Actions/Regulatory Actions

The facility entered into Virginia's Phase 2 monitoring program on July 16, 1992. Additional information was not readily available.

Sources of Information

Annual Summary Report on Phase I Groundwater Monitoring at the Hercules Forster Plant Landfill, February 1992.

Hercules Incorporated Industrial Waste Landfill, Covington, Virginia, 1993 Groundwater Annual Report, February 28, 199

Virginia Solid Waste Management Facilities List - Industrial Waste Landfills in Phase 2 Monitoring Program, August 22, 1

Hercules Incorporated, Statistics Report, Comparison of Indicator Parameters Detected in Groundwater During Phase I Monitoring, September 27, 1995.

Drinking Water Regulations and Health Advisories, US EPA, Office of Water, February 1996.

Virginia Solid Waste Management Facilities List - Industrial Waste Landfills, June 17, 1996.

Virginia Solid Waste Management Facilities List - Industrial Waste Landfills in Phase 2 GW Monitoring, June 17, 1996.

Written correspondence submitted by facility and/or State on draft version of release descriptions, October 1996.

APPLETON PAPERS LOCK MILLS WISCONSIN

Facility Overview

Facility Name:	Appleton Papers Lock Mills
Location:	Combined Locks, Wisconsin
Waste Stream:	Paper mill sludge
Media Affected:	Groundwater

Appleton Papers Lock Mills is a paper mill located in Combined Locks, Wisconsin. The Fox River is located 400 feet from the site.

Wastes and Waste Management Practices

The 11-acre unlined landfill closed in 1992. The site was previously an old gravel pit, and in the 1970s the mill began disposing of its sludge in the pit. The site placed a cover on the landfill in the late 1980s. Groundwater is monitored quarterly. There are residential areas near the facility.

Extent of Contamination

The Wisconsin Department of Natural Resources (DNR) is unsure of the source of contamination. The Fox River raised and lowered often, which affects sampling. There is no apparent trend to the exceedances.

As shown in the table below, chloride, iron, pH, sulfate, and total dissolved solids exceeded Wisconsin or Federa water standards.

GROUNDWATER CONTAMINANTS COMPARED TO WISCONSIN OR FEDERAL DRINKING WATER STANDARDS

Contaminant	Highest Detected Level (mg/l)	WI Standard (mg/l)	MCL (mg/l)	SMCL (mg/l)
Boron	2.8	--	--	--
Calcium	810	--	--	--
Calcium carbonate	3,228	--	--	--
Chloride	446	125	--	250
Iron	0.68	0.15	--	0.3
Magnesium	325	--	--	--
pH	5.4	6.5-8.5	--	6.5-8.5
Potassium	382	--	--	--
Sodium	274	--	--	--
Sulfate	1,685	125	500	250
Total dissolved solids	1,120	--	--	500
Total suspended solids	675	--	--	--

Corrective Actions/Regulatory Actions

In 1993, the site placed another cover on the landfill. There are no further remedial actions planned.

Sources of Information

Wisconsin Department of Natural Resources, Bureau of Solid and Hazardous Waste Management, Solid Waste Manage Section, Solid and Hazardous Waste Inventory Management System database printout, August 15, 1995.

Wisconsin Department of Natural Resources, Bureau of Solid and Hazardous Waste Management, Solid Waste Manage Section, Groundwater and Environmental Monitoring System database printout, August 15, 1995.

Meeting with Wisconsin DNR hydrogeologist, August 21, 1995.

Facility Overview

Badger Paper Mill is located in Peshtigo, Wisconsin. The Peshtigo River is located 300 feet from the site.

Wastes and Waste Management Practices

The 5-acre landfill is unlined and disposes of 9,000 tons/year of waste. Groundwater is monitored quarterly. The nearest drinking water well is located 3,000 feet from the site.

Facility Name:	Badger Paper Mill
Location:	Peshtigo, Wisconsin
Waste Stream:	Paper mill sludge
Media Affected:	Groundwater

Extent of Contamination

As shown in the table below, chloride, iron, and manganese exceeded Wisconsin or Federal water standards.

GROUNDWATER CONTAMINANTS COMPARED TO WISCONSIN OR FEDERAL DRINKING WATER STANDARDS

Contaminant	Highest Detected Level (mg/l)	WI Standard (mg/l)	MCL (mg/l)	SMCL (mg/l)
Calcium	220	--	--	--
Calcium carbonate	759	--	--	--
Chloride	130	125	--	250
Iron	44	0.15	--	0.3
Manganese	1.75	0.025	--	0.05
pH	6.4	--	--	6.5-8.5
Sulfate	84	125	500	250

Corrective Actions/Regulatory Actions

There is no groundwater remedial action being taken. The Wisconsin Department of Natural Resources (DNR) h requested that the site propose a remedial plan.

Sources of Information

Wisconsin Department of Natural Resources, Bureau of Solid and Hazardous Waste Management, Solid Waste Manage Section, Solid and Hazardous Waste Inventory Management System database query, August 21, 1995.

Wisconsin Department of Natural Resources, Bureau of Solid and Hazardous Waste Management, Solid Waste Manage Section, Groundwater and Environmental Monitoring System database printout, August 15, 1995.

Meeting with Wisconsin DNR hydrogeologist, August 21, 1995.

CONSOLIDATED PAPERS KRAFT DIVISION WISCONSIN

Facility Overview

Consolidated Papers Kraft Division is a paper mill located in Wisconsin Rapids, Wisconsin. The Wisconsin River is 50 feet from the site.

Facility Name:	Consolidated Papers Kraft Division
Location:	Wisconsin Rapids, Wisconsin
Waste Stream:	Pulp mill wastes
Media Affected:	Groundwater

Wastes and Waste Management Practices

The 37-acre landfill is unlined, with several phases closed and capped. The open cells are receiving waste at a slow rate. The site is near closure according to the Wisconsin Department of Natural Resources (DNR). The landfill receives related waste such as boiler ash, wood wastes, knots, lime dregs, asbestos, sand, clean fill, and rubble.

Groundwater is monitored quarterly but is expected to switch to semiannually. The nearest drinking water well is located 2,000 feet from the site.

Extent of Contamination

Most monitoring wells indicate exceedances of some Wisconsin standard. As shown in the table below, chloride, iron, and pH exceeded Wisconsin or Federal water standards.

GROUNDWATER CONTAMINANTS COMPARED TO WISCONSIN OR FEDERAL DRINKING WATER STANDARDS

Contaminant	Highest Detected Level (mg/l)	WI Standard (mg/l)	MCL (mg/l)	SMCL (mg/l)
Aluminum	0.08	--	--	0.05-0.2
Calcium	568	--	--	--
Calcium carbonate	1860	--	--	--
Chloride	1200	125	--	250
Iron	710	0.15	--	0.3
Magnesium	20	--	--	--
pH	4.3	6.5-8.5	--	6.5-8.5
Phenols	0.047	--	--	--
Sodium	12060	--	--	--
Sulfate	17	125	500	250
Total suspended solids	1135	--	--	--

Corrective Actions/Regulatory Actions

The site installed a groundwater collection trench; no further action is anticipated.

Sources of Information

Wisconsin Department of Natural Resources, Bureau of Solid and Hazardous Waste Management, Solid Waste Manage
Section, Groundwater and Environmental Monitoring System database printout, August 15, 1995.

Wisconsin Department of Natural Resources, Bureau of Solid and Hazardous Waste Management, Solid Waste Manage
Section, Solid and Hazardous Waste Inventory Management System database query, August 21, 1995.

Meeting with Wisconsin DNR hydrogeologist, August 21, 1995.

Written correspondence submitted by facility and/or State on draft version of release descriptions, October 1996.

CONSOLIDATED PAPERS WATER RENEWAL WISCONSIN

Facility Overview

Consolidated Papers Water Renewal is a paper mill located in Linwood, Wisconsin. The Wisconsin River is 300 feet from the site.

Facility Name: Consolidated Papers Water Renewal

Location: Linwood, Wisconsin

Waste Stream: Paper mill sludge

Wastes and Waste Management Practices

The nine-acre landfill began receiving waste in 1971. Area 1 is unlined, and now closed and capped. Areas 2 and 3 still receive waste and both have liners and leachate collection systems. Groundwater is monitored semi-annually. The nearest drinking water well is located two miles from the site.

Extent of Contamination

It appears that the impact to groundwater is from waste disposed in the older, unlined portion of the landfill (Area Most of the wells with impacted groundwater are installed through waste in Area 1.

As shown in the table below, chloride, chloroform, dichloromethane, iron, manganese, nitrate/nitrite, pH, phenol, sulfate, toluene, total dissolved solids, trichloroethylene, and zinc exceeded Wisconsin or Federal water standards.

GROUNDWATER CONTAMINANTS COMPARED TO WISCONSIN OR FEDERAL DRINKING WATER STANDARDS

Contaminant	Highest Detected Level (mg/l)	WI Standard (mg/l)	MCL (mg/l)	SMCL (mg/l)
Boron	44	--	--	--
Calcium	780	--	--	--
Calcium carbonate	3,600	--	--	--
Chloride	580	125	--	250
Chloroform	0.01	0.0006	0.1	--
Dichloromethane	0.018	0.015	0.005	--
Ethylbenzene	0.0013	0.14	0.7	--
Iron	860	0.15	--	0.3
Magnesium	350	--	--	--
Manganese	37	0.025	--	0.05
Nitrate/nitrite as N	64	2	10	--
pH	4.4	6.5-8.5	--	6.5-8.5
Phenol	60	1.2	--	--
Phosphorous	14	--	--	--
Silica	170	--	--	--
Sodium	11	--	--	--
Sulfate	2,200	125	500	250
Toluene	1.3	0.069	1	--
Total dissolved solids	2,880	--	--	500
Total suspended solids	4,100	--	--	--
Trichloroethylene	0.0085	0.0005	0.005	--
Xylene	0.002	--	10	--
Zinc	110	2.5	--	5

Corrective Actions/Regulatory Actions

There is a groundwater gradient control system in place for all four landfill areas. Groundwater from Area 1 wells extracted and treated at a wastewater treatment plant adjacent to the landfill. A clay cutoff was installed around Area 1.

Sources of Information

Wisconsin Department of Natural Resources, Bureau of Solid and Hazardous Waste Management, Solid Waste Manage Section, Groundwater and Environmental Monitoring System database printout, August 15, 1995.

Wisconsin Department of Natural Resources, Bureau of Solid and Hazardous Waste Management, Solid Waste Manage Section, Solid and Hazardous Waste Inventory Management System database printout, August 22, 1995.

Meeting with Wisconsin DNR hydrogeologist, August 21, 1995.

Written correspondence submitted by facility and/or State on draft version of release descriptions, October 1996.

CONSOLIDATED PAPERS WATER QUALITY CENTER WISCONSIN

Facility Overview

Consolidated Papers Water Quality Center (WQC) is a paper mill located in Wisconsin Rapids, Wisconsin. Cranberry Creek runs adjacent to the site, and the Wisconsin River is 2,600 feet away.

Facility Name:	Consolidated Papers Water Quality Center
Location:	Wisconsin Rapids, Wisconsin
Waste Stream:	Paper mill sludge
Media Affected:	Groundwater

Wastes and Waste Management Practices

The 32-acre landfill began receiving waste in 1975. Area 1, the oldest portion, is unlined. Areas 2 through 5 have three-foot clay liners and leachate collection systems. Groundwater is monitored semi-annually. The nearest drinking water well is located 1,200 feet from the site.

Extent of Contamination

Groundwater is impacted from waste disposed in Area 1. In the early 1980's, the facility installed a clay cut-off wa down to the bedrock and a sand and dewatering trench upgradient of the cut-off wall. The bedrock fractured and contaminants went under the cut-off wall.

As shown in the table below, barium (dissolved), benzene, chloride, chromium (hexavalent), dichloromethane, iro (total), lead, mercury, nitrate as N, pH, sulfate, toluene, and total dissolved solids exceeded Wisconsin or Federal water standards.

GROUNDWATER CONTAMINANTS COMPARED TO WISCONSIN OR FEDERAL DRINKING WATER STANDARDS

Contaminant	Highest Detected Level (mg/l)	WI Standard (mg/l)	MCL (mg/l)	SMCL (mg/l)
Ammonia as N	200	--	--	--
Barium (dissolved)	2.6	0.4	2	--
Benzene	0.0032	0.0005	0.005	--
Calcium	540	--	--	--
Calcium carbonate	1,880	--	--	--
Chloride	1,360	125	--	250
Chromium (hexavalent)	23	0.010	0.1	--
Copper	0.064	0.13	1.3*	1
Dichloromethane	0.012	0.015	0.005	--
Ethylbenzene	0.022	0.14	0.7	--
Iron (total)	230	0.15	--	0.3
Lead	0.12	0.0015	0.015*	--
Magnesium	150	--	--	--
Mercury	0.002	0.0002	0.002	--
Nitrate	13.36	--	10	--
pH	4.4	6.5-8.5	--	6.5-8.5
Phenols	1.2	--	--	--
Silica	27	--	--	--
Sodium	390	--	--	--
Sulfate	490	125	500	250
Toluene	0.92	0.0686	1	--
Total dissolved solids	4,500	--	--	500
Total suspended solids	6,100	--	--	--
Zinc	0.1	2.5	--	5

* Action level

Corrective Actions/Regulatory Actions

The site has installed extraction wells downgradient, which seem to be effective in reversing the groundwater flow
The groundwater is removed to a wastewater treatment plant adjacent to the site.

Sources of Information

Wisconsin Department of Natural Resources, Bureau of Solid and Hazardous Waste Management, Solid Waste Manager
Section, Groundwater and Environmental Monitoring System database printout, August 15, 1995.

Wisconsin Department of Natural Resources, Bureau of Solid and Hazardous Waste Management, Solid Waste Manager
Section, Solid and Hazardous Waste Inventory Management System database printout, August 21, 1995.

Meeting with Wisconsin DNR hydrogeologist, August 21, 1995.

Written correspondence submitted by facility and/or State on draft version of release descriptions, October 1996

Facility Overview

Facility Name:	Derosso Landfill
Location:	Oak Creek, Wisconsin
Waste Stream:	Foundry sand
Media Affected:	Groundwater

Derosso Landfill is a foundry sand mining landfill located in Oak Creek, Wisconsin. Across the street from the landfill is a pond which was created when clay was removed pursuant to a DNR closure order for use as capping on the closed landfill.

Wastes and Waste Management Practices

The 45-acre landfill began receiving foundry sand in 1972 and was closed under the terms and conditions of a DNR closure plan and order in 1989. The landfill is lined with naturally occurring clay, and does not have a leachate colle system. Groundwater is currently monitored quarterly. The nearest drinking water well is located two miles from the site.

Extent of Contamination

This landfill has only received foundry sand during the life of its operation. During 1982 or 1983, the landfill enter into a contract with the Wisconsin Department of Transportation to remove some foundry sand for use as road base mate During the process of removing some of this road base material two to three empty open topped barrels were discovered the landfill. There is no evidence that drummed waste was ever disposed of at this landfill. Regardless of this fact, the Department of Natural Resources (DNR) believes that some of the volatile organics exceedances a result from waste oth than foundry sand waste. The phenol exceedances are most likely resulting from the foundry sand waste.

As shown in the table below, arsenic, benzene, cadmium, chloride, chromium, cyanide, ethylbenzene, fluoride, iro lead, manganese, pH, phenol, sulfate, toluene, and xylenes have at times exceeded Wisconsin or Federal water standard There is no evidence of any off-site impact caused by these exceedances. Some of the constituents listed below, includin calcium carbonate, potassium and sodium have no State or Federal standards, and in many cases the highest detected l does not exceed either the State or Federal standard.

GROUNDWATER CONTAMINANTS COMPARED TO WISCONSIN OR FEDERAL DRINKING WATER STANDARDS

Contaminant	Highest Detected Level (mg/l)	WI Standard (mg/l)	MCL (mg/l)	SMCL (mg/l)
Arsenic	0.018	0.005	0.05	--
Benzene	0.82	0.0005	0.005	--
Cadmium	0.025	0.005	0.005	--
Calcium carbonate	1,400	--	--	--
Chloride	570	125	--	250
Chromium	0.5	0.01	0.1	--
Copper	0.02	0.13	1.3*	1
Cyanide	0.4	0.04	0.2	--
Ethylbenzene	0.66	0.14	0.7	--
Fluoride	10	0.44*	4	2
Iron	9	0.15	--	0.3
Lead	0.4	0.005	0.015*	--
Manganese	0.41	0.025	--	0.05
Nickel	0.02	--	0.1	--
Nitrate/nitrite	0.3	2.0	10	--
pH	10.2	6.5-8.5	--	6.5-8.5
Phenol	1.7	1.2	--	--
Potassium	26	--	--	--
Sodium	960	--	--	--

GROUNDWATER CONTAMINANTS COMPARED TO WISCONSIN OR FEDERAL DRINKING WATER STANDARDS

Sulfate	11,000	124	500	250
Toluene	1.7	0.068	1	2
Total suspended solids	380	--	--	--
Xylenes	3	0.124	10	--
Zinc	0.09	0.25	--	5

* Action level

Corrective Actions/Regulatory Actions

EPA considered listing the site as a Superfund site, but determined the damage did not merit a listing. The landfi now capped as part of the closure requirements. No further remedial action is planned.

Sources of Information

Wisconsin Department of Natural Resources, Bureau of Solid and Hazardous Waste Management, Solid Waste Manager Section, Groundwater and Environmental Monitoring System database printout, August 15, 1995.

Wisconsin Department of Natural Resources, Bureau of Solid and Hazardous Waste Management, Solid Waste Manager Section, Solid and Hazardous Waste Inventory Management System database printout, August 22, 1995.

Phone conversation with Wisconsin DNR engineer, September 10, 1995.

Written correspondence submitted by facility and/or State on draft version of release descriptions, October 1996

Facility Overview

Facility Name:	Falk Foundry
Location:	Franklin, Wisconsin
Waste Stream:	Foundry sand, wastewater from foundry
Media Affected:	Groundwater, potentially surface water

Falk Foundry is an industrial sand mining landfill located in Franklin, Wisconsin. Root River is 200 feet from the site.

Wastes and Waste Management Practices

The disposal site is a 17-acre unlined landfill. Groundwater is monitored quarterly.

Extent of Contamination

The discharge region is downgradient of a large industrial area. Thus, the Wisconsin Department of Natural Resources (DNR) believes that the source of the contamination may extend beyond the landfill.

As shown in the table below, aluminum, arsenic, barium, cadmium, chloride, chromium, fluoride, iron, lead, manganese, mercury, pH, and sulfate exceeded Wisconsin or Federal water standards.

GROUNDWATER CONTAMINANTS COMPARED TO WISCONSIN OR FEDERAL DRINKING WATER STANDARDS

Contaminant	Highest Detected Level (mg/l)	WI Standard (mg/l)	MCL (mg/l)	SMCL (mg/l)
Aluminum	2.2	--	--	0.05-0.2
Arsenic	0.28	0.005	0.05	--
Barium	0.086	0	2	--
Cadmium	0.001	0.0005	0.005	--
Calcium	170	--	--	--
Calcium carbonate	280	--	--	--
Chloride	1,700	125	--	250
Chromium	0.04	0.01	0.1	--
Copper	0.03	0.13	1.3*	1.0
Fluoride	26	0.44*	4	2
Iron	1,300	0.15	--	0.3
Lead	0.06	0.005	0.015*	--
Magnesium	72	--	--	--
Manganese	0.86	0.025	--	0.05
Mercury	0.0044	0.0002	0.002	--
Nickel	0.02	--	0.1	--
pH	10.4	--	--	6.5-8.5
Phenols	0.01	6	--	--
Potassium	3.7	--	--	--
Selenium	0.002	0.010	0.05	--
Sodium	640	--	--	--
Sulfate	1,350	125	500	250
Zinc	0.08	2.5	--	5

* Action level

Corrective Actions/Regulatory Actions

There is no remediation currently being taken. The DNR recently asked Falk Foundry to analyze leachate to gai more meaningful data.

Sources of Information

Wisconsin Department of Natural Resources, Bureau of Solid and Hazardous Waste Management, Solid Waste Manager Section, Groundwater and Environmental Monitoring System database printout, August 15, 1995.

Wisconsin Department of Natural Resources, Bureau of Solid and Hazardous Waste Management, Solid Waste Manager Section, Solid and Hazardous Waste Inventory Management System database printout, August 22, 1995.

Meeting with Wisconsin DNR hydrogeologist, August 22, 1995.

Written correspondence submitted by facility and/or State on draft version of release descriptions, October 1996

FLAMBEAU PAPER CORPORATION WISCONSIN

Facility Overview

Facility Name:	Flambeau Paper Corporation
Location:	Eisenstein, Wisconsin
Waste Stream:	Paper mill sludge

Flambeau Paper Corporation is a paper mill located in Eisenstein, Wisconsin. Flambeau River is 1,200 feet from the site.

Wastes and Waste Management Practices

The disposal site is an 18-acre landfill that is currently closed. Groundwater is monitored quarterly. The nearest drinking water well is located 1,400 feet from the site.

Extent of Contamination

The facility is in a highly contaminated area. Adjacent areas formerly contained sulfide liquor lagoons, which are thought to be the source of sulfate contamination.

As shown in the table below, chloride, iron, pH, and sulfate exceeded Wisconsin or Federal water standards.

GROUNDWATER CONTAMINANTS COMPARED TO WISCONSIN OR FEDERAL DRINKING WATER STANDARDS

Contaminant	Highest Detected Level (mg/l)	WI Standard (mg/l)	MCL (mg/l)	SMCL (mg/l)
Calcium carbonate	8,500	--	--	--
Chloride	610	125	--	250
Iron	642	0.15	--	0.3
pH	4.4	--	--	6.5-8.5
Sodium	29	--	--	--
Sulfate	2,800	125	500	250
Total dissolved solids	37,507	--	--	500

Corrective Actions/Regulatory Actions

There is no remediation at the landfill; however, the sulfide liquor lagoons are under remediation.

Sources of Information

Wisconsin Department of Natural Resources (DNR), Bureau of Solid and Hazardous Waste Management, Solid Waste Management Section, Groundwater and Environmental Monitoring System database printout, August 15, 1995.

Wisconsin Department of Natural Resources, Bureau of Solid and Hazardous Waste Management, Solid Waste Manager Section, Solid and Hazardous Waste Inventory Management System database printout, August 21, 1995.

Meeting with Wisconsin DNR hydrogeologist, August 22, 1995.

GEORGIA-PACIFIC - TOMAHAWK MILL WISCONSIN

Facility Name:	Georgia-Pacific - Tomahawk Mill
Location:	Tomahawk, Wisconsin
Waste Stream:	Mixed Paper Mill Waste
Media Affected:	Groundwater

Facility Overview

The Tomahawk Mill is a paper mill located in Tomahawk, Wisconsin. Located on a peninsula, the site is 500 feet from the Wisconsin River and 1600 feet from the Spirit River flowage.

Wastes and Waste Management Practices

The disposal site is a 30-acre unlined landfill, which is now closed. Portions of the landfill are covered with silty clay, bentonite amended soil, or geomembrane. There is also a lined landfill adjacent to the unlined disposal site, which is not believed to be causing contamination. Groundwater is monitored quarterly. The nearest drinking water is about 700 feet from the site.

Extent of Contamination

As shown in the table below, cadmium, chloride, iron, manganese, nitrite as N, pH, sulfate, and zinc exceeded Wisconsin or Federal water standards.

GROUNDWATER CONTAMINANTS COMPARED TO WISCONSIN OR FEDERAL DRINKING WATER STANDARDS

Contaminant	Highest Detected Level (mg/l)	WI Standard (mg/l)	MCL (mg/l)	SMCL (mg/l)
Ammonia as N	410	--	--	--
Boron	31.2	--	--	--
Cadmium	0.001	0.0005	0.005	--
Calcium carbonate	540	--	--	--
Chloride	3,625	125	--	250
Fluoride	0.17	0.8	4	2
Iron	320	0.15	--	0.3
Manganese	1.18	0.025	--	0.05
Nitrite as N	2.32	1	10	--
pH	5.6	--	--	6.5-8.5
Potassium	670	--	--	--
Sodium	359	--	--	--
Sulfate	5,000	125	500	250
Zinc	100	2500	--	5

Corrective Actions/Regulatory Actions

There is no further corrective action required. The cover is in place and the site no longer receives waste. The facility is preparing a groundwater investigation report.

Sources of Information

Wisconsin Department of Natural Resources (DNR), Bureau of Solid and Hazardous Waste Management, Solid Waste Management Section, Groundwater and Environmental Monitoring System database printout, August 15, 1995.

Wisconsin Department of Natural Resources, Bureau of Solid and Hazardous Waste Management, Solid Waste Manage Section, Solid and Hazardous Waste Inventory Management System database printout, August 22, 1995.

Meeting with Wisconsin DNR hydrogeologist, August 22, 1995.

GEORGIA-PACIFIC - SARATOGA WISCONSIN

Facility Overview

The Georgia Pacific facility in Saratoga, Wisconsin is a paper mill. The Wisconsin River is 300 feet from the site.

Facility Name:	Georgia-Pacific Waste Water Treatment Site/Landfill Number 3
Location:	Saratoga, Wisconsin
Waste Stream:	Paper mill sludge
Media Affected:	Groundwater

Wastes and Waste Management Practices

The disposal site is a 20-acre three-phase landfill. Phase I is an un-engineered landfill. Phase II is an engineered and lined landfill. Phase III is a lined landfill. Groundwater is monitored quarterly. The nearest drinking water well is 1,000 feet from the site.

Extent of Contamination

Phase I of the landfill is the source of the groundwater contamination.

As shown in the table below, barium, chloride, chromium, copper, iron, manganese, mercury, pH, and sulfate exceeded Wisconsin or Federal water standards.

GROUNDWATER CONTAMINANTS COMPARED TO WISCONSIN OR FEDERAL DRINKING WATER STANDARDS

Contaminant	Highest Detected Level (mg/l)	WI Standard (mg/l)	MCL (mg/l)	SMCL (mg/l)
Barium	3.3	0.2	2	--
Chloride	669	125	--	250
Chromium	0.042	0.01	0.1	--
Copper	0.9	0.13	1.3*	1
Iron	493	0.15	--	0.3
Manganese	72	0.025	--	0.05
Mercury	0.007	0.0002	0.002	--
pH	4.4	--	--	6.5-8.5
Sulfate	680	125	500	250

* Action level

Corrective Actions/Regulatory Actions

A cut-off wall and collection system were installed in the mid 1980s. This system has been very effective in reduc contaminant concentrations in the groundwater and is still active.

Sources of Information

Wisconsin Department of Natural Resources (DNR), Bureau of Solid and Hazardous Waste Management, Solid Waste Management Section, Groundwater and Environmental Monitoring System database printout, August 15, 1995.

Wisconsin Department of Natural Resources, Bureau of Solid and Hazardous Waste Management, Solid Waste Manager Section, Solid and Hazardous Waste Inventory Management System database printout, August 22, 1995.

Meeting with Wisconsin DNR hydrogeologist, August 22, 1995.

Facility Overview

The Kohler Company site is an industrial waste landfill. The Sheboygan River is 150 feet from the site.

Facility Name:	Kohler Co.
Location:	Sheboygan County, Wisconsin
Waste Stream:	Waste foundry sand cores, pottery cull and molds and other non-hazardous industrial wastes.
Media Affected:	Groundwater and surface water

Wastes and Waste Management Practices

The 53-acre landfill, located on a 82-acre parcel is unlined. Groundwater is monitored quarterly. The nearest drinking water well is located one-half mile from the site. From the 1950's through 1975, the site received solvents, oil, and plating wastes.

Extent of Contamination

Pre-RCRA, dike failures occurred and the Sheboygan River was contaminated. The extent of contamination of th Sheboygan River is difficult to measure. The impact to groundwater is a result of releases from the landfill waste mass. Liquids disposed in the landfill and leachate from the site have entered the groundwater system. The impact to groundwa results from a phenolic resin used as a binder for foundry sand molds, as well as other industrial waste received at the lar

As shown in the table below, aluminum, arsenic, barium, cadmium, chloride, chromium (total), iron, lead, manganese, nickel, phenol, sulfate, and total dissolved solids exceeded Wisconsin or Federal water standards.

GROUNDWATER CONTAMINANTS COMPARED TO WISCONSIN OR FEDERAL DRINKING WATER STANDARDS

Contaminant	Highest Detected Level (mg/l)	WI Standard (mg/l)	MCL (mg/l)	SMCL (mg/l)
Aluminum	1.36	--	--	0.05-0.2
Antimony	0.32	--	--	--
Arsenic	0.008	0.005	0.05	--
Barium	10.7	0.2	2	--
Beryllium	0.010	--	0.004	--
Boron	82	--	--	--
Cadmium	0.07	0.0005	0.005	--
Calcium	386	--	--	--
Chloride	148	125	--	250
Chromium (total)	0.048	0.01	0.1	--
Copper	0.12	0.13	1.3*	1
Iron	0.39	0.15	--	0.3
Lead	0.006	0.0015	0.015*	--
Magnesium	127	--	--	--
Manganese	0.37	0.025	--	0.05
Mercury	0.0002	0.0002	0.002	--
Molybdenum	0.0006	--	--	--
Nickel	0.31	--	0.1	--
pH	7.7	6.5-8.5	--	6.5-8.5
Phenol	6	1.2	--	--
Phosphorous	0.41	--	--	--
Potassium	16	--	--	--
Silver	0.0091	0.1	--	0.1
Sodium	546	--	--	--
Strontium	6.5	--	--	--
Sulfate	778	125	500	250
Tin	0.03	--	--	--
Titanium	0.03	--	--	--

GROUNDWATER CONTAMINANTS COMPARED TO WISCONSIN OR FEDERAL DRINKING WATER STANDARDS

Total dissolved solids	2,700	--	--	500
Vanadium	0.442	--	--	--
Zinc	0.15	2.5	--	5

* Action level

Corrective Actions/Regulatory Actions

The Wisconsin Department of Natural Resources (DNR) and USEPA have issued both a Source Control and Groundwater Record of Decision (March 1992 and April 1996, respectively). The selected remedy specifies closure, placement of a clay cap, installation of a groundwater interceptor drain and groundwater monitoring. Remedial action is scheduled to begin in 1997.

Sources of Information

Data from table 5-1 “Constituents of Concern” Environmental Contamination Assessment and Groundwater Remedial Ac Alternatives Report Addendum, Kohler Co. Landfill, November 1995.

Wisconsin Department of Natural Resources, Bureau of Solid and Hazardous Waste Management, Solid Waste Manage Section, Groundwater and Environmental Monitoring System database printout, August 15, 1995.

Wisconsin Department of Natural Resources, Bureau of Solid and Hazardous Waste Management, Solid Waste Manage Section, Solid and Hazardous Waste Inventory Management System database printout, August 21, 1995.

Meeting with Wisconsin DNR hydrogeologist, August 21, 1995.

Written correspondence submitted by facility and/or State on draft version of release descriptions, October 1996

MOSINEE PAPER WISCONSIN

Facility Overview

Facility Name:	Mosinee Paper
Location:	Mosinee, Wisconsin
Waste Stream:	Paper mill sludge primarily, but also ash and bark

The Mosinee Paper Mill is located in Mosinee, Wisconsin. The Wisconsin River is 550 feet from the site.

Wastes and Waste Management Practices

The 10.7-acre landfill has been licensed by the Wisconsin Department of Natural Resources (DNR), since 1978. Of this 10.7 acres, 3.8 acres were closed during 1995 using approved cover procedures. Originally the site was a wastewater lagoon that was converted to an unlined landfill. Groundwater is monitored quarterly. The nearest drinking water well is located 1,300 feet from the site and has n been impacted.

Extent of Contamination

As shown in the table below, chromium, iron, manganese, mercury, pH, and sulfate exceeded Wisconsin or Fede water standards. Background levels of iron are also high in background wells.

GROUNDWATER CONTAMINANTS COMPARED TO WISCONSIN OR FEDERAL DRINKING WATER STANDARDS

Contaminant	Highest Detected Level (mg/l)	WI Standard (mg/l)	MCL (mg/l)	SMCL (mg/l)
Chloride	51	125	--	250
Chromium	0.05	0.01	0.1	--
Iron	988	0.15	--	0.3
Manganese	38.6	0.025	--	0.05
Mercury	0.002	0.0002	0.002	--
Nitrate as N	0.65	--	10	--
pH	5.4	6.5-8.5	--	6.5-8.5
Phosphorous	1.03	--	--	--
Sodium	420	--	--	--
Sulfate	174	125	500	250
Total dissolved solids	1,268	--	--	500

* Action level

Corrective Actions/Regulatory Actions

A downgradient groundwater collection trench was installed by Mosinee in 1987 in response to a negotiated remediation plan with the Wisconsin DNR, but no cut-off walls were required or installed. The groundwater collection tren collects downgradient groundwater and returns it for treatment through a WPDES wastewater facility along with leachate collected from the site. There is no further remedial action planned.

Sources of Information

Wisconsin Department of Natural Resources, Bureau of Solid and Hazardous Waste Management, Solid Waste Manager Section, Groundwater and Environmental Monitoring System database printout, August 15, 1995.

Wisconsin Department of Natural Resources, Bureau of Solid and Hazardous Waste Management, Solid Waste Manager Section, Solid and Hazardous Waste Inventory Management System database printout, August 22, 1995.

Meeting with Wisconsin DNR hydrogeologist, August 22, 1995.

Written correspondence submitted by facility and/or State on draft version of release descriptions, October 1996

Facility Name: Neenah Parkside - Bergstrom
Location: Neenah, Wisconsin
Waste Stream: Paper mill sludge
Media Affected: Groundwater

Facility Overview

The Neenah Parkside-Bergstrom site is a paper mill located in Neenah, Wisconsin. Lake Butte is 25 feet from the site.

Wastes and Waste Management Practices

The disposal site is a 23-acre unlined landfill. The facility is located within the floodplain of Lake Butte. Sludge is used to fill this area of the floodplain. Groundwater is monitored quarterly.

Extent of Contamination

As shown in the table below, chloride, iron, pH, and sulfate exceeded Wisconsin or Federal water standards.

GROUNDWATER CONTAMINANTS COMPARED TO WISCONSIN OR FEDERAL DRINKING WATER STANDARDS

Contaminant	Highest Detected Level (mg/l)	WI Standard (mg/l)	MCL (mg/l)	SMCL (mg/l)
Calcium carbonate	1,880	--	--	--
Chloride	854	125	--	250
Iron	80	0.15	--	0.3
pH	5.7	--	--	6.5-8.5
Sulfate	764	125	500	250

Corrective Actions/Regulatory Actions

A partial non-engineered cap exists on the landfill. There are no further plans to upgrade the design of the dispos site.

Sources of Information

Wisconsin Department of Natural Resources (DNR), Bureau of Solid and Hazardous Waste Management, Solid Waste Management Section, Groundwater and Environmental Monitoring System database printout, August 15, 1995.

Wisconsin Department of Natural Resources, Bureau of Solid and Hazardous Waste Management, Solid Waste Manage Section, Solid and Hazardous Waste Inventory Management System database printout, August 21, 1995.

Meeting with Wisconsin DNR hydrogeologist, August 22, 1995.

Written correspondence submitted by facility and/or State on draft version of release descriptions, October 1996.

NEKOOSA PAPERS INC. WISCONSIN

Facility Overview

Facility Name:	Nekoosa Papers Inc.
Location:	Nekoosa, Wisconsin
Waste Stream:	Ash and bark
Media Affected:	Groundwater

The Nekoosa Paper Mill is located in Port Edwards, Wisconsin. The Wisconsin River is 1,500 feet from the site.

Wastes and Waste Management Practices

The disposal site, licensed in 1976, is a 35-acre unlined landfill. A clay cut-off wall and gradient system were installed in 1980. The cut-off wall was constructed on three sides of the original landfill and an expansion site, on the west, north, and east side of the combined sites. The cut-off wall was keyed into the decomposed rock to a depth of approximately 16 to 24 feet below grade. the cut-off wall was designed to take advantage of the groundwater mound configuration at the site and the fact that there is no tendency for water to flow to the south from the landfill area. To ensu that positive gradients are maintained towards the landfill and that contaminants leached from the sludge do not migrate t south, a groundwater gradient control system was incorporated into the design. Groundwater is monitored quarterly.

Extent of Contamination

As shown in the table below, chloride, iron, pH, sulfate, and total dissolved solids exceeded Wisconsin or Federa water standards. In the case of iron, the area groundwater is known to have high iron content. The data in the table does reflect present conditions. Most data are prior to additional remediation efforts taken in 1983.

GROUNDWATER CONTAMINANTS COMPARED TO WISCONSIN OR FEDERAL DRINKING WATER STANDARDS

Contaminant	Highest Detected Level (mg/l)	WI Standard (mg/l)	MCL (mg/l)	SMCL (mg/l)
Calcium	244	--	--	--
Calcium carbonate	981	--	--	--
Chloride	150	125	--	250
Iron	382	0.15	--	0.3
pH	5.2	--	--	6.5-8.5
Sodium	623	--	--	--
Sulfate	1,800	125	500	250
Total dissolved solids	2,170	--	--	500

Corrective Actions/Regulatory Actions

The site was modified in 1977 to include a clay cut-off wall keyed into the weathered bedrock zone, where it exist and rested on solid bedrock over the remainder of the perimeter. The cut-off wall was constructed around the full perime the landfill. An interior leachate collection system and french drain system were installed and operated in late 1977. The efforts were undertaken under the direction of the State of Wisconsin and were completed with the cooperation and participation between the Wisconsin Department of Natural Resources and Nekoosa Papers Inc. Gradual groundwater degradation in wells 19 and 20 was noticed beginning in 1981 after showing improvement after the modification. An addi french drain was installed on the south side and partially on the east and west sides in late 1982. A new, higher capacity leachate pump was started up in 1983, which lowered the water level within the cut-off wall under the landfill and assured in-gradient flow of groundwater from outside the periphery. The groundwater quality in the vicinity of the landfill has impro since reconstruction of the landfill.

Sources of Information

Wisconsin Department of Natural Resources, Bureau of Solid and Hazardous Waste Management, Solid Waste Manage Section, Groundwater and Environmental Monitoring System database printout, August 15, 1995.

Wisconsin Department of Natural Resources, Bureau of Solid and Hazardous Waste Management, Solid Waste Manage
Section, Solid and Hazardous Waste Inventory Management System database printout, August 22, 1995.

Meeting with Wisconsin DNR hydrogeologist, August 22, 1995.

Written correspondence submitted by facility and/or State on draft version of release descriptions, October 1996.

NIAGARA OF WISCONSIN PAPER CORP. WISCONSIN

Facility Overview

The Niagara Paper Mill is located in Marinette County, Wisconsin. Monitoring wells are located within 50 feet of the Menominee River. The facility is located along the side of the river.

Facility Name: Niagara of Wisconsin Paper Corp.
Location: Marinette County, Wisconsin
Waste Stream: Paper mill sludge
Media Affected: Groundwater

Wastes and Waste Management Practices

The landfill is closed, with no other industry in the immediate vicinity. The landfill was completely capped in the last two years. Groundwater is monitored quarterly.

Extent of Contamination

As shown in the table below, boron, cadmium, iron, pH, selenium, and sulfate exceeded Wisconsin or Federal wa standards.

GROUNDWATER CONTAMINANTS COMPARED TO WISCONSIN OR FEDERAL DRINKING WATER STANDARDS

Contaminant	Highest Detected Level (mg/l)	WI Standard (mg/l)	MCL (mg/l)	SMCL (mg/l)
Boron	80.3	2.9	--	--
Cadmium	3	0.0005	0.005	--
Calcium carbonate	2,820	--	--	--
Iron	0.5	0.15	--	0.3
pH	6.2		--	6.5-8.5
Potassium	495	--	--	--
Selenium	26.6	0.01	0.05	--
Sulfate	4,404	125	500	250
Zinc	0.1	2.5	--	5

Corrective Actions/Regulatory Actions

Wisconsin Department of Natural Resources (DNR) received an Environmental Contamination Assessment (ECA report from the site in August 1995. An upgraded cap and additional wells were installed. The agency has not recommen further action.

Sources of Information

Wisconsin Department of Natural Resources, Bureau of Solid and Hazardous Waste Management, Solid Waste Manage Section, Groundwater and Environmental Monitoring System database printout, August 15, 1995.

Wisconsin Department of Natural Resources, Bureau of Solid and Hazardous Waste Management, Solid Waste Manage Section, Solid and Hazardous Waste Inventory Management System database printout, August 22, 1995.

Phone conversation with Wisconsin DNR hydrogeologist, September 14, 1995.

Written correspondence submitted by facility and/or State on draft version of release descriptions, October 1996.

POPE & TALBOT WISCONSIN INC. LANDFILL WISCONSIN

Facility Overview

The Pope & Talbot landfill is located in Eau Claire County, Wisconsin. Six Mile Creek is 200 feet from the site.

Facility Name:	Pope & Talbot Wisconsin Inc. Landfill
Location:	Eau Claire County, Wisconsin
Waste Stream:	Paper mill sludges
Media Affected:	Groundwater

Wastes and Waste Management Practices

The 19-acre landfill began receiving waste in 1978. Currently, the site has a three-foot clay liner and leachate collection system (Phase 3 area). Previously, the site dewatered the sludge, compacted it, and used it as a liner (Phases 1 and 2 areas). The sludge liner is suspected to have developed fractures and leachate permeated the compacted waste liner.

Groundwater is monitored quarterly. The nearest drinking water well is located 1,350 feet from the site.

Extent of Contamination

A breach in the compacted sludge liner in Phases 1 and 2 and leachate handling practices resulted in an impact t groundwater. The paper mill manufactures recycled paper, and therefore, must use solvents to de-ink the recycled paper Many of the contaminants found in the groundwater are process solvents used in the de-inking phase. Private drinking w wells, located approximately 1,000 feet from the facility, were contaminated with volatile organic compounds (VOCs) and There is no evidence that organisms in the surface water have been impacted.

As shown in the table below, benzene, cadmium, chloride, chromium, 1,1-dichlorethylene, trans-1,2-dichloroethylene, iron (dissolved), manganese, naphthalene, nitrate/nitrite as N, pH, sodium, toluene, trichloroethylene, a vinyl chloride exceeded Wisconsin or Federal water standards.

GROUNDWATER CONTAMINANTS COMPARED TO WISCONSIN OR FEDERAL DRINKING WATER STANDARDS

Contaminant	Highest Detected Level (mg/l)	WI Standard (mg/l)	MCL (mg/l)	SMCL (mg/l)
Ammonia as N	19	--	--	--
Benzene	0.0015	0.0005	0.005	--
Bromodichloromethane	0.0001	0.036	0.1	--
n-Butylbenzene	0.00078	--	--	--
sec-Butylbenzene	0.00042	--	--	--
Cadmium	0.001	0.0005	0.005	--
Calcium	32	--	--	--
Calcium carbonate	5,300	--	--	--
Carbon tetrachloride	0.0001	0.0005	0.005	--
Chloride	210	125	--	250
Chlorobenzene	0.0017	--	--	--
Chloroethane	0.003	0.08	--	--
Chloroform	0.0001	0.0006	0.1	--
Chloromethane	0.00033	--	--	--
o-Chlorotoluene	0.016	--	--	--
p-Chlorotoluene	0.00027	--	--	--
Chromium	0.082	0.01	0.1	--
Dibromochloromethane	0.0001	0.043	--	--
m-Dichlorobenzene	0.0001	0.125	0.6	--

GROUNDWATER CONTAMINANTS COMPARED TO WISCONSIN OR FEDERAL DRINKING WATER STANDARDS

o-Dichlorobenzene	0.0001	0.06	0.6	--
p-Dichlorobenzene	0.0001	0.015	0.075	--
1,1-Dichloroethane	0.016	0.085	--	--
1,1-Dichlorethylene	0.005	0.0007	0.007	--
cis-1,2-Dichloroethylene	0.0016	0.01	0.07	--
trans-1,2-Dichloroethylene	0.052	0.02	0.1	--
Dichloromethane	0.004	0.015	0.005	--
1,2-Dichloropropane	0.0001	0.0005	0.005	--
trans-1,3-Dichloropropylene	0.0001	--	--	--
Ethylbenzene	0.0012	0.14	0.7	--
Freon	0.0025	0.698	--	--
Iron (dissolved)	230	0.15	--	0.3
Isopropylbenzene	0.0024	--	--	--
Isopropyl toluene	0.00058	--	--	--
Manganese	1.34	0.025	--	0.05
Naphthalene	0.019	0.008	--	--
Nickel	0.057	--	0.1	--
Nitrate/nitrite as N	11	2	10	--
pH	4.8	6.5-8.5	--	6.5-8.5
n-Propylbenzene	0.0051	--	--	--
Sodium	64	15	--	--
Sulfate	10	125	500	250
Toluene	0.79	0.069	1.0	--
Tribromomethane	0.0001	--	--	--
Trichloroethylene	0.006	0.0005	0.005	--
1,1,1-Trichloroethylene	0.0001	0.04	0.005	--
1,2,4-Trimethylbenzene	0.028	--	--	--
1,3,5-Trimethylbenzene	0.0098	--	--	--
Vinyl chloride	0.016	0.00002	0.002	--
Xylene	0.0045	0.124	10	--
Zinc	0.285	2.5	--	5

Corrective Actions/Regulatory Actions

The facility altered its de-inking process. The site placed a composite cap over Phase 1 and 2 areas of the landfi
The site attempted to install leachate extraction wells through the sludge, but the wells have had limited success in remov
leachate. The site was required to replace impacted private wells with a sidegradient shared well.

Sources of Information

Wisconsin Department of Natural Resources, Bureau of Solid and Hazardous Waste Management, Solid Waste Manage
Section, Groundwater and Environmental Monitoring System database printout. August 15, 1995.

Wisconsin Department of Natural Resources, Bureau of Solid and Hazardous Waste Management, Solid Waste Manage
Section, Solid and Hazardous Waste Inventory Management System database printout, August 21, 1995.

Meeting with Wisconsin DNR hydrogeologist, August 21, 1995.

Written correspondence submitted by facility and/or State on draft version of release descriptions, October 1996

RICHLAND CENTER FOUNDRY WISCONSIN

Facility Overview

Facility Name:	Richland Center Foundry
Location:	Richland Center, Wisconsin
Waste Stream:	Foundry sand
Media Affected:	Groundwater

The Richland Center Foundry is an industrial spent sand landfill in Richland Center, Wisconsin. The Pine River is an average of 350 feet away from the mouth foot of the landfill.

Wastes and Waste Management Practices

The 3.7 acre landfill received foundry sand waste from 1975 until its closure in 1990. Phases I, II, and III of the landfill are unlined but are clay capped according to applicable regulations; phase IV is both lined and capped. Eleven groundwater monitoring wells are tested biannually an leachate wells are checked monthly to verify their dry condition. There are no drinking wells near the site.

Extent of Contamination

The groundwater has exceedances of Wisconsin groundwater standards for iron and chloride, as well as high conductivity and chemical oxygen demand. No specific data were available. It is possible that the high iron levels are du natural causes and that the high chloride levels are due to the practice of "salting" Highway 14 during the winter months.

Corrective Actions/Regulatory Actions

As part of its closure plan, the site installed a multi-layered cap of clay and cover soils. No further action is anticipated.

Sources of Information

Wisconsin Department of Natural Resources, Bureau of Solid and Hazardous Waste Management, Solid Waste Manage Section, Solid and Hazardous Waste Inventory Management System database query, August 21, 1995.

Meeting with Wisconsin DNR hydrogeologist, August 21, 1995.

Written correspondence submitted by facility and/or State on draft version of release descriptions, October 1996

Facility Overview

The Tomahawk Paper Mill is located in Tomahawk, Wisconsin. Wetlands exist 1,360 feet from the site. The facility is currently bankrupt.

Wastes and Waste Management Practices

The disposal facility is a 20-acre unlined landfill. Groundwater was monitored quarterly from 1976 to 1989. The nearest drinking water well is two miles from the site.

Facility Name:	Tomahawk Tissue Corporation
Location:	Tomahawk, Wisconsin
Waste Stream:	Paper mill sludge
Media Affected:	Groundwater

Extent of Contamination

As shown in the table below, iron, manganese, and pH exceeded Wisconsin or Federal water standards.

GROUNDWATER CONTAMINANTS COMPARED TO WISCONSIN OR FEDERAL DRINKING WATER STANDARDS

Contaminant	Highest Detected Level (mg/l)	WI Standard (mg/l)	MCL (mg/l)	SMCL (mg/l)
Calcium	88	--	--	--
Chloride	28.4	125	--	250
Chlorobenzene	0.0067	--	--	--
p-Dichlorobenzene	0.0029	0.015	0.075	--
Iron	40.5	0.15	--	0.3
Magnesium	26.4	--		--
Manganese	4.8	0.025	--	0.05
pH	5.9	--	--	6.5-8.5
Sulfate	23	125	500	250
Total dissolved solids	370	--	--	500
Total suspended solids	37,860	--	--	--
Xylene	0.0042	0.124	10	--

Corrective Actions/Regulatory Actions

In 1991 the facility's license was revoked. No other information about the facility was readily available.

Sources of Information

Wisconsin Department of Natural Resources, Bureau of Solid and Hazardous Waste Management, Solid Waste Manage Section, Groundwater and Environmental Monitoring System database printout, August 15, 1995.

Wisconsin Department of Natural Resources, Bureau of Solid and Hazardous Waste Management, Solid Waste Manage Section, Solid and Hazardous Waste Inventory Management System database printout, August 22, 1995.

Meeting with Wisconsin DNR hydrogeologist, August 22, 1995.

Written correspondence submitted by facility and/or State on draft version of release descriptions, October 1996.

TORK ALUM LANDFILL WISCONSIN

Facility Overview

Facility Name:	Tork Alum Landfill
Location:	Wisconsin Rapids, Wisconsin
Waste Stream:	Alum sludge
Media Affected:	Groundwater

The Tork Alum Landfill is located in Wisconsin Rapids, Wisconsin. Cranberry Creek is located 300 feet from the landfill.

Wastes and Waste Management Practices

The disposal site is a 10-acre unlined landfill. The landfill is licensed by the Wisconsin Department of Natural Resources and was owned and operated between the mid 1950's and 1983 by Tork Landfill Corporation. While in operation, the landfill accepted low-pH waste clay residue generated during the production of aluminum sulfate (alum) by the former Allied Chemical Corporation (now Allie Signal Inc.) at a facility in Wisconsin Rapids, WI. Groundwater and surface water monitoring at the site has continued on routine basis since the site closed, with the analytical results submitted to the WDNR on a quarterly basis.

Extent of Contamination

The site has been closed for many years; however, it is still impacting groundwater. Wisconsin Department of Natural Resources also believes that surface water may be affected, but does not have surface water data.

As shown in the table below, cadmium, chloride, chromium, iron, lead, pH, and sulfate exceeded Wisconsin or Federal water standards.

GROUNDWATER CONTAMINANTS COMPARED TO WISCONSIN OR FEDERAL DRINKING WATER STANDARDS

Contaminant	Highest Detected Level (mg/l)	WI Standard (mg/l)	MCL (mg/l)	SMCL (mg/l)
Aluminum	99	--	--	0.05-0.2
Cadmium	0.7	0.0005	0.005	--
Calcium	103	--	--	--
Chloride	1,065	125	--	250
Chromium	58	0.01	0.1	--
Iron	600	0.15	--	0.3
Lead	28	0.0015	0.015*	--
Magnesium	475	--	--	--
pH	3.2	--	--	6.5-8.5
Sulfate	26,000	125	500	250
Total dissolved solids	1730	--	--	500
Zinc	1.19	2.5	--	5

* Action level

The highest concentrations detected for cadmium, chromium, and lead are not from the routine monitoring progra and represent a one-time monitoring event in August of 1979. It is doubtful the sampling techniques utilized at the time m current standards. It is also unlikely the samples were field filtered. The 1992 DNR SSI and 1996 ACE sampling results not support the data collected in 1979. It should also be noted that the reported highest concentrations are above the lev reported in the pore water of the alum residue.

The highest chloride level noted in the draft table is from February 1978 in well AC-6B. This is one of the two questionable chloride results that exceeded 1,000 mg/L during that time period. Also, the alum residue pore water had a low chloride concentration, 17 mg/L.

Corrective Actions/Regulatory Actions

A soil cap was placed over the site upon closure and construction documentation of the closure was approved by the State on March 15, 1984. The State completed a Potential Hazardous Waste Site-Preliminary Assessment of the lan in June 1984 and ranked the landfill as a low priority. As part of a cooperative agreement between the USEPA and the S a Site Screening Inspection (SSI) was conducted at the landfill by the State on April 2, 1991. In December, 1995, the Sta issued a Plan Modification Approval to address exceedances of state standards for sulfates in groundwater at the site. T Plan Modification required an Environmental Contamination Assessment be prepared and conducted at the site, which is currently underway.

Sources of Information

Wisconsin Department of Natural Resources, Bureau of Solid and Hazardous Waste Management, Solid Waste Manage Section, Groundwater and Environmental Monitoring System database printout, August 15, 1995.

Wisconsin Department of Natural Resources, Bureau of Solid and Hazardous Waste Management, Solid Waste Manage Section, Solid and Hazardous Waste Inventory Management System database printout, August 22, 1995.

Meeting with Wisconsin DNR hydrogeologist, August 22, 1995.

Written correspondence submitted by facility and/or State on draft version of release descriptions, October 1996.

Facility Overview

The Ward Paper Mill is located in Merrill, Wisconsin. The facility ceased operations in late 1994 and the landfill ceased receiving paper mill sludge at that time. No known surface water bodies exist on or near the site.

Facility Name: Ward Paper
Location: Merrill, Wisconsin
Waste Stream: Paper mill sludge
Media Affected: Groundwater

Wastes and Waste Management Practices

The 9-acre site began receiving waste in 1983. The landfill is divided into five cells. Cells I-IV are unlined. Cell V has a liner composed of recompacted native soil (silty sand) overlain by a geomembrane. The final cover is soil and geomembrane. Groundwater is monitored quarterly.

Extent of Contamination

The site is fairly isolated. Wisconsin's hydrogeologists believe that the landfill waste is the sole source of the groundwater contamination.

As shown in the table below, cadmium, iron, lead, mercury, nitrate/nitrite, and pH exceeded Wisconsin or Federal water standards.

GROUNDWATER CONTAMINANTS COMPARED TO WISCONSIN OR FEDERAL DRINKING WATER STANDARDS

Contaminant	Highest Detected Level (mg/l)	WI Standard (mg/l)	MCL (mg/l)	SMCL (mg/l)
Arsenic	0.0039	0.005	--	--
Boron	2.1	--		--
Cadmium	0.02	0.0005	0.005	--
Calcium carbonate	317	--	--	--
Chloride	80	125	--	250
Chromium	0.0014	0.010	--	--
Iron	17.6	0.15	--	0.3
Lead	0.008	0.005	0.015*	--
Magnesium	75	--	--	--
Mercury	0.004	0.0002	0.002	--
Nitrate/nitrite as N	3.8	2	10	--
pH	6	--	--	6.5-8.5
Selenium	0.0045	0.01	0.05	--
Sodium	4	--	--	--
Sulfate	52.3	125	500	250
Zinc	0.1	2.5	--	5

* Action level

Corrective Actions/Regulatory Actions

The facility performed an Environmental Contamination Assessment and determined that a composite liner shoul be installed in Cell V if the facility is to remain active. The landfill has been closed and the final closure documentation is being developed. Under the new Wisconsin solid waste regulations promulgated in July 1996, the Wisconsin Departmen Natural Resources is considering relaxing the monitoring requirements from quarterly to semi-annually.

Sources of Information

Wisconsin Department of Natural Resources, Bureau of Solid and Hazardous Waste Management, Solid Waste Manager Section, Groundwater and Environmental Monitoring System database printout, August 15, 1995.

Wisconsin Department of Natural Resources, Bureau of Solid and Hazardous Waste Management, Solid Waste Manage
Section, Solid and Hazardous Waste Inventory Management System database printout, August 21, 1995.

Meeting with Wisconsin DNR hydrogeologist, August 22, 1995.

Written correspondence submitted by facility and/or State on draft version of release descriptions, October 1996

WAUSAU PAPER MILLS WISCONSIN

Facility Overview

The Wausau Paper Mill is located in Brokaw, Wisconsin. The Wisconsin River is 1,000 feet from the site.

Facility Name:	Wausau Paper Mills
Location:	Brokaw, Wisconsin
Waste Stream:	Paper mill sludge
Media Affected:	Groundwater

Wastes and Waste Management Practices

The disposal site is a 6-acre landfill. The landfill is divided into three cells. Cell I is unlined and has no leachate collection system. Cell II is lined and has a leachate collection system. Cell III has a five-foot clay liner and a leachate collection system. Groundwater is currently monitored quarterly but may be changed in part to semi-annually. The nearest drinking water well is 2,650 feet side gradient from the site.

Extent of Contamination

The contamination is thought to be caused by Cell I of the landfill. According to the Wisconsin Department of Natural Resources (DNR) hydrogeologist, there are exceedances of Wisconsin groundwater quality standards for the following parameters: alkalinity, chemical oxygen demand, iron, manganese, and hardness.

As shown in the table below, chloride and iron exceeded Wisconsin or Federal water standards. The standard fo iron has also been exceeded at several upgradient (background) wells.

GROUNDWATER CONTAMINANTS COMPARED TO WISCONSIN OR FEDERAL DRINKING WATER STANDARDS

Contaminant	Highest Detected Level (mg/l)	WI Standard (mg/l)	MCL (mg/l)	SMCL (mg/l)
Calcium carbonate	5,160	--	--	--
Chloride	310	125	--	250
Iron	11.1	0.15	--	0.3
pH	6.06	--	--	6.5-8.5
Sulfate	20.5	125	500	250

Corrective Actions/Regulatory Actions

Cell I and Cell II are currently closed. The Wisconsin DNR has required Cell I to be recapped with a composite c of clay, bentonite mat, and geomembrane, which was subsequently completed by July 1996. If the problem continues, th other cells will be considered for additional corrective action.

Sources of Information

Wisconsin Department of Natural Resources, Bureau of Solid and Hazardous Waste Management, Solid Waste Manage Section, Groundwater and Environmental Monitoring System database printout, August 15, 1995.

Wisconsin Department of Natural Resources, Bureau of Solid and Hazardous Waste Management, Solid Waste Manage Section, Solid and Hazardous Waste Inventory Management System database printout, August 22, 1995.

Meeting with Wisconsin DNR hydrogeologist, August 22, 1995.

Written correspondence submitted by facility and/or State on draft version of release descriptions, October 1996

SECTION A.2:

CONSTRUCTION AND DEMOLITION LANDFILL RELEASE DESCRIPTIONS

GAROFALO C&D SITE ISLIP, NEW YORK

Media Affected: Groundwater

Overview of Site/Site History

The Garofalo C&D landfill was operated illegally by the Garofalo Carting Company (the Company) on land owne Pilgrim State Psychiatric Center (PSPC) in Islip, New York. In 1978, the Company was confronted by the New York Stat Department of Environmental Conservation (NYSDEC) concerning illegal dumping and excavating on land owned by the PSPC. The Company has been fined and repeatedly ordered to clean up the site, but has not complied with the sanction

The Garofalo site is located in a densely populated section of Long Island. Approximately 10,000 people reside within three miles of the landfill, including 1,200 people at the PSPC located immediately south of the site. Several schoo are located within one mile of the site.

Facility Operations

The Garofalo C&D landfill was cited for violations under the New York State Environmental Conservation Law, Article 27, in 1986. Testing found the landfill material to be comprised of 10 to 60 percent sandy soil with lesser amounts silt, and mechanically crushed wood, metal, plastic, bricks, concrete, whole trees and brush, large timbers, pilings, railroa ties, chain link fencing, rugs, plastic, and fiberglass sheeting. In 1989, approximately 100 syringes with needles and som intravenous tubing were found on PSPC property, near the landfill site.

Facility Design

Five test pits excavated at the site revealed no engineered cover material. We assume that there is no liner or leachate collection system, but the Preliminary Site Assessment (PSA) did not specifically discuss these features.

Site Environment and Hydrogeology

The landfill is located in the Upper Glacial geologic unit, which extends to at least 90 feet below the land surface. The unit is comprised of coarse to fine sand and medium to fine gravel, with less than five percent silt. The soils are high permeable, with hydraulic conductivities ranging from 1.46 x 10^{-1} to 6.55 x 10^{-1} centimeters per second (cm/sec). Average annual precipitation for the region is 43.4 inches per year, 21 inches of which is available for infiltration.

The landfill is located in a primary recharge area to the Upper Glacial aquifer, which is hydraulically connected to other aquifers (the Magothy Formation and the Lloyd sand of the Raritan Formation). Both the Upper Glacial and the Mag aquifers are pumped for domestic and industrial uses in the vicinity of the site. Two municipal well fields are located abou 1.25 miles and 3 miles from the site. The aquifer system has been designated a "Sole Source Aquifer" by the U.S. EPA u the provisions of the Federal State Drinking Water Act.

Although wetlands are located near the site, they are isolated from the landfill by road systems. It is not likely tha surface water run-off will reach any rivers or creeks due to topographic and human-built borders.

Summary of Environmental Damages

Groundwater monitoring at the perimeter of the landfill detected seven inorganic contaminants at elevations that exceed the New York State Class GA standards for groundwater. The levels of these contaminants, as well as the level o total dissolved solids (TDS) are compared to Class GA standards and EPA drinking water standards (MCLs and SMCLs) Table 1.

TABLE 1
GROUNDWATER CONTAMINANTS EXCEEDING
NEW YORK AND/OR FEDERAL DRINKING WATER STANDARDS

Contaminant	Highest Detected Level (µg/l)	Class GA Standard (µg/l)	MCL (µg/l)	SMCL (µg/l)
Chromium	134	50	100	--
Iron	130,000	300	--	300

Lead	90	25	15*	--
Magnesium	94,900	35,000	--	--
Manganese	33,200	300	--	50
Sodium	178,000	20,000	--	--
TDS	1,630,000	500,000	--	500,000
Zinc	391	300	--	5000

*Value is action level for lead at the tap

Discussion

Ground water at the perimeter of the landfill was found to contain several contaminants at levels above their drink water standards.

Municipal well fields are located about 1.25 to 3 miles from the site. Off-site groundwater monitoring was not conducted as part of this study. According to the investigators, data from this one round of sampling do not conclusively determine whether or not the C&D landfill is affecting groundwater quality near the site.

No disposal of hazardous waste (as defined in 6NYCRR Part 371) was documented during the PSA. The PSA recommended closing the Garofalo C&D site, and capping it to reduce infiltration and provide surface water control.

Source

Final Preliminary Site Assessment: Garofalo C&D Site; New York State Department of Environmental Conservation (NYSDEC); November 1991.

COX'S DARBYTOWN ROAD LANDFILL HENRICO COUNTY, VIRGINIA

Media Affected: Groundwater

Overview of Site/Site History

The 100-acre site is located in Henrico County, Virginia, adjacent to a road and two miles from the Richmond International Airport runway. According to an engineering company working for the landfill, the shallow aquifer in the area the landfill receives only limited use. Although the exact opening date of the landfill is unknown, the landfill received a pe on June 20, 1989 for its third parcel (a 34-acre area) to accept wastes; the other two parcels had already been receiving demolition wastes. According to the source documents, the landfill has accepted only construction, demolition, and debri wastes.

Facility Operations

The site is permitted to accept only construction, demolition, and debris wastes, including construction debris, demolition debris, broken brick, block, concrete rubble, brush, tree trimmings, stumps, and leaves. Excluded are municip solid waste (any putrescible waste), industrial waste, liquid waste, and hazardous waste. According to the 1989 site investigation, the site apparently also accepted tires.

Facility Design

The design of the landfill required a one-foot liner of on-site soil with a permeability of less than 1 x 10^{-6} centimeters/second, a leachate collection system of PVC pipe for each cell, a collection manhole for each cell, and a pum and haul process to a treatment facility. A 1988 memo from the Wiley and Wilson engineering firm noted that where exis sand pits were located, the pits would be filled with non-organic waste material consisting of broken concrete, bricks, brok pavement, and soil up to an elevation of one foot below the bottom of the landfill and then covered with a one-foot liner la The design included a 100-foot wide buffer strip around the perimeter of the entire landfill with a 50-foot buffer strip on the inside boundaries of the adjoining sections of the landfill. Groundwater monitoring is conducted at one upgradient and th downgradient wells.

Site Environment and Hydrogeology

The shallow aquifer lies 1 to 14 feet below the ground surface in the area of the landfill, but the landfilll design required at least 3 feet between the seasonal high groundwater elevation and the bottom of the landfill, including a one-fo liner. It is unclear whether the landfill design is in violation of this requirement. A nearly impermeable marl layer serves a confining layer to the deeper aquifer. The site apparently has gently sloping topography.

In the shallow aquifer, the dominant groundwater flow direction at the site is northward. The groundwater velocity ranges from 5.6 x 10^{-6} cm/sec at the eastern portion of the site to 8.8 x 10^{-6} cm/sec at the western portion of the site. The hydraulic gradient ranges from 0.012-0.019 ft/ft at the site. Little is known about the deeper aquifer except that it is virtua confined by an overlaying marl.

Summary of Environmental Damages

A 1989 site inspection revealed waste slopes exposed due to lack of sufficient cover, a breach of the 50-foot buff zone between wastes and the edge of the property, and leachate seeps that did not leave the site.

1993 monitoring results indicated statistically significant increases in specific conductance and total organic carbo (TOC) in downgradient on-site wells when compared to an upgradient well. In addition, pH was found to be unusually low during the 1991 monitoring.

TABLE 1
GROUNDWATER PARAMETERS EXCEEDING BACKGROUND LEVELS AND FEDERAL DRINKING WATER STANDARDS

Parameter	Highest Detected Level	Background Level	MCL	SMCL
TOC (μg/l)	57,000	21,200	--	--
Conductance (umhos/cm)	2,758	170	--	--

Parameter	Lowest	Background	MCL	SMCL
pH	5.98	6.6	--	6.5-8.5

Discussion

According to the 1993 Annual Report, data gathered from groundwater monitoring indicate that contamination ma be occurring in the groundwater at Cox's Darbytown Road Landfill. The facility was moved into the Phase II monitoring program because specific conductance and TOC were significantly higher in downgradient wells than in the upgradient/background well. The source documents do not address whether or not the contamination extends off-site.

Sources

1993 Annual Report, Cox's Darbytown Road Landfill, Inc. Prepared by Joyce Engineering, Inc., June 1994.

1st Quarter Phase I Sampling Event Results, Cox's Darbytown Road Landfill, Inc. Prepared by Joyce Engineering, Inc., M 1994.

2nd Quarter Water Monitoring Analyses, Cox's Darbytown Road Landfill, Inc. Prepared by Joyce Engineering, Inc., July

Chemical Analytical Report, Central Virginia Laboratories and Consultants, May 1994.

Commonwealth of Virginia, Solid Waste Disposal Site Inspection Report of Darbytown Landfill, September 5, 1989.

Commonwealth of Virginia, Department of Health Permit to M&M Wrecking Company, Inc., for a Sanitary Landfill, July 3, 1975.

Memorandum from Linda K. Lightfoot to Berry F. Wright, Virginia Department of Waste Management, November 20, 198

Memorandum from Wiley & Wilson to Berry F. Wright, Jr., Virginia Department of Waste Management, January 13, 1988

Memorandum from Wiley & Wilson to Berry F. Wright, Jr., Virginia Department of Waste Management, January 20, 1988

Memorandum from John F. Deal to Dr. W. Gulevich, Virginia Department of Waste Management, August 19, 1987.

Memorandum from S.B. Cox, Inc. to Hassan Vakili, Virginia Department of Waste Management, January 8, 1993.

Memorandum from Edward Hollos, Joyce Engineering, Inc. to Howard Freeland, Virginia Department of Environmental Quality, June 30, 1994.

Memorandum from Harry Gregori, Virginia Department of Waste Management to S.B. Cox, Inc., June 21, 1991.

Solid Waste Facility Permit, June 20, 1989.

Solid Waste Facility Permit, July 26, 1988.

Media Affected: Groundwater, Surface Water

Overview of Site/Site History

The Qualla Road Landfill is an active 33-acre C&D landfill located in a mainly agricultural area in Chesterfield County, Virginia. The landfill opened in 1983 with an 11-acre area, and 22 acres were added in 1988. To date, 16 of thos acres have received waste. The facility is owned by a private farmer and leased to Sanifill, Inc. The landfill capacity is estimated to be 1.523 million cubic yards over a design life of 12 years.

Two fires have been reported at the landfill, one in 1990 and one in 1993. Both were quickly extinguished.

Facility Operations

The Qualla Road Landfill accepts C&D waste, brick, concrete rubble, brush, tree trimmings, and stumps. Approximately 40 percent of the waste at the site is land-clearing debris, which is currently disposed on approximately te unlined acres. The remaining 60 percent is building material and demolition waste and is disposed on approximately six acres. Prohibited wastes include hazardous waste, liquids, garbage, refuse, agricultural waste, industrial waste, paper products, asbestos, fly ash, bottom ash, sludge, tires, white goods, leaves, and metal scrap. According to the permit, six inches of daily cover must be applied.

Facility Design

The Qualla Road Landfill has been permitted in sections, and the facility design varies depending on when a sect was permitted. The original 11 acres probably were unlined. As of 1987, at least five feet between the cell bottoms and t seasonal high groundwater table were required. Of the 22 acres added in 1988, 10 acres are unlined, 6 acres are equipp with a compacted soil bottom liner (permeability of 1 x 10^{-6} cm/sec) and a leachate collection system, and the remaining 6 acres have not yet been put to use. As of 1994, leachate must be discharged to an underground storage tank to be ultim pumped and hauled to a waste treatment plant. Run-on and run-off controls, and a groundwater interceptor were also described for portions of the landfill in the 1994 design.

Site Environment and Hydrogeology

Soils under the landfill consist of a 2- to 4-foot upper layer of lean to fat clays and elastic silt, underlain by silty sa and sandy silt soils to depths of 20 to 50 feet. Groundwater in the area is found 10 to 38 feet below the ground surface. T general movement of groundwater is to the west (toward Reedy Branch), with a gradient of 0.03 to 0.08 feet/feet. Lateral is about 3.5 x 10^{-5} to 3.8 x 10^{-4} centimeters per second (cm/sec) and vertical flow is about 9.7 x 10^{-5} cm/sec. Rainfall is estimated at 42 inches a year.

The landfill drains into Swift Creek (to the north) and Reedy Branch (to the west), a tributary to Swift Creek. The original 11 acres were located within the 100-year flood plain of Swift Creek. A flowing stream, possibly fed by discharge through the groundwater from a pond at the southern edge of the site, was located on the site prior to the 1987 proposed expansion.

Summary of Environmental Damages

In 1987, debris was protruding from the original landfill adjacent to Swift Creek, and the relief was too steep to ret soil covering. The source documents attested that the presence of a stream within the boundaries of the proposed landfi expansion was “unacceptable” and could present “erosion and sediment control problems.” A 1987 Request Analysis an Recommendation also noted that “unless actions are taken to stabilize the existing fill area, siltation of Swift Creek itself m occur” and that “due to the significant topographic relief of the proposed landfill area, the potential for siltation of the adjac property and streams, including Swift Creek, appears to be even greater than that of the existing landfill.” A 1993 inspect found leachate emanating from the landfill that “had the potential for discharging off-site.” The leachate break was immediately repaired.

Surface water samples have been taken from two sampling sites, but it is unclear whether the sampling was conducted on or off site. Surface water monitoring found iron, lead, and acidity levels exceeding freshwater chronic AWQ protective of aquatic life (Table 1).

TABLE 1 SURFACE WATER CONTAMINANTS EXCEEDING FEDERAL AWQC		
Contaminant/Parameter	**Highest Detected Level (µg/l)**	**Fresh Chronic AWQC (µg/l)**
Iron	252,000	1,000
Lead	113	7*
Parameter	**Lowest**	**AWQC**
pH	5.6	6.5-9

*EPA calculated the AWQC value using a reported measured hardness value of 196 ppm.

Groundwater monitoring has been conducted on-site at one upgradient and three downgradient wells. For each well, samples are compared to background data for that well (i.e., based on samples taken earlier). In addition, samples downgradient wells are compared to the background data from the upgradient well. In 1992, groundwater monitoring fou elevated levels of lead, manganese, and total organic carbon (TOC) in a downgradient well compared to the upgradient background level. In addition, the lead, manganese, total dissolved solids (TDS), and specific conductance exceeded the background mean for that downgradient well.

Groundwater monitoring has also shown iron and manganese levels to exceed Federal drinking water standards (secondary MCLs) (Table 2).

TABLE 2 GROUNDWATER CONTAMINANTS EXCEEDING VIRGINIA PROTECTION LEVELS AND FEDERAL DRINKING WATER STANDARDS			
Contaminant	**Highest Detected Level (µg/l)**	**MCL (µg/l)**	**SMCL (µg/l)**
Iron	103,000	--	300
Manganese	4,600	--	50

Discussion

Schnabel Environmental Services, the company that performs groundwater monitoring at Qualla Road Landfill, concluded in 1993 that the data do not indicate that the landfill poses a “substantial threat to human health or the environment.” However, monitoring has indicated exceedances of AWQC in surface water (whether on or off site is unkn and on-site exceedances of Federal drinking water standards in groundwater.

Sources

General Testing Corporation, Laboratory Reports, dated November 25, 1992, February 12, 1993, April 13, 1993, July 21, 1993, and March 17, 1994.

Letter from Kenton Chestnut, Jr., Division of Regulation, Department of Waste Management, Commonwealth of Virginia, Lane Ramsey, County Administrator, Chesterfield County, Virginia, February 5, 1990.

Letter from William Gilley, Division of Regulation, Department of Waste Management, Commonwealth of Virginia, to Paul Robins, Qualla Road Landfill, January 12, 1990.

Letter from Carl Benson, Schnabel Environmental Services, to Jim Leiper, Sanifill, October 5, 1993.

Letter from Schnabel Environmental Services to Chuck Hurt, J.K. Timmons & Associates, February 27, 1992.

Letter from Schnabel Environmental Services to Jim Leiper, Sanifill, April 8, 1992.

Letter from Stephen Werner, Hatcher-Sayer, Inc. to Paul Robins, Qualla Road Landfill, December 11, 1990.

Letter from A.M. Tope, Hydrogeologist, State Water Control Board, Commonwealth of Virginia, to Berry Wright, Departme Waste Management, Commonwealth of Virginia, May 15, 1987.

Letter from Scott Bullock, Department of Environmental Quality, Commonwealth of Virginia to Gregory Cekander, Sanifill, February 2, 1994.

Memorandum from Scott Bullock, Department of Environmental Quality, Commonwealth of Virginia, to Timothy Torrez, Q Road Landfill, January 12, 1994.

Memorandum from Charles Plott, Landfill Manager, Qualla Road Landfill, to Robert Timmons, Department of Environmen Quality, Commonwealth of Virginia, April 28, 1993.

Memorandum to the file from Berry Wright, Department of Waste Management, Commonwealth of Virginia, August 25, 19

Memorandum from Charles Plott, Landfill Manager, Qualla Road Landfill, to Robert Timmons, Department of Environmen Quality, Commonwealth of Virginia, May 10, 1993.

Memorandum from J.A. Adams to Berry Wright, Department of Waste Management, Commonwealth of Virginia, July 23, 1987.

Qualla Road Landfill Design Report, March 31, 1994.

Request Analysis and Recommendation, Linwood Belcher, Matoaca Magisterial District, January 20, 1987.

Sanifill, Groundwater Monitoring Data, for Robert Timmons, Department of Waste Management, Commonwealth of Virgin November 11, 1993.

Solid Waste Facility Permit, Permit Amendment Number 516, February 1, 1988.

Solid Waste Management Permit, Department of Waste Management, Commonwealth of Virginia, January 14, 1988.

SCHUYLKILL DEBRIS LANDFILL PRINCE GEORGE COUNTY, VIRGINIA

Media Affected: Groundwater

Overview of Site/Site History

The Schuylkill Debris Landfill comprises approximately seven acres near the western edge of the Appomattox Ri in Prince George County. The landfill received its permit to accept C&D wastes in November 1984 and closed in 1988. I owned and operated by the U.S. Army Quartermaster Center and Fort Lee. A few leachate seeps were discovered in 199 but they led to no obvious visual signs of contamination.

Facility Operations

The landfill is a permitted debris facility. An October 1989 questionnaire revealed that the facility has accepted wood, stumps, brick, concrete, and other inert construction and demolition debris material.

Facility Design

The source document provides no information on facility design.

Site Environment and Hydrogeology

The source document provides no information on site environment or hydrogeology.

Summary of Environmental Damages

A Response Record from August 6, 1992 indicated that the local water supply smelled and tasted badly. Howeve during the same investigation, the almost adjacent Appomattox River showed no signs of contamination from the landfill.

Various groundwater monitoring records over 1991 and 1992 indicate levels of beryllium, iron, lead, sulfate, and t dissolved solids (TDS) above Federal drinking water standards (primary or secondary MCLs) at least several times over t course of the monitoring (Table 1). Also, pH was consistently low in the series of groundwater results, often below 5. The location of the monitoring wells (i.e., whether they are on-site or off-site) was not reported in the available source docume Monitoring wells at Virginia landfills that reported the well locations generally were located within the landfill owner's prope boundaries.

TABLE 1
GROUNDWATER CONTAMINANTS EXCEEDING
FEDERAL DRINKING WATER STANDARDS

Contaminant/ Parameter	Highest Detected Level (µg/l)	MCL (µg/l)	SMCL (µg/l)
Beryllium	6	4	--
Iron	33,500	--	300
Lead	56	15*	--
Sulfate	465,000	--	250,000
TDS	670,000	--	500,000
Parameter	**Lowest**	**MCL**	**SMCL**
pH	4.22	--	6.5-8.5

*MCL is action level for lead at the tap

Discussion

Groundwater contamination has occurred at the landfill, but the source documents do not specifically state wheth the landfill is the cause of the contamination. Because no information is readily available on site geology or facility desig location, it is not possible to further evaluate the cause of damages at the Schuylkill Debris Landfill. It is also unknown whether off-site contamination has been documented, because the location of the monitoring wells was not presented in t source document.

Sources

Laboratory Report, Schuylkill, Montgomery Laboratories, December 16, 1992.

Memorandum from Thomas L. Kowalski, Environmental Inspector, to Department of Waste Management File, December 1992.

Memorandum from Jonathan P. Adams, Lieutenant, U.S. Army, to Richard Burton, Department of Environmental Quality, 7, 1994.

Memorandum from William M. Munson, Lieutenant Colonel, U.S. Army, to Linda Lightfoot, Department of Waste Management, October 11, 1989.

Solid Waste Management Permit, Commonwealth of Virginia, Department of Health, December 11, 1984.

1st Quarter Groundwater Analysis, Environmental Laboratories, Inc., April 30, 1992.

2nd Quarter Groundwater Analysis, Environmental Laboratories, Inc., July 23, 1992.

JANESVILLE DEMOLITION WASTE LANDFILL JANESVILLE, WISCONSIN

Media Affected: Groundwater

Overview of Site/Site History

The Janesville Demolition Landfill is a six-acre site located in Janesville, Wisconsin, just east of the Rock River. The site was never licensed and began to accept demolition waste in 1981 until its closure in 1992. The site was open to residents of Janesville and Rock County.

Facility Operations

The landfill received demolition waste from 1981 to 1992. A sign at the site identified concrete, broken pavement untreated/unpainted wood, and brush as acceptable materials, but a wide variety of waste may have been accepted. An attendant inspected all incoming loads to the landfill.

Facility Design

After the site was closed, two feet of compacted clay was placed on the site to mitigate infiltration of surface wate and precipitation. Groundwater monitoring is conducted using one upgradient and four downgradient wells. The source document does not mention any other engineering controls, such as liners, leachate collection systems, or run-on/run-off controls.

Site Environment and Hydrogeology

The landfill is located in the drainage basin of the Rock River, which flows south. The landfill lies in a large sand and gravel quarry, which is still partly active. Logs from monitoring well installation indicate that the soils are comprised m of sand and gravel, with some clay and rock fragments as well. Samples from the bottom of the deepest well were predominantly silt.

The underlying bedrock is St. Peter Sandstone, which is underlain by other sandstone layers. These sandstones make up the principal aquifer in this area and provide residents with potable water. The groundwater flow is generally fro the northeast to the southwest with a strong westward component due to the influence of the Rock River, which is about 1 feet west of the site. The depth to groundwater in the wells varies from 37 to 75 feet. The large component of sand and gravel in the area suggests that groundwater could be moving rapidly.

The total annual precipitation is about 32 inches.

Summary of Environmental Damages

Groundwater samples were taken periodically over a two-year period at one upgradient, one sidegradient, and tw downgradient wells. The source document is unclear as to whether the wells are inside or outside of the property line, bu both downgradient wells appear to be within the property line. Several parameters were significantly higher in the two downgradient wells compared to the upgradient well. Constituents that were found in downgradient wells at levels higher their Federal drinking water standard (primary or secondary MCL) are shown in Table 1. According to the source docume levels of sulfate, chloride, and manganese were above the Wisconsin Public Welfare Standards. The high sulfate levels attributed to gypsum, a common component of wallboard. Phenolic, a common constituent of tree and vegetative decay products, was detected once in one of the downgradient wells slightly above reporting limits.

TABLE 1
GROUNDWATER CONTAMINANTS EXCEEDING
FEDERAL DRINKING WATER STANDARDS

Contaminant	Highest Detected Level (µg/l)	MCL (µg/l)	SMCL (µg/l)
Chloride	430,000	--	250,000

Manganese	710	--	50
Sulfate	1,900,000	--	250,000
Total dissolved solids (TDS)	3,780,000	--	500,000

Discussion

Adverse on-site groundwater quality impacts from demolition waste disposal were documented at this landfill. Of site groundwater monitoring was not conducted.

Source

Investigation of Groundwater Impacts at Demolition Waste Landfills, Wisconsin Department of Natural Resources, June 1

TERRA ENGINEERING DEMOLITION WASTE LANDFILL

DANE COUNTY, WISCONSIN

Media Affected: Groundwater

Overview of Site/Site History

The Terra Engineering Demolition Landfill is about 4.1 acres in size. It is located in a drained marshy area in Dar County near the city of Madison, Wisconsin. This site was licensed in 1971 for demolition waste only, and one owner has operated the site since 1972. The company expects to be able to fill at the present rate for at least 10 more years.

Facility Operations

Since 1972, the site has been filled only with waste materials from the company’s construction and demolition projects. The main fill materials have been reinforced and unreinforced concrete, wood, masonry, brick, asphalt pavemen glass, steel and metal pieces, and brush. Some asphalt and scrap metal has been sorted out for the company to sell or reuse.

Facility Design

No information is presented in the source document about the design of the landfill.

Site Environment and Hydrogeology

The landfill is in a drained marshy area bounded on the north and east by drainage ditches. Surface water is rout around the fill on the southern end of the site. The land slopes towards the southeast.

The glacial material underlying the site is undifferentiated glacial deposits consisting of ground moraine. The unconsolidated material below the surface includes layers of brown sand, silt, and clay along with some sand seams and and gravel lenses. About 100 feet below these unconsolidated deposits lies Trempealeau and Franconia sandstone bedr which is underlain by Cambrian sandstone down to Precambrian crystalline bedrock. The Cambrian sandstone acts as th principal aquifer for most Dane County residents.

Groundwater is close to the surface at the site; the measured depth to ground water is between 2.5 and 10 feet. Regional movement of groundwater deep in the sandstone aquifer is southwest towards the Yahara River, which is three miles away. Locally, there is a definite eastward gradient. The groundwater flow is very complex due to the heterogeneo nature of the glacial deposits.

Summary of Environmental Damages

Five groundwater monitoring wells were installed at the site, one within the demolition debris and the others sidegradient to the fill. All wells were sampled periodically for two years. One of the sidegradient wells had elevated leve manganese, sulfate, and total dissolved solids (TDS); the other three sidegradient wells were generally unaffected. The w installed within the demolition debris had elevated levels of many inorganics; five were detected at levels above Federal drinking water standards (primary or secondary MCLs). These are shown in Table 1.

TABLE 1
GROUNDWATER CONTAMINANTS EXCEEDING FEDERAL DRINKING WATER STANDARDS

Contaminant	Highest Detected Level (µg/l)	MCL (µg/l)	SMCL (µg/l)
Chloride	380,000	--	250,000
Iron	6,400	--	300
Manganese	1,400	--	50
Sulfate	600,000	--	250,000

TDS	3,340,000	--	500,00

Discussion

Adverse on-site groundwater quality impacts from demolition waste disposal were documented at this landfill. Of site groundwater monitoring was not conducted.

Source

Investigation of Groundwater Impacts at Demolition Waste Landfills; Wisconsin Department of Natural Resources, June 1

SECTION A.3:

CALIFORNIA SOLID

WASTE ASSESSMENT TEST

RELEASE DESCRIPTIONS

Facility ID	Facility Name	SIC Code	Management Unit Type	Media		
				Groundwater	Surface Water	Vadose Zone
CA2 071042002	WDR-SHELL LAND DISPOSAL	2911	Surface Impoundment	Y	Y	Y
CA3 270300008	JOLON ROAD SOLID WASTE SITE	4952	Landfill	Y		
CA3 270303001	MARINA DISPOSAL SITE	4953	Landfill	Y	Y	
CA4B190309001	STOUGH PK, VERDUGO	4953	Landfill	Y	Y	Y
CA5A170300001	EASTLAKE LANDFILL	4953	Landfill	Y		
CA5B050302001	RED HILLS SWDS	4953	Landfill	Y	Y	
CA5D150303014	SHAFTER-WASCO SANITARY LANDFILL	4953	Landfill	Y		
CA5D162008001	KETTLEMAN HILLS FACILITY	4953	Surface Impoundment	Y	Y	Y
CA6B150303017	TEHACHAPI CLASS III LANDFILL	4953	Landfill	Y		
CA6B360304013	LENWOOD/HINKLEY-LANDFILL	4953	Landfill	Y	Y	Y
CA6B360304025	VICTOR VILLE CLASS III LANDFILL	4953	Landfill	Y		
CA7A360304121	LANDERS CLASS III WMF 91-028	4953	Landfill	Y	Y	Y
CA7B330305021	BLYTHE CLASS III WMF 91-005	4953	Landfill	Y		
CA1B900110NSO	SCPW AIRPORT ROAD BURN DUMP	4953	Landfill	Y	Y	Y
CA1B900020NSO	SO CO ROBLAR SWDS	4953	Landfill	Y	Y	Y
CA2 071059002	WDR-USS-POSCO	3462	Waste Pile	Y		
CA2 218049N01	TIMBER COVE MOBILE HOME CO	4953	Landfill	Y		
CA2 438262N01	SAN JOSE CITY-STORY ROAD LANDFILL	4953	Landfill	Y	Y	Y
CA2 438332N01	ROBERTS ROAD LANDFILL	4953	Landfill	Y	Y	Y
CA3 420000N13	TRANSFER STATION	4952	Landfill	Y	Y	Y
CA5D543001N01	BIXBY RANCH DISPOSAL SITE	4953	Landfill	Y		
CA5D100326N01	KEPCO-PINEDALE LANDFILL	4953	Landfill	Y	Y	Y
CA5D100325N01	FOWLER CITY LANDFILL (OLD)	4953	Landfill	Y	Y	Y
CA5A340301N01	WHITE ROCK ROAD LANDFILL-NORTH	4953	Landfill	Y	Y	Y
CA5A340300N01	WHITE ROCK ROAD LANDFILL-SOUTH	4953	Landfill	Y	Y	Y
CA7A330008NUR	CATHEDRAL CITY #19 LANDFILL	4953	Landfill	Y		
CA5C220300001	MARIPOSA CO LANDFILL FACILITY	4953	Landfill	Y	Y	
CA8 362039002	SEPTAGE DISPOSAL	4959	Surface Impoundment	Y	Y	Y
CA8 362277001	LANDFILL, WATERMAN	4953	Landfill	Y	Y	Y