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CONSTRUCTION AND DEMOLITION WASTE LANDFILLS

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by

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EXECUTIVE SUMMARY

The U.S. Environmental Protection Agency (EPA) is currently developing a rule addressing non-municipal facilities (industrial waste facilities, including construction and demolition waste landfills) that may receive hazardous wastes from conditionally exempt small quantity generators (CESQGs), or generators of less than 100 kilograms per month of hazardous waste. This report, prepared in support of EPA's rulemaking, presents information on construction and demolition (C&D) waste landfills, i.e., landfills that receive materials generated from the construction or destruction of structures such as buildings, roads, and bridges. C&D waste landfills are being examined because the Agency believes that the largest potential impact from this rulemaking will be on these facilities.

BACKGROUND

The 1984 Hazardous and Solid Waste Amendments (HSWA) to the Resource Conservation and Recovery Act (RCRA) required EPA to revise the existing standards and guidelines governing the management of household hazardous wastes and hazardous wastes from small quantity generators. EPA responded in 1991 by revising the existing criteria for solid waste disposal facilities and practices (40 CFR Part 257). In 1991 EPA issued revised criteria in 40 CFR Part 258 for municipal solid waste landfills (MSWLFs) that receive household hazardous wastes and CESQG wastes. EPA did not establish revised criteria for non-municipal facilities and subsequently was sued by the Sierra Club. A consent agreement was reached in January 1994, and EPA is now fulfilling the remainder of the HSWA mandate by regulating non-municipal facilities that may receive CESQG wastes. The final rule must be signed by the EPA Administrator by May 15, 1995. The rule will require facilities receiving CESQG wastes to have adequate ground-water monitoring, corrective action requirements, and location restrictions.

COMPOSITION OF C&D WASTE

Information on the composition of C&D waste is presented below. Most of this information was compiled from the literature by the National Association of Demolition Contractors (NADC); a small number of other readily available sources were used as well. These source documents provide only snapshots of the C&D waste stream in specific locations and at specific points (e.g., generation) rather than providing a complete cradle-to-grave picture of C&D wastes nationwide, or of the portion landfilled.

C&D waste is generated from the construction, renovation, repair, and demolition of structures such as residential and commercial buildings, roads, and bridges. The composition of C&D waste varies for these different activities and structures. Overall, C&D waste is composed mainly of wood products, asphalt, drywall, and masonry; other components often present in significant quantities include metals, plastics, earth, shingles, insulation, and paper and cardboard.

C&D debris also contains wastes that may be hazardous. The source documents identify a number of wastes that are referred to using such terms as "hazardous," "excluded," "unacceptable," "problem," "potentially toxic," or "illegal." It is not necessarily true that all of these wastes meet the definition of "hazardous" under Subtitle C of RCRA, but they provide an indication of the types of hazardous wastes that may be present in the C&D waste stream. They can be divided into four categories:

- Excess materials used in construction, and their containers. *Examples: adhesives and adhesive containers, leftover paint and paint containers, excess roofing cement and roofing cement cans;*

- Waste oils, grease, and fluids. *Examples: machinery lubricants, brake fluid, form oil, engine oil;*

- Other discrete items. *Examples: batteries, fluorescent bulbs, appliances;* and

- Inseparable constituents of bulk items. *Examples: formaldehyde present in carpet, treated or coated wood.*

Some of these components are excluded from C&D landfills by state regulations.

C&D LANDFILL LEACHATE QUALITY

Construction and demolition landfill leachate sampling data were collected from states and from the general literature by NADC. Leachate sampling data for 305 parameters sampled for at one or more of 21 C&D landfills were compiled into a database.

Of the 305 parameters sampled for, 93 were detected at least once. The highest detected concentrations of these parameters were compared to regulatory or health-based "benchmarks," or concern levels, identified for each parameter. Safe Drinking Water Act Maximum Contaminant Levels (MCLs) or Secondary Maximum Contaminant Levels (SMCLs) were used as the benchmarks if available. Otherwise, health-based benchmarks for a leachate ingestion scenario were identified; these were either reference doses (RfDs) for non-carcinogens, or 10^{-6} risk-specific doses (RSDs) for carcinogens. Benchmarks were unavailable for many parameters because they have not been studied sufficiently.

Of the 93 parameters detected in C&D landfill leachate, 24 had at least one measured value above the regulatory or health-based benchmark.[1] For each of the parameters exceeding benchmarks (except pH), the median leachate concentration was calculated and compared to its benchmark. The median value was first calculated among the samples taken at each landfill, and then across all landfills at which the parameter was detected. Due to anomalies and inconsistencies among the sampling equipment used at different times and at different landfills, non-detects were not considered in determining median values; i.e., the non-detects were discarded before calculating both individual landfill concentration medians and medians across landfills. Thus, the median leachate concentrations represent the median among the detected values, rather than the median among all values. The median concentration among all values would in most cases have been lower than those calculated here.

Based on (1) the number of landfills at which the benchmark was exceeded and (2) a comparison between the median detected concentration and the benchmark, seven constituents emerge as being potentially problematic. They are listed in the table below. Also shown are the number of landfills at which the constituent was sampled, the number of landfills at which the constituent was detected, the number of landfills at which the constituent was detected above its benchmark, and the ratio of the median detected concentration to the benchmark.

For three of the seven parameters listed in the table (iron, manganese, and TDS), the benchmarks are secondary MCLs (SMCLs), which are set to protect water supplies for aesthetic reasons (e.g., taste) rather than for health-based reasons. None of the remaining four parameters exceeds its benchmark by a factor of 10 or more, indicating that concentrations in ground water where monitoring wells or drinking water wells may be located are likely to fall below the health-based benchmarks.

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[1]In the case of pH, the "exceedances" were actually pH values below the regulatory range.

C&D LANDFILL LEACHATE - POTENTIALLY PROBLEMATIC CONSTITUENTS				
Constituent	**No. Landfills Sampled**	**No. Landfills Detected**	**No. Landfills > Benchmark**	**Ratio of Median to Benchmark**
1,2-Dichloroethane	9	3	3	4
Methylene chloride	9	4	3	3
Cadmium	19	14	12	2
Iron	20	20	19	37
Lead	18	15	13	4
Manganese	14	14	13	59
Total dissolved solids	18	17	15	4

Conclusions regarding C&D landfill leachate quality must be viewed with an understanding of the data limitations. The most important limitation is that the 21 landfills represented in this report comprise just over one percent of the approximately 1,800 C&D landfills in the United States. Thus, the representativeness of the sample is questionable. Other limitations are discussed in the body of the report.

STATE REGULATIONS

State statutes and regulations for C&D landfills were summarized, and similarities and differences between current state requirements for C&D landfills and federal requirements for MSWLFs were evaluated. The following summarizes the key findings:

- **All states regulate off-site C&D landfills to some extent.** Thirteen states require off-site C&D landfills to meet state MSWLF requirements (in many states, these requirements are not as stringent as the federal MSWLF requirements found in 40 CFR Part 258), while the remaining 37 have developed separate regulations that are specific to off-site C&D landfills.[2]

- **Only seven states exempt on-site C&D landfills from regulatory requirements.** Of the remaining 43 states, 11 require on-site C&D landfills to meet state sanitary landfill requirements (in many states, these requirements are not as stringent as 40 CFR Part 258), 8 have developed separate regulations applicable to only on-site landfills, and the remaining 24 have extended the regulations for off-site landfills to on-site landfills.

- **Sixteen states mandate location restrictions, ground-water monitoring, and corrective action for off-site C&D landfills.** These requirements, however, vary in stringency relative to 40 CFR Part 258. For example, **only two states have location restrictions, ground-**

[2]Ohio expects to have specific C&D management requirements effective by the end of 1995.

water monitoring, and corrective action requirements for off-site C&D landfills that are at least as stringent as 40 CFR Part 258.

- **The most common 40 CFR Part 258 location restrictions that states apply to C&D landfills relate to: airports and bird hazards, wetlands, and floodplains.** Several states have moved beyond federal requirements and prohibit the siting of on-site (eight states) and off-site (nine states) C&D landfills in floodplains. Fewer states have adopted the 40 CFR Part 258 requirements regarding faults, seismic zones, and unstable areas.

- **A majority of states impose additional location restrictions on C&D landfills.** The most common additional restrictions are: near ground and surface waters, and near endangered species habitats.

- **Twenty-nine states (nearly 60 percent) require off-site C&D landfills to monitor ground water.** Of these 29 states, 5 have requirements substantially similar to 40 CFR Part 258, while 24 have requirements that are less stringent.[3] **The remaining 21 states do not require ground-water monitoring requirements.** Of these 21, however, 12 "may" require ground-water monitoring if the regulatory authority deems it necessary.

- **Twenty-four states (nearly 50 percent) require on-site C&D landfills to monitor ground water.** Of these 24, only 4 have requirements substantially similar to 40 CFR Part 258, while 20 have requirements that are less stringent. **The remaining 26 states do not require ground-water monitoring.** Of these 26, 9 states "may" require ground-water monitoring if the regulatory authority deems it necessary.

- **Twenty-two states have corrective action requirements for off-site C&D landfills.** These states either require the permit applicant to submit a corrective action plan with the permit application, or require the facility owner/operator to submit a plan after a release to ground water is detected.

- **Sixteen states have corrective action requirements for on-site C&D landfills.** Again, these states either require the permit applicant to submit a corrective action plan with the permit application, or require the facility owner/operator to submit a plan after a release to ground water is detected.

- **States also have mandated permit, design and operating, post-closure, and financial assurance requirements for both on-site and off-site C&D landfills.** The most common of these is permitting requirements. Respectively, 45 and 38 states require off-site and on-site C&D landfills to obtain a permit.[4] Thirty-four states require some post-closure time period for off-site landfills (11 require at least 30 years and 23 require less than 30 years). Additionally, 33 states require off-site C&D landfills to obtain financial assurance for closure, while 32 require it for post-closure care.

- **Twenty-four states prohibit all hazardous wastes from disposal at off-site C&D landfills.** In addition, three and four states require that only inert waste and C&D waste be

[3]Ohio currently does not have ground-water monitoring, but monitoring is expected to be part of C&D management regulations that should be finalized by the end of 1995.

[4]Ohio requires a permit for C&D landfills.

disposed, respectively. Fourteen states do not specifically prohibit disposal of all hazardous wastes at off-site C&D landfills. In general, the regulations for these states note that only waste specified in permit may be accepted, or only "regulated" or "controlled" hazardous waste is prohibited. Finally, five states do not specifically identify any restrictions on waste disposal at off-site C&D landfills.

CHAPTER 1
INTRODUCTION

This report presents information on construction and demolition (C&D) waste landfills. These are landfills that receive materials generated predominantly from the construction or destruction of structures such as buildings, roads, and bridges. There are currently over 1,800 C&D waste landfills operating in the United States.

This report was written in support of a rulemaking currently being developed by the U.S. Environmental Protection Agency (EPA). This chapter provides a background discussion of this rulemaking, and then discusses the purpose and organization of this report.

REGULATORY BACKGROUND

The Resource Conservation and Recovery Act (RCRA), passed in 1976, required the Environmental Protection Agency (EPA) to promulgate standards and guidelines for the management of solid wastes. In response to this mandate, EPA promulgated regulations for the management of hazardous wastes under Subtitle C of RCRA, and for non-hazardous wastes under Subtitle D. The Subtitle C standards applied to all facilities generating more than 1,000 kg/mo of hazardous wastes, but conditionally exempted from full regulation facilities generating less than this amount. Subtitle D guidelines address the management of all other solid wastes, such as municipal wastes and non-hazardous industrial wastes (including construction and demolition wastes).

In 1984, Congress passed the Hazardous and Solid Waste Amendments (HSWA), which made several changes to RCRA. One important change was the creation of two categories of small quantity hazardous waste generators: generators of 100 to 1,000 kg/mo, and generators of less than 100 kg/mo. HSWA added specific provisions for the first category, but gave EPA discretion as to whether to promulgate new requirements for the second. EPA has since defined generators of less than 100 kg/mo as conditionally-exempt small quantity generators, or CESQGs. CESQGs are responsible for the proper management of their wastes, but are not required to comply with many of the Subtitle C regulations specified for larger hazardous waste generators.

Another important change imposed by HSWA was the addition of Section 4010 to Subtitle D, requiring EPA to promulgate revised criteria addressing the management of household hazardous wastes and hazardous wastes from small quantity generators. EPA responded in October 1991 by promulgating the revised Municipal Solid Waste Landfill (MSWLF) Criteria (40 CFR Part 258). This partially fulfilled the HSWA mandate by addressing household hazardous wastes and CESQG wastes that are disposed in MSWLFs. After a consent agreement with the Sierra Club on January 28, 1994, EPA is now fulfilling the remainder of the HSWA mandate by regulating CESQG wastes that are disposed in non-municipal facilities. The final rule must be signed by the EPA Administrator by May 15, 1995. The rule will require non-municipal facilities receiving CESQG wastes to have adequate ground-water monitoring, corrective action requirements, and location restrictions.

FOCUS ON C&D LANDFILLS

CESQGs currently send their wastes to many different types of Subtitle D waste management units other than MSWLFs, including the following:

- Commercial Subtitle D industrial waste landfills;

- On-site Subtitle D industrial waste management units such as landfills, surface impoundments, land treatment units, and waste piles; and

- C&D waste landfills.

EPA believes that the only waste management units that may be impacted significantly by this rulemaking are the C&D landfills. The Agency believes that most of the 10 to 20 commercial Subtitle D industrial waste landfills in existence today already have adequate ground-water monitoring, corrective action requirements, and location restrictions. EPA also believes that CESQGs currently disposing of their wastes in on-site Subtitle D waste management units will simply start sending the hazardous portion of their waste stream off site, at relatively low cost.

On the other hand, the rulemaking will have an impact on C&D landfills. C&D landfills are therefore the focus of this report.

SCOPE AND ORGANIZATION OF THIS REPORT

This report examines C&D waste characteristics, C&D landfill leachate quality, and state regulations addressing C&D waste management facilities.

- Chapter 2 discusses the composition of C&D wastes, including any hazardous materials or constituents that are found;

- Chapter 3 presents information on the quality of C&D landfill leachate, based on sampling data taken from landfills around the country; and

- Chapter 4 presents a detailed summary of state regulations pertaining to C&D facilities. It identifies states that have regulations related to ground-water monitoring; corrective action; location restrictions; and facility design, operation, closure, and/or post closure care; and provides the specifics of those requirements.

The first two chapters are based predominantly on information supplied to EPA by the National Association of Demolition Contractors (NADC), supplemented with a small number of other readily available studies. The chapter on state regulations is based on original research performed for this report.

CHAPTER 2
CHARACTERISTICS OF CONSTRUCTION AND DEMOLITION WASTES

This chapter presents information on the composition and characteristics of the C&D waste stream based on four source documents:

- The National Association of Demolition Contractors's (NADC's) *C&D Waste Characterization Database: Volume 1 - Compilation of Report Excerpts* (1994);

- NADC's *C&D Waste Characterization Database: Volume 1 - Compilation of Articles* (1994);

- Hanrahan's *Construction and Demolition Debris Disposal Issues: An Alachua County Perspective* (1994); and

- Lambert and Domizio's *Construction and Demolition Waste Disposal: Management Problems and Alternative Solutions* (1993).

The source documents provide only snapshots of the C&D waste stream in specific locations (e.g., Vermont) and at specific points (e.g., at generation) rather than providing a complete cradle-to-grave picture of the nationwide C&D waste stream, or of the portion that is landfilled. This report reflects that segmented characterization of the waste stream and includes waste characterization information based on generated wastes. In some areas, a large portion of the complete C&D waste stream may be recycled, burned, left on site, or illegally disposed (Apotheker, 1990; Piasecki et al., 1990; Spencer, 1991; Lambert and Domizio, 1993; McGregor et al., 1993); thus, the characterizations presented in this report may be somewhat different from those of the landfilled portion of the waste stream. In Vermont, for example, only about one-third of the waste stream went to landfills in 1989 (Spencer, 1991).

The first section of this chapter discusses factors that influence C&D waste composition and characteristics. The second section provides information on components and their proportions in the C&D waste stream. The final section focuses specifically on the components and constituents of C&D waste that the source documents characterize using the terms "hazardous," "excluded," "contaminants," "chemical constituents that could affect the use of the waste as fuel," "special," "unacceptable," "problem," "potentially toxic," "nonhazardous restrictive," or "illegal." Throughout this chapter these components are referred to as "problematic." These "problematic" wastes are not necessarily wastes that are classified as hazardous under RCRA Subtitle C.

FACTORS THAT INFLUENCE C&D WASTE COMPOSITION

C&D wastes are categorized in a variety of ways, and each category produces wastes with different composition and characteristics. For example, road C&D waste differs from bridge waste, which differs from building waste. Whereas road C&D generates large quantities of just a few different waste items (mainly asphalt and concrete), building C&D generates many different waste items in smaller amounts (with wood as the largest single item). Within the category of building C&D waste, the size and type of the building (e.g., an apartment building versus a single-family house) affects the composition of the waste. Even for one building type (e.g., a single-family house), the waste generated depends on the activity conducted (i.e., new construction, renovation, or demolition). For example, construction generally produces "clean," unaltered, and separate waste items (e.g., unpainted wood, new concrete) (MVC, 1992).

In contrast, demolition wastes may include more items that have been altered or mixed (e.g., wood painted with lead-based paint, concrete with hazardous waste spilled on it) (MVC, 1992).

Thus, three main factors affect the characteristics of C&D waste (MVC, 1992):

- Structure type (e.g., residential, commercial, or industrial building, road, bridge);
- Structure size (e.g., low-rise, high-rise); and
- Activity being performed (e.g., construction, renovation, repair, demolition).

Additional factors that influence the type and quantity of C&D waste produced include (MVC, 1992; McGregor et al., 1993):

- Size of the project as a whole (e.g., custom-built residence versus tract housing);
- Location of the project (e.g., waterfront versus inland, rural versus urban);
- Materials used in construction (e.g., brick versus wood);
- Demolition practices (e.g., manual versus mechanical);
- Schedule (e.g., rushed versus paced); and
- Contractors' "housekeeping" practices.

Other factors do not affect the type and quantity of C&D waste **produced**, but do affect the type and quantity **reported** in the source documents and therefore in this report. These include:

- How state regulations define what is and is not acceptable as C&D waste;
- Where in the waste stream the C&D waste is measured (e.g., generation point, recycling station, landfill); and
- How the C&D waste is measured (e.g., by volume or weight).

The next section provides information on the components of C&D waste and their proportions in the waste stream.

COMPONENTS OF C&D WASTE

Overall, C&D waste streams are comprised mainly of wood products, asphalt, drywall (gypsum)[5], and masonry (e.g., concrete, bricks). Other notable components include metals, plastics, earth, shingles, and insulation. In one county, waste identified by the source document as "hazardous" has been estimated to comprise 0.4 percent of construction waste by weight (Triangle J Council of Governments, 1993)[6]; this is discussed further in the final section of this chapter. Table 2-1 provides a complete list of components of C&D wastes mentioned in the source documents. The bold print denotes the "problematic" components, i.e., components that the source documents refer to as "hazardous," "excluded," "contaminants," "chemical constituents that could affect the use of the waste as fuel," "special," "unacceptable," "problem," "potentially toxic," "nonhazardous restrictive," or "illegal."

In general, wood comprises one-quarter to one-third of the C&D waste stream. Other generalizations are hard to make because (1) different studies address different segments of the nation's

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5 Drywall is excluded from some C&D landfills because anaerobic breakdown of gypsum produces hydrogen sulfide.

6 Hazardous waste percentage estimate is for the 1990 Orange County, North Carolina construction waste stream (SCS Engineers, 1991 as cited in Triangle J Council of Governments, 1993).

TABLE 2-1
COMPONENTS OF C&D WASTE

ASPHALT paving shingles	**PAINT** **paint containers and waste** **paint products**	**WALL COVERINGS** **drywall (gypsum)** plaster
EARTH dirt sand, foundry soil	**PAPER PRODUCTS** cardboard fiberboard, paperboard paper	**WOOD** cabinets composites millends pallets, shipping skids, and crating lumber particle board plywood siding trees: limbs, brush, stumps, and tops veneer
ELECTRICAL fixtures wiring	**PETROLEUM PRODUCTS** **brake fluid** **form oil** **fuel tanks** **oil filters** **petroleum distillates** **waste oils and greases**	**WOOD CONTAMINANTS** **adhesives and resins** **laminates** **paintings and coatings** **preservatives** **stains/varnishes** **other chemical additives**
INSULATION **asbestos** building extruded polystyrene (rigid) **fiberglass (bat)** roofing	**PLASTICS** buckets pipe (PVC) polyethylene sheets styrofoam sheeting or bags laminate	**MISCELLANEOUS** **adhesives and adhesive cans** **aerosol cans** **air conditioning units** **appliances ("white goods")** **batteries** **carpeting**
MASONRY AND RUBBLE bricks cinder blocks concrete mortar, excess porcelain rock stone tile	**ROOF MATERIALS** **asbestos shingles** roofing, built up **roofing cement cans** roofing shingles roofing tar tar paper	**caulk (tubes)** ceiling tiles **driveway sealants (buckets)** **epoxy containers** **fiberglass** fines fireproofing products (overspray) floor tiles **furniture** **garbage**
METAL aluminum (cans, ducts, siding) brass fixtures, plumbing flashing gutters **mercury from electrical switches** iron **lead** nails pipe (steel, copper) sheet metal steel (structural, banding, decking, rerod) studs, metal wire (e.g., copper)	**VINYL** siding flooring doors windows	glass **lacquer thinners** leather **light bulbs, fluorescent and HID** light bulbs, other linoleum organic material packaging, foam **pesticide containers** rubber **sealers and sealer tubes** sheathing silicon containers **solvent containers and waste** street sweepings textiles **thermostat switches** **tires** **transformers** water treatment plant lime sludge

Source: Summarized from NADC, 1994a and 1994b; Hanrahan, 1994; and Lambert and Domizio, 1993.

C&D waste stream (e.g., road and bridge waste may be excluded from some studies; information in another study may be for waste from construction only or demolition only) and (2) C&D waste composition varies greatly from one category to another. The graphs and tables in this section provide examples of the composition of portions of the C&D waste stream. Note that they vary with location (e.g., Florida versus Vermont) and category of waste (e.g., construction versus demolition). Viewed together, they provide a good overall picture of the North American C&D waste stream, and show important differences among different categories of C&D waste.

C&D Waste Including Road and Bridge Waste (Vermont)

Figure 2-1 provides a picture of the composition of Vermont's complete C&D waste stream by weight, based on a comprehensive C&D generation study. Asphalt comprises approximately one-half of the waste stream, wood one-quarter, and concrete one-sixth (Cosper et al., 1993).

C&D Waste Excluding Road and Bridge Waste (Florida)

Figure 2-2 provides an example of the composition by volume of the C&D waste stream received at a C&D recycling facility in Florida. Although the source document (Cosper et al., 1993) states that the facility accepts "the complete C/D waste stream," it appears that the facility receives the complete **building** C&D waste stream, but does not receive wood or bridge waste, because asphalt is not listed as a component of the waste. Approximately one-third of the waste volume is wood (Cosper et al., 1993). Drywall comprises one-sixth and paper and cardboard together comprise one-sixth of the total volume (Cosper et al., 1993).

Construction-only Waste Versus Demolition-only Waste

Approximately one-third of the construction waste volume in Toronto is wood, and masonry and tile comprise less than one-sixth of the construction waste (Figure 2-3) (THBA, 1991). Demolition waste is also comprised of approximately one-third wood (in the U.S.), but concrete makes up over one-half of demolition waste (Figure 2-4) (Chatterjee-U.S. Army as cited in SPARK, 1991).

C&D Waste by Housing Type

Table 2-2 compares residential construction waste to commercial construction waste in the Twin Cities, Minnesota. Wood comprises one-fifth to one-third of the waste stream in both cases. Concrete, brick, and steel waste are greater from commercial construction than from residential, as would be expected.

COMPONENTS OF C&D WASTE THAT ARE POTENTIALLY "PROBLEMATIC"

Hazardous wastes comprise a small percentage of the C&D waste stream (McGregor et al., 1993), and can potentially cause adverse effects to human health and ecosystems (Lambert and Domizio, 1993). For example, inhalation of urea formaldehyde (a resin used in insulation and as a wood preservative) has caused a health syndrome called "ultra-sensitive allergies" in demolition workers (Lambert and Domizio, 1993). Creosote (a wood preservative) can potentially leach into ground water and discharge into surface water, possibly adversely affecting drinking water or aquatic life if concentrations reach high enough levels (Lambert and Domizio, 1993).

This section describes the "problematic" components and constituents of C&D waste and, where information was available (i.e., for treated and coated wood), the proportion of those constituents in the

FIGURE 2-1
COMPOSITION OF C&D WASTE STREAM IN VERMONT (BY WEIGHT; 1989 DATA)
(Source: C.T. Donovan Associates, 1990)

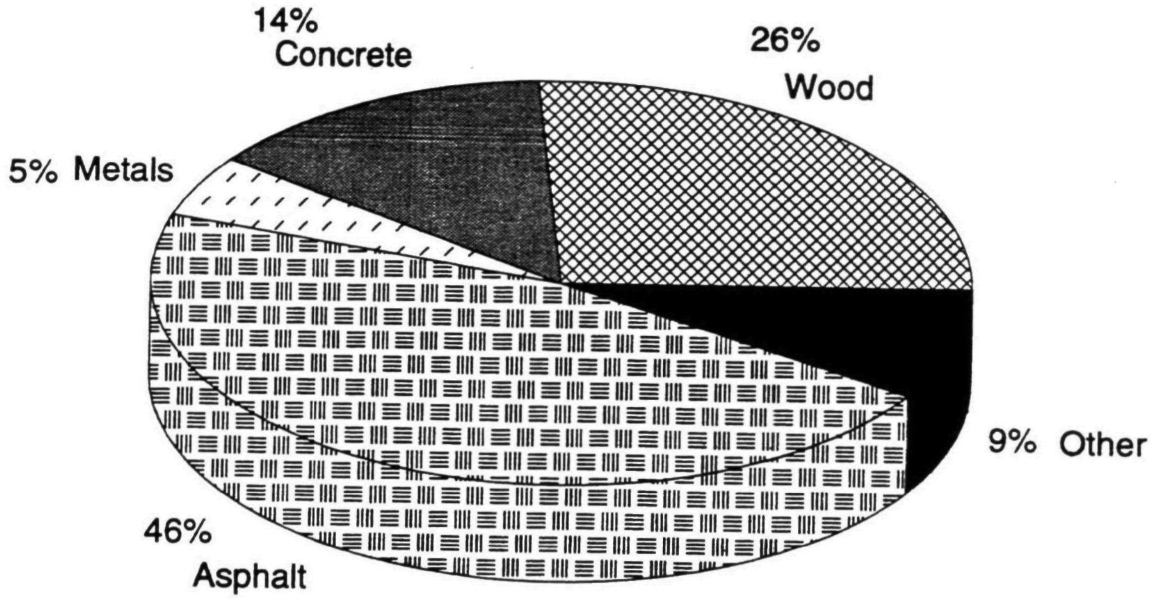

FIGURE 2-2
COMPOSITION OF THE BUILDING C&D WASTE STREAM IN FLORIDA (BY VOLUME)
(Source: Wood, 1992 as cited in Cosper et al., 1993)

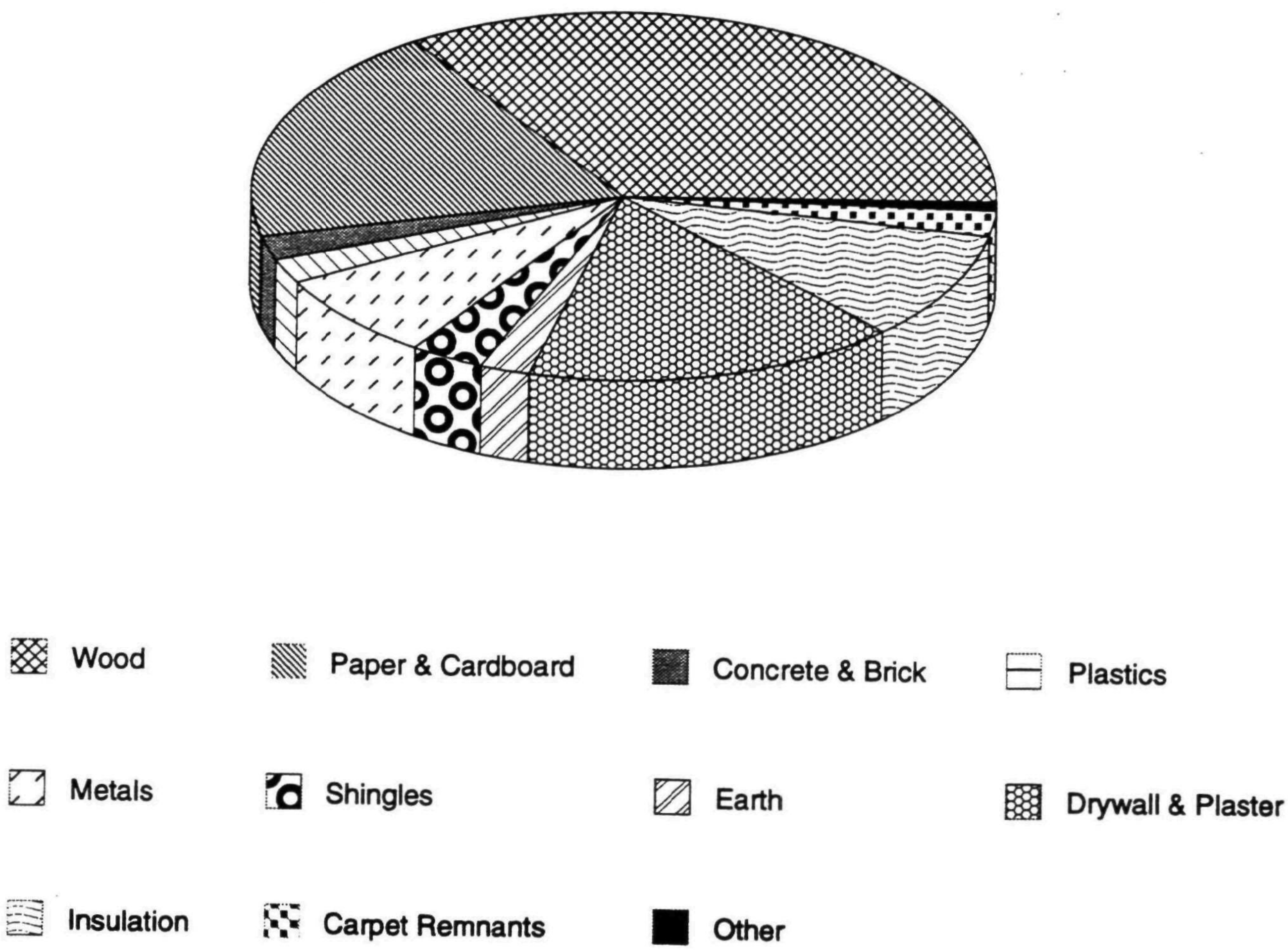

FIGURE 2-3
COMPOSITION OF CONSTRUCTION WASTE IN TORONTO (BY VOLUME)
(Source: THBA, 1991)

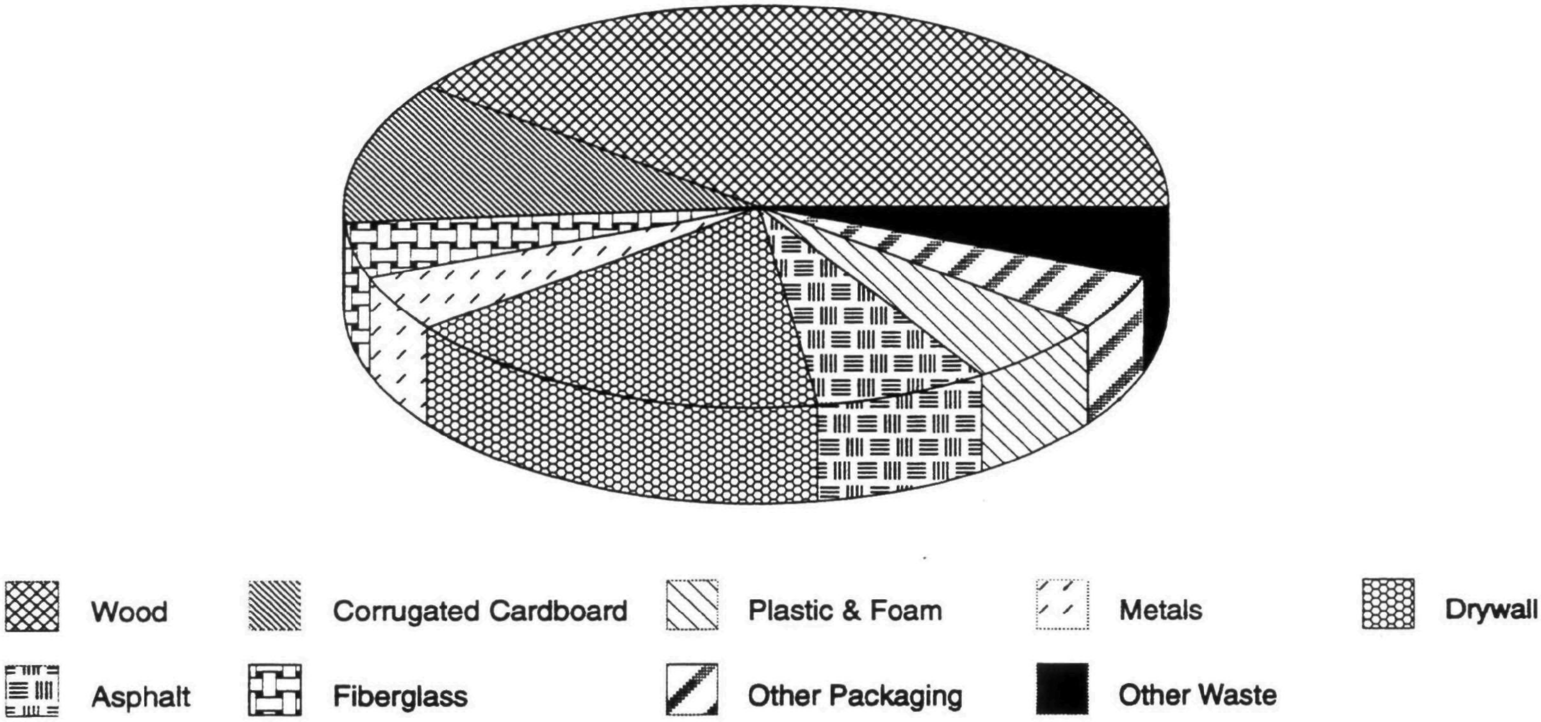

FIGURE 2-4
COMPOSITION OF U.S. DEMOLITION WASTE
(Source: Chatterjee-U.S. Army, as cited in SPARK, 1991)

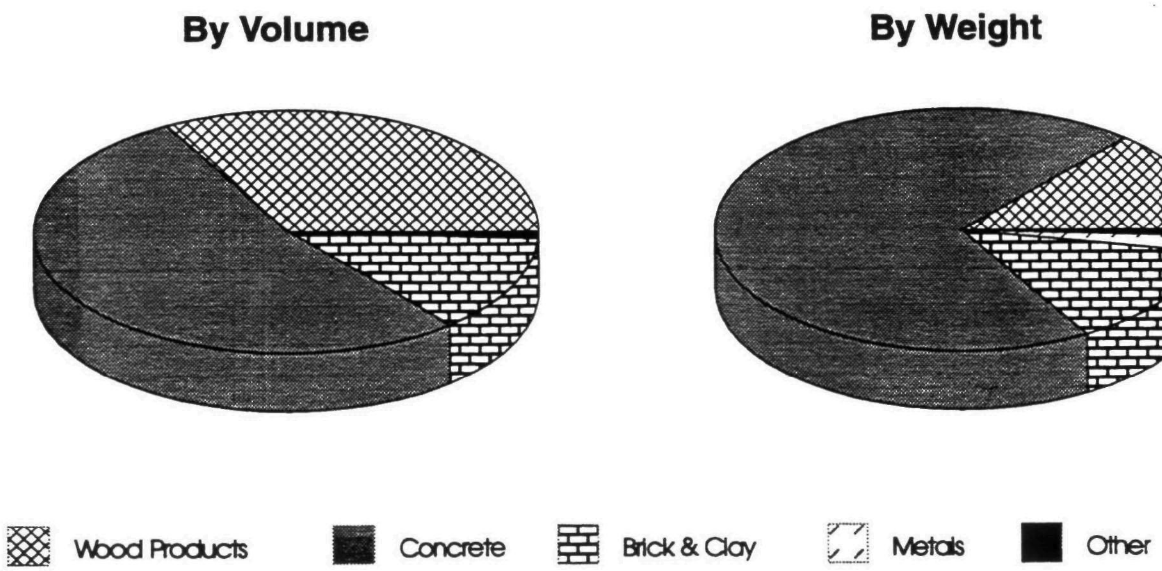

TABLE 2-2
COMPOSITION OF CONSTRUCTION WASTE BY CONSTRUCTION TYPE IN THE TWIN CITIES IN MINNESOTA (BY VOLUME) (Source: Lauer, 1993)

Waste Type	Residential Construction	Commercial Construction
Wood	20-35%	20-30%
Crates & pallets	--	1-5%
Cardboard	5-15%	5-10%
Paper packaging	<1%	~3%
Concrete & block	1-8%	10-20%
Brick	--	1-5%
Drywall	10-20%	5-10%
Electrical wire	<1%	~2%
Shingles	1-8%	--
Fiberboard	1-8%	--
Steel	<1%	1-8%
Plastic sheeting and bags	<1%	~3%
Polystyrene insulation	--	~3%
Overspray from fireproofing products	--	0-5%
Notable other materials (comprising <1% each)		
carpet scrap	<1%	<1%
solvent containers	--	<1%
epoxy containers	--	<1%
silicone containers	--	<1%
plastic laminate	--	<1%
Possible "problem materials"		
driveway sealants	<1%	--
adhesive containers	<1%	<1%
caulking containers	<1%	<1%
paint cans (including frozen or damaged)	<1%	<1%

-- Indicates that the waste was not listed under that category.

waste item. Table 2-3 lists "problematic" components and constituents of C&D waste. These "problematic" wastes are not necessarily wastes that are classified as hazardous under RCRA Subtitle C. Some may be "problematic" simply because they are recyclable (e.g., cardboard) or because they are outside the definition of C&D waste as defined by a particular jurisdiction (e.g., garbage).

It is also important to note that wastes that some jurisdictions exclude from C&D landfills or recycling centers are sometimes brought to the C&D disposal areas nonetheless. In some cases these wastes are detected and rejected (Cosper et al., 1993; Lauer, 1993), but in other cases they may not be screened out (Gates et al., 1993), and evidence shows that they are found in C&D landfills (Piasecki et al., 1990).

For discussion purposes, the "problematic" C&D wastes are divided into four categories:

- Excess hazardous materials used in construction and their containers;
- Waste oils and greases and other fluids from machinery;
- Other discrete items; and
- Incidental constituents that are inseparable from bulk C&D wastes (e.g., wood treatment chemicals).

Excess Potentially Hazardous Materials

Construction activities can produce excess "hazardous" materials and "empty" containers containing small quantities of "hazardous" materials. (The source, McGregor et al., 1993, does not define "hazardous," so these wastes may or may not be defined as hazardous under RCRA Subtitle C.) Adhesives and adhesive containers, leftover paint and paint containers, and excess roofing cement and roofing cement cans are a few examples. In some cases construction workers dump leftover paints or solvents on the ground (McGregor et al., 1993). Others may use sawdust, kitty litter, or masking tape to "dry" up empty paint cans and solvent containers (McGregor et al., 1993). "Hazardous" wastes may be disposed of in a dumpster, left at the construction site for a cleanup contractor, self-hauled to a landfill, or returned to the shop[7] (McGregor et al., 1993). Table 2-4 characterizes the 46 pounds of wastes referred to as "hazardous" from construction of a typical 1,850 square-foot single-family residence in Portland, Oregon. Assuming that the total waste weight produced by construction of some 1,810 square-foot houses in Oregon is typical, the 46 pounds would comprise less than 1 percent by weight of the total construction waste (including recycled waste), and less than 10 percent of the landfilled waste.

Machinery Lubricants

Waste oils, greases, and machine fluids are also generated by C&D activities. Examples include brake fluid, form oil, and engine oil (McGregor et al., 1993).

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7 Based on a survey of twenty builders and subcontractors in Oregon. (many of whom are conditionally-exempt small quantity generators (CESQGs)), some CESQGs want more information on how and where to dispose of small quantities of hazardous wastes (McGregor et al., 1993).

TABLE 2-3
"PROBLEMATIC" COMPONENTS OF C&D WASTE
IDENTIFIED BY THE SOURCE DOCUMENTS

Waste Item	Source	Waste Item	Source
CONTAINERS AND EXCESS		lead solder	16
aerosol cans	10	petroleum constituents, leachable from asphalt or roofing tars	16
adhesives	3,6,10	sulfate (in gypsum drywall)	16
caulk	6,8,10	wood, pressure-treated	9
coatings	10	WOOD CONTAMINANTS	
concrete & concrete products	10	Paints and Coatings	
containers with liquids	7	acrylic, acrylic paints	1,4,13,18
driveway sealants	6	lead-based paints	1,4,11,12,14
drums and containers	2	mercury-based paints	12,14
fuel tanks	2,11	pigments in paints containing: lead, arsenic, or chromium	4
joint compound	10	pigments in paints containing: lead, arsenic, barium, cadmium, zinc, mercury, or chromium	16
lacquer thinners	15	water-based paint	13
paints	3,6,7,10,11,15	alkyd	18
pesticides	15	alkyd urea	18
resins	10	polyvinyl acetate	18
roofing cement	10	polyurethane	18
sealers	10	polyesters	18
solvents	10	nitrocellulose	18
MACHINERY LUBRICANTS & FUEL		ethyl cellulose	18
brake fluid	10	butyrate	18
form oil	10	vinyl (PVA/PVC)	18
oils and greases, waste	10	epoxy (reaction products of epichlorohydrin & polyhydric phenols)	18
oil filters	15	melamine	18
INSEPARABLE CONSTITUENTS OF BULK ITEMS		polystyrene	18
asbestos	1,2,3,11,12,14,17	styrene/butadiene	18
formaldehyde (in carpeting)	2	lead	18
lead	1,3	stains	1,4,13
lead flashing	16	varnishes	1,4,13

Waste Item	Source	Waste Item	Source
WOOD CONTAMINANTS		Laminates	
Preservatives		naphthalene	13,16
arsenic & arsenic-containing water-soluble preservatives	1,4,16	melamine/paper	18
chromium & chromium-containing water-soluble preservatives	1,4,16	phenol/paper	18
acid copper chromate (ACC)	18	polyvinyl chloride	18
copper zinc chloride (CZC)	18	polyester	18
arsenates chromated copper arsenate (CCA) ammoniacal copper arsenate (ACA) ammoniacal copper zinc arsenate copperized chromated zinc arsenate (CuCZA)	18 13,18 18 18 18 18	phenol/melamine/paper	18
copper	16	Other Chemical Additives	
creosote	1,4,12,14	ammonia	18
pentachlorophenol	1,12,14,16	borates	18
petroleum distillates, ignitable	12	phosphates	18
wood preservatives	10	polyesters	18
copper naphthenate (in creosote or petroleum)	18	sulfates ammonium sulfate	 18
copper-8-quinolinolate	18	waxes	18
tributyltin oxide	18	OTHER PROBLEMATIC ITEMS	
Adhesives/Resins		appliances or "white goods"	2,3,5
formaldehyde	13,16	batteries	5,7,8,15
glues	4	cardboard	7
phenol-formaldehyde resins	1,4,13,18	carpeting	2,3
urea	13,18	corrugated container board	2
urea formaldehyde resins	1,4,18	CFCs in conditioning systems	17
melamine formaldehyde	18	fiberglass	11
resorcinol formaldehyde	18	furniture	2,3,5
isocyanates	18	garbage	2,5
epoxy	18	mercury-containing switches, bulbs	1,2,15,17
polyvinyl acetate	18	PCBs in transformers and capacitors	1,2,3,15
casein	18	tires	2,5,7
hot melts (containing polyesters, polyamides, or ethylene vinyl acetate)	18	unrecognizable pulverized or shredded waste components	2

TABLE 2-3 (continued)

NOTES:

(1) Identified as hazardous material found within C&D material (Lambert and Domizio, 1993).

(2) Excluded by NYDEC (Piasecki et al., 1990).

(3) High priority substances that should be excluded (Piasecki et al., 1990).

(4) Construction wood contaminants: chemically contained non-wood materials (Federle, 1992).

(5) Materials unacceptable at Kimmins C&D Recycling Facility (Woods 1992 as cited in Cosper et al., 1993).

(6) Materials that may be considered problem materials (Lauer, 1993).

(7) Problem materials (Gates et al., 1993).

(8) Items detected and rejected (Gates et al., 1993).

(9) Potentially toxic material (O'Brien/Palermini, 1993).

(10) Hazardous wastes generated from new construction (McGregor et al., 1993)

(11) Contaminants in construction waste and demolition debris (Apotheker, 1990)

(12) Potential hazards (per the *Vermont Hazardous Waste Regulations*, a material is defined as hazardous if it is corrosive, toxic, flammable, or reactive) (Spencer, 1991).

(13) C&D wood waste that may contain nonhazardous restrictive materials. In this report "restrictive materials" were defined as nonhazardous material present in some types of C&D waste that may restrict end uses for the waste once it is recycled (Spencer, 1991).

(14) An innocent-looking pile of debris may be illegally laced with these (Woods, 1992).

(15) Wastes that are legally considered hazardous according to state and federal regulations have been observed. Materials of concern that have been observed at C&D sites include the following (Hanrahan, 1994).

(16) Hazardous constituents contained in C&D materials (Hanrahan, 1994).

(17) Special and hazardous wastes (SPARK, 1991).

(18) Chemicals in wood products that may affect their use as fuel (ERL, 1992).

TABLE 2-4
"HAZARDOUS" WASTE GENERATED FROM CONSTRUCTION OF A SINGLE-FAMILY RESIDENCE IN PORTLAND, OREGON
(Source: McGregor et al. 1993)

Waste Generated	Quantity (pounds)	Percent of Hazardous Waste (by weight)
Sealers/caulking tubes	15	33
Adhesives	5	11
Resins	1	2
Joint compound	10	21
Aerosol cans	15	33
Total	46	100

Other Discrete Items

Other discrete items may be problematic for a variety of reasons and may be excluded from C&D landfills by state or county regulations. Batteries and fluorescent light bulbs may be excluded because they contain heavy metals (lead and mercury, respectively). Other items, such as cardboard, may be excluded because they are recyclable. As noted above, supposedly "excluded" items are found at C&D landfills, although some items are spotted and rejected during visual inspections (Cosper et al., 1993; Lauer, 1993; Piasecki et al., 1990).

Inseparable Constituents of Bulk Items

Many C&D wastes contain inseparable hazardous constituents. Examples include carpeting that can leach formaldehyde and treated or coated wood and wood products. Extensive information is available on wood treatments and coatings and their constituents. Wood products may leach hazardous constituents into ground water or release them into the air during landfill fires. In some states, fire suppression capabilities are not required at C&D landfills, and C&D landfill fires have occurred in a number of states (Connelly et al., 1991 as cited in Hanrahan, 1994). Table 2-5 provides the information available from the source documents on the concentrations of some of the "problematic" constituents found in wood products. The proportion of the chemical constituent to the wood product ranges from less than 10 parts per million (ppm) for pentachlorophenol in pallets and skids, to 20 percent for creosote in railroad ties, utility poles, pilings, and docks.

SUMMARY

As noted earlier, this report characterizes segments of the C&D waste stream based on information provided in the source documents. Much information on the waste composition is based on generated C&D wastes, which may differ from the composition of landfilled C&D wastes. Additionally, various factors affect the characteristics of C&D waste that were reported, including structure type and size, and the activity being performed.

TABLE 2-5
AMOUNT OF CHEMICAL CONSTITUENTS IN WOOD PRODUCTS
(Source: ERL, 1992)

Wood Product	Chemical Constituent	Amount of Chemical(s) in Wood Product	Note
pallets and skids, (hardwood/softwood)	pentachlorophenol lindane dimethyl phthalate copper-8-quinolinolate copper naphthenate	< 10 ppm	a
pallets, plywood	phenolic resins	2-4%	a
pallets, glued	epoxy	2-4%	
painted wood, lead-based paint	lead	1400-20,000 ppm (before 1950)	b
painted wood, acrylic-based paint	acrylic acid, styrene, vinyl toluene, nitriles	<0.01%	
painted wood, "metallic" pigments	aluminum powder, copper acetate, phenyl mercuric acetate, zinc chromate, titanium dioxide, copper ferrocyanide	<0.01%	
plywood, interior grade	urea formaldehyde (UF) resins	2-4%	c
plywood, exterior grade	phenol formaldehyde (PF) resins	2-4%	c
oriented strandboard	phenol formaldehyde resins, or PF/isocyanate resins	2-4%	
waterboard "Aspenite"	urea formaldehyde resins or phenolic resins	5-15% UF 2.5% PF, 2% wax	d
overlay panels	phenol formaldehyde resins	4-8%, sometimes up to 10%	
plywood/PVC laminate	urea formaldehyde polyvinyl chloride	2.5% UF 10% PVC	
particleboard	urea formaldehyde resins	5-15% UF	d
particleboard with PVC laminate	UF resins with polyvinyl chloride	4.5% UF 10% PVC	
hardboard	phenolic resins	1.5%	
fencing and decks: pressure treated southern pine	CCA or ACA	1-3%	e
fencing and decks: surface treated	CCA or ACA	1-3%	e

Wood Product	Chemical Constituent	Amount of Chemical(s) in Wood Product	Note
utility poles, laminated beams, freshwater pilings, bridge timbers, decking, fencing	pentachlorophenol	1.2-1.5%	f
railroad ties, utility poles	creosote containing 85% PAHs	14-20%	g
freshwater pilings, docks	creosote - coal tar	15-20%	
marine pilings, docks	creosote/chlorpyrifos	15-20%	

a Hardwood pallets are used primarily in the eastern U.S.; softwood and plywood pallets are used primarily in the western U.S.

b Lead level is highly dependent on the age of the paint; before 1950 lead comprised as much as 50% of the paint film. Legislation in 1976 reduced standard to 0.06% by weight.

c Plywood may be surface-coated with fire retardants, preservatives and insecticides, or pressure-treated with CCA.

d May be sealed with polyurethane or other sealant to prevent offgassing of formaldehyde.

e Dominant wood preservative; actual levels will be lower due to evaporation or leaching after treatment.

f Restricted use due to industry change and concern over dioxin linkage; not permitted for residential uses.

g Losses after treatment estimated to be 20-50% over 10-25 years; not recommended for residential use.

Overall, C&D waste streams are comprised mainly of wood products, asphalt, drywall, and masonry. Other notable components include metals, plastics, earth, shingles, and insulation. Most of the source documents did not provide information on the percentage of C&D waste that is "hazardous." Those that did indicated that "hazardous" waste comprised a small percentage of the total C&D waste stream (e.g., 0.4 percent of construction waste in one county in North Carolina). The source documents did not define "hazardous" or other "problematic" wastes as wastes that are classified as hazardous under RCRA Subtitle C.

The source documents did note that although C&D wastes have traditionally been considered inert and harmless, they have become an issue of concern in the 1990s. This is largely because some C&D wastes that were previously considered harmless are now considered to be "toxic" or to contain "hazardous" materials, such as wood that is coated with lead paint (Piasecki et al., 1990; Lambert and Domizio, 1993). "Problematic" wastes cited by three or more of the reports or articles in the source documents are: adhesives, caulk, paint, wood preservatives, formaldehyde resins, stains and varnishes, appliances, batteries, mercury-containing switches and lights, PCB-containing transformers and capacitors. Again, these "problematic" wastes may or may not qualify as hazardous wastes under RCRA Subtitle C. More attention has also focused on C&D landfills because they may be used to dump hazardous wastes illegally (Piasecki et al., 1990; Lambert and Domizio, 1993).

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CHAPTER 3
LEACHATE QUALITY ANALYSIS

This chapter summarizes available information on construction and demolition (C&D) debris landfill leachate. The methodology is discussed first, followed by the results of the analysis.

METHODOLOGY

This analysis is based on construction and demolition debris landfill leachate sampling data presented in two documents assembled by Gershman, Brickner & Bratton, Inc. (GBB) for the National Association of Demolition Contractors (NADC). One document, "C&D Waste Landfills, Leachate Quality Data, Volume 1, Specific State-by-State Responses," presents the results of GBB's efforts to obtain leachate data from state officials. The second document, "C&D Waste Landfills, Leachate Quality Data, Volume 2, Copies of Reports, Articles, and Other Related Data," is a compilation of several reports germane to C&D landfill leachate quality.

In addition to the information compiled by NADC, other studies of C&D debris landfill leachate have been performed. Selected studies are reviewed, and the results compared to this study, in Attachment 3-A.

The methodology for using NADC's data as a basis for characterizing C&D landfill leachate quality comprised the following steps:

- Selecting C&D landfills to include in the analysis;
- Developing a C&D landfill leachate database;
- Compiling parameter-specific regulatory and health-based "benchmarks" to use as a basis for screening potential risks;
- Screening out parameters that were never detected in C&D landfill leachate, or that never exceeded the benchmark;
- Calculating median values (using only detected values) for each parameter detected at a concentration above the benchmark; and
- Calculating the ratio of the parameters' median concentrations to the benchmarks.

Each step is discussed below.

Selecting C&D Landfills

The two reports prepared for NADC by GBB present leachate sampling data for numerous landfills in many states. While much of the information is landfill-specific, some is presented in different formats such as average parameter concentrations across landfills in a given state, or as ranges of concentrations across groups of landfills. To develop the leachate database for this report, only landfill-specific sampling data were used. Thus, this report is based on leachate sampling data for 21 C&D landfills, listed in Table 3-1. For ease in reviewing the database in Attachment 3-B, the abbreviated database code for each landfill is also presented in Table 3-1.

TABLE 3-1
LANDFILLS FROM WHICH LEACHATE DATA WERE EXTRACTED FOR ANALYSIS

Landfill Name	Database Reference
CDI, Colorado	CO
Deep River Bulky Waste Landfill, Connecticut	CT-1
Guilford Bulky Waste Landfill, Connecticut	CT-2
Groton Bulky Waste Landfill, Connecticut	CT-3
Glastonbury Bulky Waste Landfill, Connecticut	CT-4
ITI Trucking Terminal site, Connecticut	CT-5
D & M site, Connecticut	CT-6
Armetta Property, Connecticut	CT-7
Iowa #4 site, Iowa	IA-1
Iowa #5 site, Iowa	IA-2
Brandywine/Cross Trails Rubble Landfill, Maryland	MD
Unnamed Kentucky site from 1991 WMNA study, Kentucky	KY
Unnamed Massachusetts site from 1991 WMNA study, Massachusetts	MA
Unnamed Michigan site from 1991 WMNA study, Michigan	MI
SKB Rich Valley Waste Management Facility, Minnesota	MN
110 Sand & Gravel site, New York	NY-1
Blydenburg Cleanfill, New York	NY-2
South Carolina Landfill #1, South Carolina	SC
Sanifill, Inc. site (high in 3-site range), Texas	TX HI
Sanifill, Inc. site (low in 3-site range), Texas	TX LO
Mt. Olivet Landfill, Washington	WA

Developing a C&D Landfill Leachate Database

Leachate sampling data for the 21 landfills were entered into a database, Attachment 3-B. The database contains sampling data for a total of 305 parameters analyzed for at least once. A blank entry in the database indicates that the parameter was not sampled for at that landfill. In many cases, a parameter was sampled for but not detected at a landfill. Non-detects were handled in one of two ways:

- If a detection limit (say, "X") was given by GBB, "<X" was entered in the database.

- If no detection limit was given, "ND" was entered in the database.

As data were taken from many different landfills (and thus many different sampling laboratories), there were cases in which different names were used to address the same parameter. The differing nomenclatures used by different landfills were reconciled so that all synonyms were joined into one parameter row. In addition, some samples were identified as "total" and others as "dissolved." To be conservative, the "total" values were entered into the database.

Compiling Regulatory and Health-based Benchmarks

The next step was to identify parameter-specific benchmarks, or concern levels, to use as a basis for determining whether the parameter concentrations in leachate are high enough to pose potential risk. Safe Drinking Water Act National Primary and Secondary Drinking Water Standards were used as the benchmarks if these were available; these are referred to in the remainder of this report as Maximum Contaminant Levels (MCLs) or Secondary Maximum Contaminant Levels (SMCLs).[8] Both are enforceable drinking water standards. While MCLs are health-based, SMCLs are based on other factors such as aesthetics. Both MCLs and SMCLs are also based on the availability of treatment technologies and other factors such as availability of data and analytical methods.

For parameters without MCLs or SMCLs, health-based benchmarks for a leachate ingestion scenario were compiled as follows:

- Reference doses (RfDs) were compiled for non-carcinogens. EPA calculates RfDs by dividing animal toxicity values by suitable scaling or uncertainty and modifying factors. The RfDs used in this study were taken from EPA's Integrated Risk Information System (IRIS) or Health Effects Assessment Summary Tables (HEAST). The RfDs (mg/kg-day) were then converted to benchmark concentrations in drinking water using EPA's standard exposure assumptions (daily intake of two liters per day, average body weight of 70 kg, and exposure duration of 365 days per year over 70 years).

- Risk-specific doses (RSDs) were calculated for carcinogens based on cancer slope factors (CSFs). A CSF is a measure of the carcinogenic potency of low doses of carcinogens. CSFs represent the upper-bound confidence limit estimate of the excess cancer risk for individuals experiencing a given exposure over a lifetime. EPA calculates CSFs from dose-response curves, which are based on human epidemiological and/or animal bioassay data. For this study, CSFs given in IRIS or HEAST were used, and the standard exposure assumptions listed above, to calculate the drinking water concentration that would correspond to an excess lifetime cancer risk of 10^{-6}.

Many of the parameters detected in C&D landfill leachate have not been studied sufficiently to allow an RfD or a CSF to be developed. For these parameters, no benchmarks were available for this study.

Screening Out Parameters

In this step, the maximum observed value of each parameter was simply compared to its regulatory or health-based benchmark. Parameters that were never observed in C&D landfill leachate at levels above their respective benchmarks were screened out, the rationale being that if the undiluted leachate is "safe to

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[8]Where available, existing MCLs or SMCLs were used; otherwise, proposed values were used.

drink," no further analysis is needed. Also excluded from further consideration were parameters that were sampled for but never detected in landfill leachate.

Calculating Median Leachate Concentrations

For each parameter with at least one exceedance over the benchmark, the median leachate concentration was calculated across all landfills at which the parameter was sampled. Medians, rather than averages, were calculated in order to reduce the effect of single, anomalous values.

When calculating the median value for each parameter, the median value for each landfill was first calculated, and then the median value across all landfills was calculated. For example, if parameter X was sampled once at Landfill A, once at Landfill B, and six times or at six locations at Landfill C, the median concentration was calculated based on the Landfill A sample, the Landfill B sample, and the median among the Landfill C samples. Thus, each landfill is represented only once for each parameter, and each landfill is weighted equally.

Due to anomalies and inconsistencies among the sampling equipment used at different times and at different landfills, non-detects were not considered in determining median values. In other words, for those parameters for which a median was calculated, the non-detects were discarded before calculating both individual landfill concentration medians and medians across all landfills. Thus, the median leachate concentrations calculated for this analysis represent the median among the detected values, rather than the median among all values. The median concentration among all values would in most cases have been lower than those calculated here.

Comparing Medians to Benchmarks

The median value for each parameter was then compared to the benchmark for that parameter, if one was available. The results are expressed as the ratio of the median leachate concentration to the benchmark.

RESULTS

As discussed above, the leachate database contains sampling data for 305 parameters analyzed for at one or more of 21 construction and demolition landfills. Of these 305 parameters, 93 were detected at least once. The other 212 parameters, almost all organics, were never detected, and are listed in Table 3-2; many of them were sampled for at only one or two landfills, and often only once or twice at those sites.

All 93 parameters that were detected at least once are listed in Table 3-3, along with the number of landfills at which the parameter was sampled, the number of landfills at which the parameter was detected, the maximum and minimum values for each parameter (here, including non-detects), and the relevant benchmark, if available. Maximum concentrations above the benchmark are shaded. For pH, the minimum pH level below the benchmark range is shaded.

Table 3-4 focuses on the parameters whose maximum concentrations exceeded their benchmarks (i.e., the parameters shaded in Table 3-3). For each parameter, Table 3-4 repeats the number of landfills at which the parameter was sampled and detected, but also shows the number of landfills at which the benchmark was exceeded. Table 3-4 also provides the median value of each parameter across all landfills, each parameter's benchmark, and the ratio of the medians to benchmarks. Again, due to anomalies and inconsistencies among sampling equipment, non-detects were not considered in determining median values.

The results are discussed below.

TABLE 3-2
PARAMETERS ANALYZED FOR BUT NEVER DETECTED

ORGANICS			
Acetonitrile	m-Cresol	Endosulfan II	N-Nitroso-di-n-propylamine
Acetophenone	Cumene	Endrin	N-Nitrosomorpholine
2-Acetylaminofluorene	2,4-D	Endrin aldehyde	N-Nitrosopiperidine
Acrolein	4,4-DDD	Endrin ketone	N-Nitrosopyrolidine
Acrylonitrile	4,4-DDE	Ethyl ether	5-Nitro-o-toluidine
Aldrin	4,4,4-DDT	Ethylmethacrylate	PeCDD
alpha-Chlordane	delta-BHC	Ethyl methane sulfonate	PeCDF
alpha-Endosulfan	Diallate	Ethyl parathion	Pentachlorobenzene
4-Aminobiphenyl	Dibenzo(a,h)anthracene	Famphur	Pentachloronitrobenzene
Aniline	Dibenzofuran	Fluoranthene	Pentachlorophenol
Anthracene	Dibromochloromethane	Fluorene	Pentachlorothane
Aramite	1,2-Dibromo-d-chloropropane	Heptachlor	Phenacetin
Aroclor/PCB 1016	Dibromomethane	Heptachlor epoxide	Phenanthrene
Aroclor/PCB 1221	1,2-Dibromoethane	Hexachlorobenzene	Phenolphthalein Alkalinity
Aroclor/PCB 1232	Di-n-butyl phthalate	Hexachlorobutadiene	p-Phenylenediamine
Aroclor/PCB 1242	Dichloroacetonitrile	Hexachlorocyclopentadiene	Phorate
Aroclor/PCB 1248	1,2-Dichlorobenzene	Hexachloroethane	2-Picoline
Aroclor/PCB 1254	1,3-Dichlorobenzene	Hexachlorophene	Pronamide
Aroclor/PCB 1260	1,4-Dichlorobenzene	Hexachloropropene	Propionitrile, Ethyl cyanide
Benzo-a-anthracene	3-3-Dichlorobenzidine	Hx-CDD	Pyrene
Benzo-a-pyrene	trans-1,4-Dichloro-2-butene	HxCDF	Pyridine
Benzo-b-fluoranthene	Dichlorodifluoromethane	Indeno(1,2,3-cd)pyrene	Safrole
Benzo(k)fluoranthene	1,2-Dichloroethene	Iodomethane	Silvex, 2,4,5-TP
Benzo-g,h-perylene	1,1-Dichloroethene	Isobutanol	Sulfotepp
Benzo-g,h,i-perylene	Dichlorofluoromethane	Isodrin	TCDD
Benzo-k-perylene	2,4-Dichlorophenol	Isophorone	2,3,7,8-TCDD
Benzyl alcohol	2,6-Dichlorophenol	2-Isophorone	TCDF
beta-BHC	trans-1,2-Dichloropropane	Isosafrole	1,2,4,5-Tetrachlorobenzene
beta-Endosulfan	1,2-Dichloropropane	Kepone	1,1,1,2-Tetrachloroethane
Bis(2-chloroethoxy)methane	1,3-Dichloropropane	Lindane	1,1,2,2-Tetrachloroethane
Bis(2-chloroethyl)ether	2,2-Dichloropropane	Methacryonitrile	2,3,4,6-Tetrachlorophenol
Bis(2-chloroisopropyl)ether	trans-1,3-Dichloropropene	Methapyrilene	Tetrahydrofuran
Bis(2-chloro-1-methyl)ether	1,1-Dichloropropene	Methoxychlor	Thionazin
Bis(2-ethylhexyl)phthalate	2,3-Dichloro-1-propene	3-Methylchloanthrene	o-Toluidine
Bromodichloromethane	cis-1,3-Dichloropropene	Methyl methacrylate	Toxaphene
Bromoform	p-(Dimethylamino)azobenzene	Methyl methane sulfonate	1,2,4-Trichlorobenzene
Bromomethane	Dimethaote	2-Methylnaphthalene	1,1,1-Trichloroethane
4-Bromophenyl-phenylether	7/12-Dimethylbenz(a)anthracene	Methyl parathion, Parathion methyl	1,1,2-Trichloroethane
Butyl benzyl phthalate	3,3-Dimethylbenzidine	(3&4)-Methylphenol	2,4,5-Trichlorophenol
Carbon tetrachloride	Dimethylphenethylamine	1,4-Naphthoquinone	2,4,6-Trichlorophenol
Carbonate	2,4-Dimethylphenol	1-Naphthylamine	1,2,3-Trichloropropane
Chlordane	Dimethyl phthalate	2-Naphthylamine	1,1,2-Trichlorotrifluoroethane
4-Chloroaniline	1,3-Dinitrobenzene	2-Nitroaniline	o,o,o-Triethyl phosphorothioate
Chlorobenzene	4,6-Dinitro-2-methylphenol	3-Nitroaniline	sym-Trinitrobenzene
Chlorobenzilate	2,4-Dinitrophenol	4-Nitroaniline	Vinyl acetate
2-Chloro-1,3-butadiene, Chloroprene	2,4-Dinitrotoluene	Nitrobenzene	Vinyl chloride
Chlorodibromomethane	2,6-Dinitrotoluene	o-Nitrophenol	**INORGANICS**
2-Chloroethyl Vinyl Ether	Dinoseb, DNBP	p-Nitrophenol	Antimony
4-Chloro-3-methylphenol	Di-n-octyl phthalate	4-Nitroquinoline-1-oxide	Thallium
4-Chlorophenyl phenyl ether	Di-n-octyl phthalate	N-Nitrosodi-n-butylamine	Tin
2-Chloronaphthalene	1,4-Dioxane	N-Nitrosodiethylamine	**CONVENTIONAL PARAMETER**
2-Chlorophenol	Diphenylamine	N-Nitrosodimethylamine	Total Settled Solids
3-Chloropropene, Allyl Chloride	Endosulfan sulfate	N-Nitrosodimethylethylamine	
Chrysene	Endosulfan I	N-Nitrosodiphenylamine	

TABLE 3-3
FREQUENCY OF DETECTION, RANGE, AND BENCHMARK FOR DETECTED PARAMETERS
(Concentrations in ug/l)

PARAMETER	# LANDFILLS SAMPLED	# LANDFILLS DETECTED	MAXIMUM	MINIMUM	BENCHMARK	
					VALUE	SOURCE
ORGANICS						
Acenaphthene	7	1	3	ND	2000	RfD
Acetone	6	4	5100	ND	4000	RfD
alpha-BHC	6	1	0.12	ND	0.006	10^-6 RSD
Benzene	9	2	2 7	ND	5	MCL
Benzoic acid	4	2	910	ND	--	--
Carbon disulfide	5	2	15	ND	4000	RfD
Chloroethane	9	2	353	ND	--	--
Chloroform	9	1	3	ND	100	MCL
Chloromethane	9	2	43	ND	--	--
cis-1,2-Dichloroethane	2	1	1.4	ND	--	--
1,2-Dichloroethane	9	3	26	ND	5	MCL
1,1-Dichloroethane	9	3	6.2	ND	4000	RfD
1,1-Dichloroethene	9	1	3	ND	7	MCL
trans-1,2-Dichloroethene	4	1	4	ND	100	MCL
Dieldrin	6	1	0.065	ND	0 002	10^-6 RSD
Diethyl phthalate	7	1	16	ND	30000	RfD
Disulfoton	3	1	0 96	ND	1	RfD
Di-n-butyl phthalate	4	1	16	ND	4000	RfD
Ethylbenzene	9	5	18	ND	700	MCL
2-Hexanone (methyl butyl ketone)	5	1	4.8	ND	--	--
Methyl ethyl ketone (MEK)	6	2	2500	ND	20000	RfD
Methylene chloride	9	3	60	ND	5	MCL
2-Methylphenol (o-cresol)	7	2	130	ND	--	--
4-Methyl-2-pentanone	6	2	250	ND	--	--
4-Methylphenol (p-cresol)	5	4	5700	ND	--	--
Naphthalene	7	2	63	ND	1000	RfD
Phenol	8	5	2990	ND	20000	RfD
Styrene	5	1	1.1	ND	100	MCL
Tetrachloroethene	9	1	4.8	ND	5	MCL
Toluene	9	4	240	ND	1000	MCL
Trichloroethene	9	3	20	ND	5	MCL
Trichlorofluoromethane	5	2	20	ND	10000	RfD
2,4,5-T, 2,4,5-Trichlorophenoxyacetic acid	4	2	0.53	ND	50	MCL
Xylene (total)	8	4	85	ND	10000	MCL
INORGANICS						
Aluminum	1	1	6350	ND	50-200	SMCL
Arsenic	16	12	120	ND	50	MCL
Barium	13	13	8000	ND	2000	MCL
Beryllium	5	1	2 1	ND	4	MCL
Boron	2	2	3900	1400	--	--
Cadmium	19	14	2050	ND	5	MCL
Chromium	16	9	250	ND	100	MCL
Hexavalent Chromium	5	2	4920	ND	--	--
Cobalt	4	1	60.9	ND	--	--
Copper	18	14	620	ND	1000	SMCL
Cyanide	12	9	340	ND	200	MCL
Cyanides (total)	6	4	38	ND	--	--
Iron	20	20	172000	ND	300	SMCL
Filtered Iron	2	2	11000	240	--	--
Lead	18	15	2130	ND	15	Action Level
Magnesium	7	7	460000	ND	--	--
Mercury	15	4	9	ND	2	MCL
Nickel	12	7	170	ND	100	MCL
Potassium	9	9	618000	ND	--	--
Selenium	14	1	5	ND	50	MCL
Silver	12	2	30	ND	100	SMCL
Vanadium	4	2	96	ND	200	RfD
Zinc	15	15	8630	ND	5000	SMCL
CONVENTIONAL PARAMETERS						
Alkalinity	13	13	6520000	ND	--	--

ND = Not Detected
RfD = Reference Dose
10^-6 RSD = 10^-6 Risk-specific Dose

TABLE 3-3 (cont.)
FREQUENCY OF DETECTION, RANGE, AND BENCHMARK FOR DETECTED PARAMETERS
(Concentrations in ug/l)

PARAMETER	# LANDFILLS SAMPLED	# LANDFILLS DETECTED	MAXIMUM	MINIMUM	BENCHMARK	
					VALUE	SOURCE
Ammonia	3	3	480000	ND	--	--
Ammonia, Nitrogen	14	13	184000	ND	--	--
Bicarbonate	2	2	7950000	2090000	--	--
Biological Oxygen Demand (BOD) (5-day)	14	13	320000	ND	--	--
Biological Oxygen Demand (BOD) (20-day)	5	5	83000	5000	--	--
Calcium	7	7	600000	ND	--	--
Chemical Oxygen Demand (COD)	18	17	11200000	ND	--	--
Chlorides	20	20	2400000	ND	250000	SMCL
Dissolved Oxygen (%)	1	1	4 8	0 3	--	--
Fluoride	3	2	5000	ND	2000	SMCL
Hardness by Calculation	10	10	2420000	150000	--	--
Manganese	14	14	258000	ND	50	SMCL
Nitrate	14	10	13000	ND	10000	MCL
Nitrate/Nitrite	1	1	290	290	10000	MCL
Nitrite	10	6	47	ND	1000	MCL
Organic Nitrogen	7	7	11000	70	--	--
Total Kjeldahl Nitrogen	3	3	300000	3730	--	--
Oil and Grease	7	6	50000	ND	--	--
Oxidation-Reduction Potential	2	2	580	ND	--	--
pH	18	18	8	6.2	6 5-8 5	SMCL
Total Phenolics	4	3	4900	ND	--	--
Phosphate	2	1	3900	ND	--	--
Phosphorus	5	4	3890	ND	--	--
Total Phosphorus	3	3	1600	100	--	--
Sodium	12	12	1510000	ND	--	--
Solids, volatile	2	2	380000	170000	--	--
Specific Conductance (h)	12	12	25000	220	--	--
Sulfates	16	14	2700000	ND	250000	SMCL
Surfactants	1	1	1100	ND	--	--
Tannin	1	1	120000	120000	--	--
Total Dissolved Solids	18	17	8400000	ND	500000	SMCL
Total Organic Carbon	7	7	1080000	ND	--	--
Total Organic Halogens	3	3	910	740	--	--
Total Suspended Solids	16	15	43000000	ND	--	--
Turbidity (NTU)	3	3	630	ND	--	--

ND = Not Detected
RfD = Reference Dose
10^-6 RSD = 10^-6 Risk-specific Dose

TABLE 3-4
FREQUENCY OF DETECTION ABOVE BENCHMARK AND COMPARISON OF MEDIANS TO BENCHMARKS
(Concentrations in ug/l)

PARAMETER	# LANDFILLS SAMPLED	# LANDFILLS DETECTED	# LANDFILLS > BENCHMARK	MEDIAN*	BENCHMARK		MEDIAN/ BENCHMARK
					VALUE	SOURCE	
ORGANICS							
Acetone	6	4	1	230	4000	RfD	0.058
alpha-BHC	6	1	1	0 12	0.006	10^-6 RSD	20
1,2-Dichloroethane	9	3	3	19	5	MCL	3 8
Dieldrin	6	1	1	0 065	0.002	10^-6 RSD	33
Methylene chloride	9	4	3	15 2	5	MCL	3
Trichloroethene	9	3	1	3 2	5	MCL	0 6
INORGANICS							
Aluminum	1	1	1	245	50-200	SMCL	4.9 (1 2 Min)
Arsenic	16	12	3	19 5	50	MCL	0.39
Barium	13	13	1	340	2000	MCL	0.17
Cadmium	19	14	12	10 5	5	MCL	2 1
Chromium	16	9	3	45	100	MCL	0 45
Cyanide	12	9	2	24 5	200	MCL	0.12
Iron	20	20	19	11003	300	SMCL	37
Lead	18	15	13	55	15	Action Level	3 7
Mercury	15	4	1	0 5	2	MCL	0 25
Nickel	12	7	2	50	100	MCL	0 5
Zinc	15	15	1	135	5000	SMCL	0.027
CONVENTIONAL PARAMETERS							
Chlorides	20	20	4	110000	250000	SMCL	0 44
Fluoride	3	2	1	2700	2000	SMCL	1.4
Manganese	14	14	13	2925	50	SMCL	59
Nitrate	14	10	1	520	10000	MCL	0.052
Sulfates	16	14	6	119000	250000	SMCL	0.48
Total Dissolved Solids	18	17	15	1770000	500000	SMCL	3 5

* Medians of detected values only

Organics

The frequency of detection of organics was generally low compared to metals and conventional parameters. Of the 34 organics listed in Table 3-3, only 8 were detected at half or more of the landfills at which they were sampled: acetone, benzoic acid, cis-1,2-dichloroethane, ethylbenzene, 4-methylphenol, phenol, 2,4,5-T, and xylenes. Six organics exceeded their respective benchmarks at least once, including acetone, alpha-BHC, 1,2-dichloroethane, dieldrin, methylene chloride, and trichloroethene.

Of the six organic constituents found above their benchmarks, Table 3-4 shows that four (acetone, alpha-BHC, dieldrin, and trichloroethene) were detected above their benchmarks at only one landfill. While this is noteworthy, these constituents are not subject to further assessment here because their exceedances cannot be considered representative.

The median leachate concentrations (among the detected values) of both of the remaining constituents -- 1,2-dichloroethane and methylene chloride -- exceed their benchmarks. Neither of them exceeds its benchmark by a factor of 10 or more, however. Assuming that a 100-fold reduction in concentration is achieved between the leachate and a downgradient drinking water well (as would be likely, based on the dilution attenuation factor [DAF] of 100 developed for the Toxicity Characteristic rulemaking), the concentrations would fall well below the benchmarks at the point of exposure. Even if a smaller DAF of 10 is applied (as may be applicable at a monitoring well located closer to the landfill), neither constituent would exceed its benchmark. Again, these medians only account for detected values. Had the non-detects been included, the median concentrations of all but one of the organics would have been in the non-detect range.

Inorganics

Most of the inorganics listed in Table 3-3 were detected at half or more of the landfills at which they were sampled: aluminum, arsenic, barium, boron, cadmium, chromium, copper, cyanide, iron, lead, magnesium, nickel, potassium, vanadium, and zinc. The 11 constituents exceeding their benchmarks included aluminum, arsenic, barium, cadmium, chromium, cyanide, iron, lead, mercury, nickel, and zinc.

As shown in Table 3-4, seven inorganics were detected above their benchmarks at more than one landfill: arsenic, cadmium, chromium, cyanide, iron, lead, and nickel. The median leachate concentrations exceed the benchmarks for only three of these inorganics, however: cadmium, iron, and lead. None of the median leachate concentrations exceeds its benchmark by a factor of 100 or more, and iron is the only constituent whose median exceeds its benchmark by a factor greater than 10. Iron was detected at all 20 landfills at which it was sampled, and was detected above its benchmark at least once at 19 of them. Excluding the few non-detects, the median concentration of iron in leachate is 37 times higher than its drinking water standard, which is a secondary MCL based on taste.

Conventional Parameters

As would be expected, all of the conventional parameters were detected at most, and often all, of the sites at which they were analyzed. The conventional parameters with maximum concentrations exceeding their respective benchmarks included chlorides, fluoride, manganese, nitrate, sulfates, and total dissolved solids (TDS). Only chlorides, manganese, sulfates, and TDS exceeded their benchmarks at more than one landfill. Of these four parameters, only manganese and TDS have medians above the benchmark. The median level of manganese exceeds its SMCL (by 59 times), while the median level of TDS exceeds its SMCL by over three times. In addition to these parameters, more than one landfill had a measured pH value outside of the range of the SMCL for pH.

SUMMARY

Leachate sampling data for 305 parameters sampled for at one or more of 21 C&D landfills were compiled into a database, shown in Attachment 3-B. Of these 305 parameters, 93 were detected at least once. Almost all of the 212 parameters that were never detected were organics; most of the inorganic and conventional parameters sampled for were detected one or more times.

Of the 93 parameters detected in C&D landfill leachate, 24 had at least one measured value above the regulatory or health-based benchmark.[9] For each of the parameters exceeding benchmarks (except pH), the median leachate concentration was calculated and compared to its benchmark. Due to anomalies and inconsistencies among the sampling equipment used at different times and at different landfills, non-detects were not considered in determining median values. Thus, the median leachate concentrations represent the medians among the detected values, rather than the median among all values. The median concentrations among all values would in most cases have been lower than those calculated here.

Based on (1) the number of landfills at which the benchmark was exceeded and (2) a comparison between the median detected concentration and the benchmark, seven parameters emerge as being potentially problematic. The list of these seven parameters, shown below, was developed by eliminating from the original list of 24 parameters (1) any parameter that was detected at only one landfill (this was determined to be not representative) and (2) any parameter whose median leachate concentration did not exceed its benchmark.

organics

- 1,2-dichloroethane
- methylene chloride

inorganics

- cadmium
- iron
- lead

conventional parameters

- manganese
- total dissolved solids (TDS)

For three of the seven parameters listed above (iron, manganese, and TDS), the benchmarks are secondary MCLs (SMCLs), which are set to protect water supplies for aesthetic reasons (e.g., taste) rather than for health-based reasons. None of the remaining four parameters exceeds its benchmark by a factor of 10 or more, indicating that concentrations in ground water where ground-water monitoring or drinking water wells may be located are likely to fall below the health-based benchmarks.

CAVEATS AND LIMITATIONS

All conclusions made from the data presented in this report should be tempered by the following weaknesses in the samples used to calculate some of the leachate characteristics:

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[9] In the case of pH, the "exceedances" were actually pH values below the regulatory range.

- First, the sample size is much smaller than the universe of C&D landfills nationwide. The 21 landfills represented in this report comprise just over one percent of the approximately 1,800 C&D landfills in the United States. Thus, the representativeness of the sample is questionable.

- Many of the parameters discussed in this report were only sampled at one or two landfills, and such data cannot be considered representative of 1,800 landfills.

- The medians calculated in this report do not account for non-detects. Although the medians would be more meaningful if the non-detects could be factored in, this report attempts to capture the impact of the non-detects by presenting both the frequency of detection and the frequency of detection above benchmarks.

- Some landfills do not characterize (or give an incomplete characterization of) the waste at their sites. Thus, in some cases, the respondents' assertions that their landfills are comprised of C&D wastes is the only basis for including the landfill in the database.

- The data relied upon were assembled recently by only one organization, using limited data gathering techniques.

REFERENCES

National Association of Demolition Contractors. *C&D Waste Landfills, Leachate Quality Data, Volume 1, Specific State-by-State Responses.* Prepared by Gershman, Brickner & Bratton, Inc. Falls Church, VA, February 18, 1994.

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ATTACHMENT 3-A

OTHER STUDIES OF C&D LANDFILL LEACHATE

ATTACHMENT 3-A
OTHER STUDIES OF C&D LANDFILL LEACHATE

This attachment summarizes the results of selected studies of C&D landfill leachate and compares them to the results of the analysis presented in Chapter 3 of this report (the "NADC/ICF analysis").

THE WMX REPORT

This section compares the results of the NADC/ICF analysis with those of the 1993 *Construction and Demolition (C&D) Landfill Leachate Characterization Study* published by WMX Technologies, Incorporated (the "WMX report"). The WMX report evaluated leachate from four landfills (in Kentucky, Michigan, Massachusetts, and Wisconsin) for all or part of a three-year period (1991 to 1993).[10] Samples from the four landfills were analyzed for 219 organics, 19 inorganics, and 13 conventional parameters.[11] The NADC/ICF analysis evaluated 21 landfills, including the 1991 results from WMX's Kentucky, Michigan, and Massachusetts landfills. Because the NADC/ICF analysis was based on data compiled from various studies, there were significant differences in the parameters sampled for at the 21 landfills. In total, the NADC/ICF analysis covered 242 organics, 26 inorganics, and 37 conventional parameters.[12]

As the remainder of this section will show, the results of the NADC/ICF analysis and the WMX report are quite similar. Below, the two studies are compared in terms of the following factors:

- The number and percent of parameters detected;
- Parameters detected at concentrations exceeding regulatory and/or health-based benchmarks; and
- Parameters that are potentially problematic (*i.e.*, detected at more than one landfill and have median leachate concentrations above a benchmark).

This information is summarized in Table 3A-1 and discussed in the remaining sections.

Organics

In both the NADC/ICF and WMX reports, the percent of organics detected in C&D leachate was low compared to inorganics and conventional parameters. In the NADC/ICF analysis, 14 percent of the organics sampled for were detected (34 out of 242), compared to 15 percent (33 of 219) in the WMX report.

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[10] Results from an Ohio landfill sampled in 1991 and included in an earlier WMX report were discarded because WMX later discovered that steel mill slag had been used in the leachate collection system and had contaminated the leachate.

[11] Although iron was categorized as a conventional parameter by the WMX report, it is counted here as an inorganic parameter to be consistent with the NADC/ICF analysis.

[12] This includes some double-counting of parameters because similar parameters were reported differently in different studies. For example, nitrate and nitrite were reported separately in one study but together in another study, so the ICF analysis counts three separate categories: nitrate, nitrite, and nitrate/nitrite.

TABLE 3A-1
COMPARISON OF NADC/ICF AND WMX STUDIES[a]

Parameter Type	Number of parameters detected/sampled		Parameters with maximum concentrations exceeding benchmarks		Parameters that are potentially "problematic" (ratio of median leachate concentration to benchmark)[b]	
	NADC/ICF	WMX	NADC/ICF analysis	WMX Report	NADC/ICF analysis	WMX Report
Organics	34/242 (14%)	33/219 (15%)	**acetone** **alpha-BHC** **1,2-dichloroethane** **dieldrin** **methylene chloride** **trichloroethene**	**acetone** **alpha-BHC** **1,2-dichloroethane** **dieldrin** **methylene chloride** **trichloroethene** **DEHP** **disulfoton**	**1,2-dichloroethane (4)** **methylene chloride (3)**	**1,2-dichloroethane (4)** **methylene chloride (7)** **DEHP (3)** **dieldrin (66)** **disulfoton (3)**
Inorganics	23/26 (88%)	11/19[c] (58%)	aluminum **arsenic** **barium** **cadmium** **chromium** **cyanide** iron **lead** **mercury** **nickel** zinc	**cadmium** iron **lead**	**cadmium (2)** iron (37) **lead (4)**	iron (6) **lead (29)**
Conventional parameters	36/37 (97%)	13/13 (100%)	chlorides fluoride manganese **nitrate** pH (below range) sulfates TDS	chorides sulfates TDS	manganese (59) TDS (4)	TDS (4) sulfates (1)
Total	93/305 (30%)	57/251 (23%)	24	14	7	9

a Parameters in bold exceeded human health-based benchmarks (MCLs, RfDs, RSDs, or action levels); unbolded parameters exceeded aesthetic-based benchmarks (SMCLs).

b "Potentially problematic" parameters are those (1) detected at more than one landfill and (2) with median leachate concentrations above a benchmark. Median leachate concentrations are calculated based on detected values only.

c Here we include iron as an inorganic, although WMX had categorized iron as a conventional parameter.

The maximum concentrations of six organics exceeded benchmarks in the NADC/ICF analysis. Those six organics plus an additional two [di(2-ethylhexyl)phthalate and disulfoton] were exceeded in the WMX Report. The maximum leachate concentration of di(2-ethylhexyl)phthalate was five times its MCL, and disulfoton was found at levels six times its RfD. In both reports, all of the benchmarks exceeded by organics were based on human health (i.e., primary MCLs, action levels, reference concentrations, or 10^{-6} risk-specific concentrations for carcinogens) rather than aesthetics.

In the NADC/ICF analysis, parameters were considered "potentially problematic" if they were (1) detected at more than one landfill and (2) had median leachate concentrations above a benchmark (with the median concentrations calculated based on detected values only). Using these criteria, organics that are potentially problematic in each study, and the ratios of their median leachate concentrations to their benchmarks, are shown in Table 3A-1. The list is somewhat longer for the WMX study, but the magnitude of the exceedances (one ratio is greater than 10 but none is greater than 100) are similar.

Inorganics

Both the absolute number and the percentage of inorganics detected were higher in the NADC/ICF analysis (88 percent; 23 out of 26) than in the WMX report (58 percent; 11 out of 19). Three inorganics (cadmium, iron, and lead) had maximum concentrations above benchmarks in both reports. The NADC/ICF analysis found an additional eight parameters above their benchmarks, some of which are health-based and some of which are based on aesthetics.

Inorganic constituents that are potentially problematic for the two studies are similar: iron and lead for both studies, plus cadmium only for the NADC/ICF study. Overall, the ratios of the median leachate concentrations to the benchmarks for the inorganic constituents are similar.

Conventional Parameters

In both reports, all of the conventional parameters sampled for were detected, with the single exception of total settled solids (sampled for in the NADC/ICF analysis). The maximum concentrations of three parameters (chlorides, sulfates, and TDS) exceeded benchmarks in both reports (benchmarks are all SMCLs), with an additional four exceeding benchmarks in the NADC/ICF analysis only (only one, nitrate, has a health-based benchmark).

The only potentially problematic conventional parameter common to both studies is TDS, whose median leachate concentration exceeds its SMCL by a factor of 4 in both studies. The other two constituents are manganese (NADC/ICF study only) and sulfates (WMX study only). The benchmarks for all three parameters are SMCLs, and the median leachate concentrations are less than 100 times the benchmark for all three constituents.

OTHER REPORTS

We also reviewed the results of other readily-available information on C&D landfill leachate, including (1) eight summaries of various studies provided in the WMX report, and (2) two other reports. The eight summaries are:

- "Demolition Disposal-Problems and Alternative Solutions: Draft Report" (By Massachusetts Department of Environmental Protection [MADEP], 1991)
- "Migration of Contaminants in Groundwater at a Landfill: A Case Study" (By Nicholson, Cherry, & Reardon - University of Waterloo, 1983)

- "The Water Pollution Potential from Demolition Waste Disposal" (By Ferguson & Mall - University of Massachusetts, 1980)
- 1989 Pennsylvania C&D Leachate Samples (Pennsylvania Department of Environmental Resources, unpublished)
- Four Maryland C&D Landfills: 1989 and 1990 samples
- "Demolition Landfills-How Much Regulation is Needed?" (By Connelly, Pugh, and Mitchell - Wisconsin Department of Natural Resources, 1991)
- "Properties of Leachate from Construction/Demolition Waste Landfills (By Norstrom, Williams, and Pabor, 1991)
- "C&D Debris: A Crisis is Building" (*Waste Age* article by Randy Woods, 1992)

The two additional reports are:

- Hanrahan, Pegeen. *Construction and Demolition Debris Disposal Issues: An Alachua County Perspective*. Alachua County Environmental Protection Department. May 1994.
- Lambert, Geri, and Domizio, Linda. *Construction and Demolition Waste Disposal: Management Problems and Alternative Solutions*. Massachusetts Department of Environmental Protection. February 1993.

Much of the information on leachate from C&D landfills provided in these summaries and reports is already covered in the NADC/ICF analysis presented in Chapter 3. Information that was not covered in the NADC/ICF analysis is generally consistent with the findings presented in Chapter 3:

- C&D landfill leachate in Pennsylvania exceeded SMCLs for iron, manganese, sulfates, and TDS (study summarized in WMX report).
- The Spencer Landfill in Maryland measured pH levels as low as 4.96, which is well outside of the SMCL range of 6.5 to 8.5 (study summarized in WMX Report).
- Connelly et al. (1991, as cited in WMX report) analyzed the leachate quality of two landfills in Wisconsin (Barrett Landfill and Mad-Prairie Landfill). Chloride and iron concentrations exceeded SMCLs.

The parameters that exceeded benchmarks above (chloride, iron, pH, manganese, sulfates, and TDS) also exceeded benchmarks in the NADC/ICF analysis.

ATTACHMENT 3-B

C&D LANDFILL LEACHATE DATABASE

ATTACHMENT 3-B

NOTES

ND = Not Detected
NA = Sampled but Not Available

(a) Measured in mV.
(b) Measured in standard pH units.
(c) Measured in micro umhos/cm.
(d) Measured in ul/l.
(e) Estimated value.
(f) Concentration is between the instrument detection limit and the contract required detection limit.
(g) No non-detection limits were given for this landfill. Also, no descriptions of any parameter concentrations which fell below benchmarks were given.
(h) A range for each parameter over the three Texas sites were given. These two columns represent the two known values, the high concentration found and the low concentration found.
(i) Quantitated value falls above the limit of the calibration curve and dilution should be run.
(j) Indicates an estimated value when result is less than specified detection limit.

LANDFILL CODE

PARAMETER	CO	CT-1(1)	CT-1(2)	CT-1(3)	CT-1(4)	CT-2(1)	CT-2(2)	CT-2(3)	CT-3(1)	CT-3(2)	CT-3(3)	CT-3(4)
ORGANICS												
Acenaphthene												
Acetone												
Acetonitrile												
Acetophenone												
2-Acetylaminofluorene												
Acrolein												
Acrylonitrile												
Aldrin												
alpha-BHC												
alpha-Chlordane												
alpha-Endosulfan												
4-Aminobiphenyl												
Aniline												
Anthracene												
Aramite												
Aroclor/PCB 1016												
Aroclor/PCB 1221												
Aroclor/PCB 1232												
Aroclor/PCB 1242												
Aroclor/PCB 1248												
Aroclor/PCB 1254												
Aroclor/PCB 1260												
Benzene												
Benzo-a-anthracene												
Benzo-a-pyrene												
Benzo-b-fluoranthene												
Benzo(k)fluoranthene												
Benzo-g,h-perylene												
Benzo-g,h,i-perylene												
Benzo-k-perylene												
Benzoic acid												
Benzyl alcohol												
beta-BHC												
beta-Endosulfan												
Bis(2-chloroethoxy)methane												
Bis(2-chloroethyl)ether												
Bis(2-chloroisopropyl)ether												
Bis(2-chloro-1-methyl)ether												
Bis(2-ethylhexyl)phthalate												
Bromodichloromethane												
Bromoform												
Bromomethane												

LANDFILL CODE

PARAMETER	CO	CT-1(1)	CT-1(2)	CT-1(3)	CT-1(4)	CT-2(1)	CT-2(2)	CT-2(3)	CT-3(1)	CT-3(2)	CT-3(3)	CT-3(4)
4-Bromophenyl-phenylether												
Butyl benzyl phthalate												
Carbon disulfide												
Carbon tetrachloride												
Carbonate												
Chlordane												
4-Chloroaniline												
p-Chloroaniline												
Chlorobenzene												
Chlorobenzilate												
2-Chloro-1,3-butadiene, Chloroprene												
Chlorodibromomethane												
2-Chloroethyl Vinyl Ether												
Chloroethane												
Chloroform												
Chloromethane												
4-Chloro-3-methylphenol												
4-Chlorophenyl phenyl ether												
2-Chloronaphthalene												
2-Chlorophenol												
3-Chloropropene, Allyl Chloride												
Chrysene												
m-Cresol												
Cumene												
2,4-D												
4,4-DDD												
4,4-DDE												
4,4-DDT												
delta-BHC												
Di-a-butyl phthalate												
Diallate												
Di-a-octyl phthalate												
Dibenzo(a,h)anthracene												
Dibenzofuran												
Dibromochloromethane												
1,2-Dibromo-d-chloropropane												
Dibromomethane												
1,2-Dibromoethane												
Dichloroacetonitrile												
1,2-Dichlorobenzene												
1,3-Dichlorobenzene												
1,4-Dichlorobenzene												
3-3-Dichlorobenzidine												

LANDFILL CODE

PARAMETER	CO	CT-1(1)	CT-1(2)	CT-1(3)	CT-1(4)	CT-2(1)	CT-2(2)	CT-2(3)	CT-3(1)	CT-3(2)	CT-3(3)	CT-3(4)
trans-1,4-Dichloro-2-butene												
Dichlorodifluoromethane												
1,1-Dichloroethane												
cis-1,2-Dichloroethane												
1,2-Dichloroethane												
1,1-Dichloroethene												
1,2-Dichloroethene												
cis-1,2-Dichloroethene												
trans-1,2-Dichloroethene												
Dichlorofluoromethane												
2,4-Dichlorophenol												
2,6-Dichlorophenol												
1,2-Dichloropropane												
1,3-Dichloropropane												
2,2-Dichloropropane												
1,1-Dichloropropene												
cis-1,3-Dichloropropene												
trans-1,3-Dichloropropene												
2,3-Dichloro-1-propene												
Dieldrin												
Diethyl phthalate												
Dimethoate												
p-(Dimethylamino)azobenzene												
7/12-Dimethylbenz(a)anthracene												
3,3-Dimethylbenzidine												
Dimethylphenethylamine												
2,4-Dimethylphenol												
Dimethyl phthalate												
Di-n-butyl phthalate												
1,3-Dinitrobenzene												
4,6-Dinitro-2-methylphenol												
2,4-Dinitrophenol												
2,4-Dinitrotoluene												
2,6-Dinitrotoluene												
Di-n-octyl phthalate												
Dinoseb, DNBP												
1,4-Diomene												
Diphenylamine												
Disulfoton												
Endosulfan I												
Endosulfan II												
Endosulfan sulfate												
Endrin												

LANDFILL CODE

PARAMETER	CO	CT-1(1)	CT-1(2)	CT-1(3)	CT-1(4)	CT-2(1)	CT-2(2)	CT-2(3)	CT-3(1)	CT-3(2)	CT-3(3)	CT-3(4)
Endrin aldehyde												
Endrin ketone												
Ethylbenzene												
Ethyl ether												
Ethylmethacrylate												
Ethyl methane sulfonate												
Ethyl parathion												
Famphur												
Fluoranthene												
Fluorene												
Heptachlor												
Heptachlor epoxide												
Hexachlorobenzene												
Hexachlorobutadiene												
Hexachlorocyclopentadiene												
Hexachloroethane												
Hexachlorophene												
Hexachloropropene												
2-Hexanone												
Hx-CDD												
HxCDF												
Indeno(1,2,3-cd)pyrene												
Iodomethane												
Isobutanol												
Isodrin												
Isophorone												
2-Isophorone												
Isosafrole												
Kepone												
Lindane												
Methacryonitrile												
Methapyrilene												
Methoxychlor												
3-Methylcholanthrene												
Methylene chloride												
Methyl ethyl ketone (MEK)												
Methyl methacrylate												
Methyl methane sulfonate												
2-Methylnaphthalene												
Methyl parathion; Parathion mehtyl												
4-Methyl-2-pentanone												
2-Methylphenol												
(3&4)-Methylphenol												

LANDFILL CODE

PARAMETER	CO	CT-1(1)	CT-1(2)	CT-1(3)	CT-1(4)	CT-2(1)	CT-2(2)	CT-2(3)	CT-3(1)	CT-3(2)	CT-3(3)	CT-3(4)
4-Methylphenol												
Naphthalene												
1,4-Naphthoquinone												
1-Naphthylamine												
2-Naphthylamine												
2-Nitroaniline												
3-Nitroaniline												
4-Nitroaniline												
Nitrobenzene												
5-Nitro-o-toluidine												
2-Nitrophenol												
4-Nitrophenol												
4-Nitroquninoline-1-oxide												
N-Nitrosodiethylamine												
N-Nitrosodimethylamine												
N-Nitrosodimethylethylamine												
N'Nitroso-di-n-propylamine												
N-Nitrosodiphenylamine												
N-Nitrosodi-a-butylamine												
N-Nitrosomorpholine												
N-Nitrosopiperidine												
N'Nitrosopyrolidine												
PeCDD												
PeCDF												
Pentachlorobenzene												
Pentachloroethane												
Pentachloronitrobenzene												
Pentachlorophenol												
Phenacetin												
Phenanthrene												
Phenol												
Total Phenolics												
Phenolphthalein Alkalinity												
p-Phenylemediamine												
Phorate												
2-Picoline												
Pronamide												
Propionitrile, Ethyl cyanide												
Pyrene												
Pyridine												
Safrole												
Silvex, 2,4,5-TP												
Styrene												

LANDFILL CODE

PARAMETER	CO	CT-1(1)	CT-1(2)	CT-1(3)	CT-1(4)	CT-2(1)	CT-2(2)	CT-2(3)	CT-3(1)	CT-3(2)	CT-3(3)	CT-3(4)
Sulfotepp												
TCDD												
2,3,7,8-TCDD												
TCDF												
1,2,4,5-Tetrachlorobenzene												
1,1,1,2-Tetrachloroethane												
1,1,2,2-Tetrachloroethane												
Tetrachloroethene												
2,3,4,6-Tetrachlorophenol												
Tetrahydrofuran												
Thionazin												
Toluene												
o-Toluidine												
Toxaphene												
1,2,4-Trichlorobenzene												
1,1,1-Trichloroethane												
1,1,2-Trichloroethane												
Trichloroethene												
Trichlorofluoromethane												
2,4,5-Trichlorophenol												
2,4,6-Trichlorophenol												
1,2,3-Trichloropropane												
1,1,2-Trichlorotrifluoroethane												
o,o,o-Triethyl phosphorothioate												
2,4,5-T, 2,4,5-Trichlorophenoxyacetic acid												
sym-Trinitrobenzene												
Vinyl acetate												
Vinyl chloride												
Xylene (total)												
INORGANICS												
Aluminum												
Antimony												
Arsenic		0	0	0	0	0	0	0	0	0	20	0
Barium		160	300	200	200	60	100	100	400	300	800	100
Beryllium												
Boron												
Cadmium		0	0	0	10	10	0	10	20	0	10	10
Chromium		0	0	0	0	0	0	0	10	0	40	0
Hexavalent Chromium												
Cobalt												
Copper		30	20	110	40	50	30	50	50	30	620	50
Cyanide		0	0	0	340	0	0	20	0	0	0	300
Cyanides (total)												

LANDFILL CODE

PARAMETER	CO	CT-1(1)	CT-1(2)	CT-1(3)	CT-1(4)	CT-2(1)	CT-2(2)	CT-2(3)	CT-3(1)	CT-3(2)	CT-3(3)	CT-3(4)
Iron	50	36000	88000	33000	29000	7800	6600	14000	200	400	33000	14000
Filtered Iron												
Lead		50	50	100	70	40	40	70	60	40	40	40
Magnesium	15000											
Mercury		0	0	0	0	0	0	0	0	0	0	
Nickel						50			50			
Potassium	4800											
Selenium		0	0	0	0	0	0	0	0	0	0	0
Silver		10	0	0	0	0	0	0	0	0	0	0
Thallium												
Tin												
Vanadium												
Zinc						70			70			
CONVENTIONAL PARAMETERS												
Alkalinity		360000	300000	170000		190000	0	240000	500000	440000	550000	260000
Ammonia												
Ammonia, Nitrogen		3000	3000	4800	4200	1400	80	200	100	0	0	40
Bicarbonate												
Biological Oxygen Demand (BOD) (5-day)		45000	11000	24000		40000	5700	2100	<1000	<1000		
Biological Oxygen Demand (BOD) (20-day)		83000	5000	47000	65000	70000	18000	7600	70000	20000	24000	16000
Calcium	91000											
Chemical Oxygen Demand (COD)	<5000	45000	50000	30000	58000	350000	120000	67000	30000	13000	0	15000
Chlorides	56700	23000	120000	100000	120000	45000	60000	25000	21000	17000	20000	18000
Dissolved Oxygen (%)												
Fluoride												
Hardness by Calculation		400000	420000	250000		330000	280000	250000	440000	720000	500000	250000
Manganese	19	2200	6300	3500	2600	4100	2800.	960	70	80	2100	3100
Nitrate		0	0	0	0	800	400	1400	4600	5300	3000	5100
Nitrate/Nitrite												
Nitrite		0	3	0	3	47	1	33	13	17	20	18
Organic Nitrogen		2000	700		800	2200	1800	2400	1100	900	320	320
Total Kjeldahl Nitrogen												
Oil and Grease	<1000											
Oxidation-Reduction Potential (a)												
pH (b)	7.2	6.7	6.7	6.6	6.4	6.9	7.0	6.3	7.3	6.9	7.0	6.7
Phosphate												
Phosphorus												
Total Phosphorus												
Sodium	64000	20000	82000	24000		34000	32000	31000	61000	78000	54000	33000
Solids, volatile												
Specific Conductance (c)	611	770	780	840		670	540	450	970	220	1000	980
Sulfates	118000	95000	21000	55000		64000	97000	99000	42000	36000	44000	58000
Surfactants												

LANDFILL CODE

PARAMETER	CO	CT-1(1)	CT-1(2)	CT-1(3)	CT-1(4)	CT-2(1)	CT-2(2)	CT-2(3)	CT-3(1)	CT-3(2)	CT-3(3)	CT-3(4)
Tannin												
Total Dissolved Solids	<5000	480000	510000	500000	550000	440000	460000	270000	700000	700000	630000	720000
Total Organic Carbon												
Total Organic Halogens												
Total Settled Solids (d)												
Total Suspended Solids		150000	150000	110000	100000	440000	78000	300000	5000000	3600000	1900000	2400000
Turbidity (NTU)												

PARAMETER	CT-4(1)	CT-4(2)	CT-4(3)	CT-4(4)	CT-4(5)	CT-4(6)	CT-5(1)	CT-5(2)	CT-6(1)	CT-6(2)	CT-7(1)	CT-7(2)
ORGANICS												
Acenaphthene												
Acetone												
Acetonitrile												
Acetophenone												
2-Acetylaminofluorene												
Acrolein												
Acrylonitrile												
Aldrin												
alpha-BHC												
alpha-Chlordane												
alpha-Endosulfan												
4-Aminobiphenyl												
Aniline												
Anthracene												
Aramite												
Aroclor/PCB 1016												
Aroclor/PCB 1221												
Aroclor/PCB 1232												
Aroclor/PCB 1242												
Aroclor/PCB 1248												
Aroclor/PCB 1254												
Aroclor/PCB 1260												
Benzene												
Benzo-a-anthracene												
Benzo-a-pyrene												
Benzo-b-fluoranthene												
Benzo(k)fluoranthene												
Benzo-g,h-perylene												
Benzo-g,h,i-perylene												
Benzo-k-perylene												
Benzoic acid												
Benzyl alcohol												
beta-BHC												
beta-Endosulfan												
Bis(2-chloroethoxy)methane												
Bis(2-chloroethyl)ether												
Bis(2-chloroisopropyl)ether												
Bis(2-chloro-1-methyl)ether												
Bis(2-ethylhexyl)phthalate												
Bromodichloromethane												
Bromoform												
Bromomethane												

PARAMETER	CT-4(1)	CT-4(2)	CT-4(3)	CT-4(4)	CT-4(5)	CT-4(6)	CT-5(1)	CT-5(2)	CT-6(1)	CT-6(2)	CT-7(1)	CT-7(2)
4-Bromophenyl-phenylether												
Butyl benzyl phthalate												
Carbon disulfide												
Carbon tetrachloride												
Carbonate												
Chlordane												
4-Chloroaniline												
p-Chloroaniline												
Chlorobenzene												
Chlorobenzilate												
2-Chloro-1,3-butadiene, Chloroprene												
Chlorodibromomethane												
2-Chloroethyl Vinyl Ether												
Chloroethane												
Chloroform												
Chloromethane												
4-Chloro-3-methylphenol												
4-Chlorophenyl phenyl ether												
2-Chloronaphthalene												
2-Chlorophenol												
3-Chloropropene, Allyl Chloride												
Chrysene												
m-Cresol												
Cumene												
2,4-D												
4,4-DDD												
4,4-DDE												
4,4-DDT												
delta-BHC												
Di-a-butyl phthalate												
Diallate												
Di-a-octyl phthalate												
Dibenzo(a,h)anthracene												
Dibenzofuran												
Dibromochloromethane												
1,2-Dibromo-d-chloropropane												
Dibromomethane												
1,2-Dibromoethane												
Dichloroacetonitrile												
1,2-Dichlorobenzene												
1,3-Dichlorobenzene												
1,4-Dichlorobenzene												
3-3-Dichlorobenzidine												

PARAMETER	CT-4(1)	CT-4(2)	CT-4(3)	CT-4(4)	CT-4(5)	CT-4(6)	CT-5(1)	CT-5(2)	CT-6(1)	CT-6(2)	CT-7(1)	CT-7(2)
trans-1,4-Dichloro-2-butene												
Dichlorodifluoromethane												
1,1-Dichloroethane												
cis-1,2-Dichloroethane												
1,2-Dichloroethane												
1,1-Dichloroethene												
1,2-Dichloroethene												
cis-1,2-Dichloroethene												
trans-1,2-Dichloroethene												
Dichlorofluoromethane												
2,4-Dichlorophenol												
2,6-Dichlorophenol												
1,2-Dichloropropane												
1,3-Dichloropropane												
2,2-Dichloropropane												
1,1-Dichloropropene												
cis-1,3-Dichloropropene												
trans-1,3-Dichloropropene												
2,3-Dichloro-1-propene												
Dieldrin												
Diethyl phthalate												
Dimethoate												
p-(Dimethylamino)azobenzene												
7/12-Dimethylbenz(a)anthracene												
3,3-Dimethylbenzidine												
Dimethylphenethylamine												
2,4-Dimethylphenol												
Dimethyl phthalate												
Di-n-butyl phthalate												
1,3-Dinitrobenzene												
4,6-Dinitro-2-methylphenol												
2,4-Dinitrophenol												
2,4-Dinitrotoluene												
2,6-Dinitrotoluene												
Di-n-octyl phthalate												
Dinoseb, DNBP												
1,4-Diomene												
Diphenylamine												
Disulfoton												
Endosulfan I												
Endosulfan II												
Endosulfan sulfate												
Endrin												

PARAMETER	CT-4(1)	CT-4(2)	CT-4(3)	CT-4(4)	CT-4(5)	CT-4(6)	CT-5(1)	CT-5(2)	CT-6(1)	CT-6(2)	CT-7(1)	CT-7(2)
Endrin aldehyde												
Endrin ketone												
Ethylbenzene												
Ethyl ether												
Ethylmethacrylate												
Ethyl methane sulfonate												
Ethyl parathion												
Famphur												
Fluoranthene												
Fluorene												
Heptachlor												
Heptachlor epoxide												
Hexachlorobenzene												
Hexachlorobutadiene												
Hexachlorocyclopentadiene												
Hexachloroethane												
Hexachlorophene												
Hexachloropropene												
2-Hexanone												
Hx-CDD												
HxCDF												
Indeno(1,2,3-cd)pyrene												
Iodomethane												
Isobutanol												
Isodrin												
Isophorone												
2-Isophorone												
Isosafrole												
Kepone												
Lindane												
Methacryonitrile												
Methapyrilene												
Methoxychlor												
3-Methylcholanthrene												
Methylene chloride												
Methyl ethyl ketone (MEK)												
Methyl methacrylate												
Methyl methane sulfonate												
2-Methylnaphthalene												
Methyl parathion; Parathion mehtyl												
4-Methyl-2-pentanone												
2-Methylphenol												
(3&4)-Methylphenol												

PARAMETER	CT-4(1)	CT-4(2)	CT-4(3)	CT-4(4)	CT-4(5)	CT-4(6)	CT-5(1)	CT-5(2)	CT-6(1)	CT-6(2)	CT-7(1)	CT-7(2)
4-Methylphenol												
Naphthalene												
1,4-Naphthoquinone												
1-Naphthylamine												
2-Naphthylamine												
2-Nitroaniline												
3-Nitroaniline												
4-Nitroaniline												
Nitrobenzene												
5-Nitro-o-toluidine												
2-Nitrophenol												
4-Nitrophenol												
4-Nitroquninoline-1-oxide												
N-Nitrosodiethylamine												
N-Nitrosodimethylamine												
N-Nitrosodimethylethylamine												
N'Nitroso-di-n-propylamine												
N-Nitrosodiphenylamine												
N-Nitrosodi-a-butylamine												
N-Nitrosomorpholine												
N-Nitrosopiperidine												
N'Nitrosopyrolidine												
PeCDD												
PeCDF												
Pentachlorobenzene												
Pentachloroethane												
Pentachloronitrobenzene												
Pentachlorophenol												
Phenacetin												
Phenanthrene												
Phenol												
Total Phenolics												
Phenolphthalein Alkalinity												
p-Phenylemediamine												
Phorate												
2-Picoline												
Pronamide												
Propionitrile, Ethyl cyanide												
Pyrene												
Pyridine												
Safrole												
Silvex, 2,4,5-TP												
Styrene												

PARAMETER	CT-4(1)	CT-4(2)	CT-4(3)	CT-4(4)	CT-4(5)	CT-4(6)	CT-5(1)	CT-5(2)	CT-6(1)	CT-6(2)	CT-7(1)	CT-7(2)
Sulfotepp												
TCDD												
2,3,7,8-TCDD												
TCDF												
1,2,4,5-Tetrachlorobenzene												
1,1,1,2-Tetrachloroethane												
1,1,2,2-Tetrachloroethane												
Tetrachloroethene												
2,3,4,6-Tetrachlorophenol												
Tetrahydrofuran												
Thionazin												
Toluene												
o-Toluidine												
Toxaphene												
1,2,4-Trichlorobenzene												
1,1,1-Trichloroethane												
1,1,2-Trichloroethane												
Trichloroethene												
Trichlorofluoromethane												
2,4,5-Trichlorophenol												
2,4,6-Trichlorophenol												
1,2,3-Trichloropropane												
1,1,2-Trichlorotrifluoroethane												
o,o,o-Triethyl phosphorothioate												
2,4,5-T, 2,4,5-Trichlorophenoxyacetic acid												
sym-Trinitrobenzene												
Vinyl acetate												
Vinyl chloride												
Xylene (total)												
INORGANICS												
Aluminum												
Antimony												
Arsenic	0	0	0				0	0				
Barium	400	200	200				300	100				
Beryllium												
Boron												
Cadmium	20	0	10				0	10			10	30
Chromium	0	0	10				0	0			0	120
Hexavalent Chromium												
Cobalt												
Copper	60	20	40				20	40			50	440
Cyanide	0	0	40	20			0	90				
Cyanides (total)												

PARAMETER	CT-4(1)	CT-4(2)	CT-4(3)	CT-4(4)	CT-4(5)	CT-4(6)	CT-5(1)	CT-5(2)	CT-6(1)	CT-6(2)	CT-7(1)	CT-7(2)
Iron	13000	54000	14000	3600	120		2500		300	2000	1100	10000
Filtered Iron												
Lead	80	70	90				40	70			40	360
Magnesium												
Mercury							0	0				
Nickel								0			90	170
Potassium												
Selenium	0	0	0				0	0				
Silver	0	0	0				0	0				
Thallium												
Tin												
Vanadium												
Zinc											240	2600
CONVENTIONAL PARAMETERS												
Alkalinity	320000	240000	260000	304000			280000	58000	620000		750000	1200000
Ammonia											2000	11000
Ammonia, Nitrogen	400	1100	800	440	450	670	500	300				
Bicarbonate												
Biological Oxygen Demand (BOD) (5-day)	21000	10000	<1000	<1000	9000		28000					
Biological Oxygen Demand (BOD) (20-day)	50000	29000	32000				60000					
Calcium												
Chemical Oxygen Demand (COD)	110000	35000	50000	40000	24000		68000	35000			330000	880000
Chlorides	33000	30000	37000	30000	39500		15000	8000	17000	38000	80000	140000
Dissolved Oxygen (%)												
Fluoride												
Hardness by Calculation	320000	720000	250000				280000	300000				
Manganese	3400	5600	3400	3130	3200		5800	1100			1200	1500
Nitrate	0	5	100	2800	<100		0	100			40	440
Nitrate/Nitrite												
Nitrite	8	5	7	5	0	<5	0	9			6	14
Organic Nitrogen	1500	500	200	320			70	500	1800		5000	11000
Total Kjeldahl Nitrogen												
Oil and Grease												
Oxidation-Reduction Potential (a)												
pH (b)	6.8	6.7	6.7	6.5	6.5		6.7	6.2	7.2	8.0		
Phosphate												
Phosphorus												
Total Phosphorus												
Sodium	20000	28000	31000	33000	21000		17000	11000				
Solids, volatile												
Specific Conductance (c)	570	810	810	760		600	610	530			24000	25000
Sulfates	26000	55000	140000	75000	46000		40000	200000				
Surfactants												

PARAMETER	CT-4(1)	CT-4(2)	CT-4(3)	CT-4(4)	CT-4(5)	CT-4(6)	CT-5(1)	CT-5(2)	CT-6(1)	CT-6(2)	CT-7(1)	CT-7(2)
Tannin											120000	
Total Dissolved Solids	440000	580000	530000	510000	521000		400000	440000	640000	2900000	2700000	4200000
Total Organic Carbon												
Total Organic Halogens												
Total Settled Solids (d)												
Total Suspended Solids	260000	6600	140000	18000			270000	53000	26000		15000	490000
Turbidity (NTU)												

PARAMETER	CT-7(3)	IA-1	IA-2	MD (1)	MD (2)	MD (3)	MD (4)	KY	MA	MI	MN (1)	MN (2)
ORGANICS												
Acenaphthene		<10	<10					<100	<48	<47		
Acetone								<100	5100	160	ND	
Acetonitrile								<100	<250	<100		
Acetophenone								<100	<48	<47		
2-Acetylaminofluorene								<500	<240	<240		
Acrolein				<50	<100	<100	<100	<75	<190	<75		
Acrylonitrile				<50	<100	<100	<100	<50	<120	<50		
Aldrin		<0.05	<0.05					<0 01	<0.094	<0.94		
alpha-BHC		<0.05	<0.05					<0.01	0.12	<0.94		
alpha-Chlordane												
alpha-Endosulfan												
4-Aminobiphenyl								<100	<48	<47		
Aniline								<100	<48	<47		
Anthracene		<10	<10					<100	<48	<47		
Aramite								<100	<470	<480		
Aroclor/PCB 1016		<0.1	<0.1					<0.1	<0.47	<9.4		
Aroclor/PCB 1221		<0.1	<0.1					<0.2	<0.94	<19		
Aroclor/PCB 1232		<0.1	<0.1					<0.2	<0.94	<19		
Aroclor/PCB 1242		<0.1	<0.1					<0.1	<0.47	<9.4		
Aroclor/PCB 1248		<0.1	<0.1					<0.1	<0.47	<9.4		
Aroclor/PCB 1254		<0.1	<0.1					<0.2	<0.94	<19		
Aroclor/PCB 1260		<0.1	<0.1					<0.2	<0.94	<19		
Benzene		2.7	<1	0.8	<10	<10	<10	<5	<12	<5	ND	
Benzo-a-anthracene		<10	<10					<100	<48	<47		
Benzo-a-pyrene		<10	<10					<100	<48	<47		
Benzo-b-fluoranthene		<10	<10					<100	<48	<47		
Benzo(k)fluoranthene		<10	<10									
Benzo-g,h-perylene								<100	<48	<47		
Benzo-g,h,i-perylene		<10	<10									
Benzo-k-perylene								<100	<48	<47		
Benzoic acid		<50	<50									
Benzyl alcohol		<10	<10					<100	<48	<47		
beta-BHC		<0.05	<0.05					<0.01	<0 047	<0.94		
beta-Endosulfan												
Bis(2-chloroethoxy)methane		<10	<10					<100	<48	<47		
Bis(2-chloroethyl)ether								<100	<48	<47		
Bis(2-chloroisopropyl)ether		<10	<10									
Bis(2-chloro-1-methyl)ether								<100	<48	<47		
Bis(2-ethylhexyl)phthalate		<10	<10					<100	<47	<48		
Bromodichloromethane		<1	<1	<0.5	<10	<10	<10	<5	<12	<5	ND	
Bromoform		<1	<1	<0.5	<10	<10	<10	<5	<12	<5	ND	
Bromomethane		<10	<10	<0.5	<10	<10	<10	<10	<25	<10	ND	

PARAMETER	CT-7(3)	IA-1	IA-2	MD (1)	MD (2)	MD (3)	MD (4)	KY	MA	MI	MN (1)	MN (2)
4-Bromophenyl-phenylether		<10	<10					<100	<48	<47		
Butyl benzyl phthalate		<10	<10					<100	<48	<47		
Carbon disulfide								15	<12	<5		
Carbon tetrachloride		<0.3	<0.3	<0.5	<10	<10	<10	<5	<12	<5	ND	
Carbonate												
Chlordane		<0.1	<0.1					<0.05	<0.24	<4.70		
4-Chloroaniline		<10	<10									
p-Chloroaniline								<100	<47	<48		
Chlorobenzene		<1	<1	<0.5	<10	<10	<10	<5	<12	<5	ND	
Chlorobenzilate								<100	<48	<47		
2-Chloro-1,3-butadiene, Chloroprene								<25	<62	<25		
Chlorodibromomethane				<0.5							ND	
2-Chloroethyl Vinyl Ether		<1	<1	<0.5	<20	<20	<20				ND	
Chloroethane		10.5	353	<0.5	<10	<10	<10	<10	<25	<10	ND	
Chloroform		<1	<1	<0.5	<10	<10	<10	<5	<12	<5	ND	
Chloromethane		<10	<10	<0.5	<10	<10	<10	24	43	<10	ND	
4-Chloro-3-methylphenol		<10	<10					<100	<47	<48		
4-Chlorophenyl phenyl ether		<10	<10					<100	<47	<48		
2-Chloronaphthalene		<10	<10					<100	<48	<47		
2-Chlorophenol		<10	<10					<100	<48	<47		
3-Chloropropene, Allyl Chloride								<5	<12	<5	ND	
Chrysene		<10	<10					<100	<47	<48		
m-Cresol								<100	<47	<48		
Cumene											ND	
2,4-D								<1.2	<1.1	<1.1		
4,4-DDD		<0.05	<0.05					<0.01	<0.047	<0.94		
4,4-DDE		<0.05	<0.05					<0.01	<0.047	<0.94		
4,4-DDT		<0.05	<0.05					<0.02	<0 094	<1.90		
delta-BHC		<0.05	<0.05					<0.01	<0 047	<0.94		
Di-a-butyl phthalate								<100	<47	<48		
Diallate								<100	<47	<48		
Di-a-octyl phthalate		<10	<10					<100	<47	<48		
Dibenzo(a,h)anthracene		<10	<10					ND	ND	ND		
Dibenzofuran		<10	<10					<100	<47	<48		
Dibromochloromethane		<1	<1					<5	<12	<5		
1,2-Dibromo-d-chloropropane								<20	<50	<20		
Dibromomethane								<5	<12	<5	ND	
1,2-Dibromoethane								<5	<12	<5	ND	
Dichloroacetonitrile											ND	
1,2-Dichlorobenzene		<10	<10	<0.5				<100	<48	<47	ND	
1,3-Dichlorobenzene		<10	<10	<0.5				<100	<48	<47	ND	
1,4-Dichlorobenzene		<10	<10	<0.5				<100	<47	<48	ND	
3-3-Dichlorobenzidine		<20	<20					<200	<94	<48		

PARAMETER	CT-7(3)	IA-1	IA-2	MD (1)	MD (2)	MD (3)	MD (4)	KY	MA	MI	MN (1)	MN (2)
trans-1,4-Dichloro-2-butene								<10	<25	<10		
Dichlorodifluoromethane								<20	<50	<20	ND	
1,1-Dichloroethane		6.2	5.6	<0.5	<10	<10	<10	<5	0.048	<5	ND	
cis-1,2-Dichloroethane		1.4	<1									
1,2-Dichloroethane		<0.4	<0.4	<0.5	<10	<10	<10	19	26	9.2	ND	
1,1-Dichloroethene		<1	<1	<0.5	<10	<10	<10	<5	<12	<5	ND	
1,2-Dichloroethene												
cis-1,2-Dichloroethene								<10	<10	<10	ND	
trans-1,2-Dichloroethene		<1	<1	<0.5	<10	<10	<10	<5	<12	<5		
Dichlorofluoromethane											ND	
2,4-Dichlorophenol		<10	<10					<100	<47	<48		
2,6-Dichlorophenol .								<100	<47	<48		
1,2-Dichloropropane		<1	<1	<0.5	<10	<10	<10	<5	<12	<5	ND	
1,3-Dichloropropane								<10	<10	<10	ND	
2,2-Dichloropropane								<10	<10	<10		
1,1-Dichloropropene								<10	<10	<10	ND	
cis-1,3-Dichloropropene		<1	<1	<0.5	<10	<10	<10	<5	<12	<5	ND	
trans-1,3-Dichloropropene		<1	<1	<0.5	<10	<10	<10	<5	<12	<5	ND	
2,3-Dichloro-1-propene											ND	
Dieldrin		<0.05	<0.05					<0.01	0.065	<0.94		
Diethyl phthalate		<10	16					<100	<47	<48		
Dimethoate								<1	<1.9	<0.94		
p-(Dimethylamino)azobenzene								<100	<47	<48		
7/12-Dimethylbenz(a)anthracene								<250	<120	<120		
3,3-Dimethylbenzidine								<200	<47	<96		
Dimethylphenethylamine								<100	<47	<48		
2,4-Dimethylphenol		<10	<10					<100	<47	<48		
Dimethyl phthalate		<10	<10					<100	<240	<48		
Di-n-butyl phthalate		<10	<10									
1,3-Dinitrobenzene								<100	<240	<48		
4,6-Dinitro-2-methylphenol		<50	<50					<100	<240	<48		
2,4-Dinitrophenol		<50	<50					<500	<47	<240		
2,4-Dinitrotoluene		<10	<10					<100	<47	<48		
2,6-Dinitrotoluene		<10	<10					<100	<47	<48		
Di-n-octyl phthalate								<100	<47	<48		
Dinoseb, DNBP								<0.15	<0.14	<0.14		
1,4-Diomene								<5	<12	<5		
Diphenylamine								<100	<47	<48		
Disulfoton								<1	<1.9	0.96		
Endosulfan I		<0.05	<0.05					<0.01	<0 047	<0.94		
Endosulfan II		<0.05	<0.05					<0.03	<0.14	<2.8		
Endosulfan sulfate		<0.05	<0.05					<0.05	<0.24	<4.7		
Endrin		0.07	<0.05					<0.01	<0.047	<0.94		

PARAMETER	CT-7(3)	IA-1	IA-2	MD (1)	MD (2)	MD (3)	MD (4)	KY	MA	MI	MN (1)	MN (2)
Endrin aldehyde		<0.05	<0.05					<0.02	<0.094	<1.9		
Endrin ketone								<0.05	<0 24	<4.7		
Ethylbenzene		2.6	1.9	<0.5	15	13	<10	<5	18	<5	ND	
Ethyl ether											ND	
Ethylmethacrylate								<5	<12	<5		
Ethyl methane sulfonate								<100	<47	<48		
Ethyl parathion								<0.75	<1.5	<0.75		
Famphur								<2.5	<4.8	<2.5		
Fluoranthene		<10	<10					<100	<47	<48		
Fluorene		<10	<10					<100	<47	<48		
Heptachlor		<0.05	<0.05					<0.01	<0.047	<0.94		
Heptachlor epoxide		<0.05	<0.05					<0 01	<0.047	<0.94		
Hexachlorobenzene		<10	<10					<100	<47	<48		
Hexachlorobutadiene		<10	<10					<100	<47	<48		
Hexachlorocyclopentadiene		<10	<10					<100	<47	<48		
Hexachloroethane		<10	<10					<100	<47	<48		
Hexachlorophene								<100	<47	<48		
Hexachloropropene								<100	<47	<48		
2-Hexanone								<50	<120	<50		
Hx-CDD								<1.8	<1.1	<1.6		
HxCDF								<2.30	<2.00	<2.7		
Indeno(1,2,3-cd)pyrene		<10	<10					<100	<47	<48		
Iodomethane								<5	<12	<5		
Isobutanol								<10	<10	<10		
Isodrin								<0.01	<0.094	<0.94		
Isophorone		<10	<10					<100	<47	<48		
2-Isophorone		<10	<10									
Isosafrole								<100	<47	<48		
Kepone								<0.01	<0.047	<0.94		
Lindane		<0.05	<0.05					<0.01	<0 047	<0 94		
Methacryonitrile								<10	<10	<10		
Methapyrilene								<100	<47	<48		
Methoxychlor								<0.05	<0.24	<4.7		
3-Methylcholanthrene								<100	<47	<48		
Methylene chloride		24.4	<5	<0.5	<10	<10	<10	<5	60	6	5	
Methyl ethyl ketone (MEK)								<10	2500	<10	ND	
Methyl methacrylate								<5	<12	<5		
Methyl methane sulfonate								<100	<47	<48		
2-Methylnaphthalene		<10	<10					<100	<47	<48		
Methyl parathion; Parathion mehtyl								<0.15	<0.29	<0.15		
4-Methyl-2-pentanone								<50	250	<50	ND	
2-Methylphenol		<10	<10					<100	64	<48		
(3&4)-Methylphenol		<10	<10									

PARAMETER	CT-7(3)	IA-1	IA-2	MD (1)	MD (2)	MD (3)	MD (4)	KY	MA	MI	MN (1)	MN (2)
4-Methylphenol								<100	5700	190		
Naphthalene		<10	<10					<100	63	<48		
1,4-Naphthoquinone								<100	<47	<48		
1-Naphthylamine								<100	<47	<48		
2-Naphthylamine								<100	<47	<48		
2-Nitroaniline		<50	<50					<500	<240	<240		
3-Nitroaniline		<50	<50					<500	<240	<240		
4-Nitroaniline		<20	<20					<500	<240	<240		
Nitrobenzene		<10	<10					<100	<47	<48		
5-Nitro-o-toluidine								<100	<47	<48		
2-Nitrophenol		<10	<10					<100	<47	<48		
4-Nitrophenol		<20	<20					<500	<240	<240		
4-Nitroquinoline-1-oxide								<1000	<470	<480		
N-Nitrosodiethylamine								<100	<47	<48		
N-Nitrosodimethylamine								<100	<47	<48		
N-Nitrosodimethylethylamine		<10	<10					<100	<47	<48		
N'Nitroso-di-n-propylamine								<100	<47	<48		
N-Nitrosodiphenylamine		<10	<10					<100	<47	<48		
N-Nitrosodi-a-butylamine								<100	<47	<48		
N-Nitrosomorpholine								<100	<47	<48		
N-Nitrosopiperidine								<100	<47	<48		
N'Nitrosopyrolidine								<100	<47	<48		
PeCDD								<1.8	<1.3	<3.1		
PeCDF								<1.1	<2.6	<3.3		
Pentachlorobenzene								<100	<47	<48		
Pentachloroethane								<100	<47	<48	ND	
Pentachloronitrobenzene								<100	<47	<48		
Pentachlorophenol		<20	<20					<500	<240	<240		
Phenacetin								<100	<47	<48		
Phenanthrene		<10	<10					<100	<47	<48		
Phenol								<100	<47	<48		
Total Phenolics								ND	4900	140		
Phenolphthalein Alkalinity												
p-Phenylemediamine								<100	<47	<48		
Phorate								<0.75	<1.5	<0.75		
2-Picoline								<100	<47	<48		
Pronamide								<100	<47	<48		
Propionitrile, Ethyl cyanide								<100	<250	<100		
Pyrene		<10	<10					<100	<47	<48		
Pyridine								<100	<47	<48		
Safrole								<100	<47	<48		
Silvex, 2,4,5-TP								<0.16	<0.16	<0.16		
Styrene								<5	<12	<5		

PARAMETER	CT-7(3)	IA-1	IA-2	MD (1)	MD (2)	MD (3)	MD (4)	KY	MA	MI	MN (1)	MN (2)
Sulfotepp								<0.50	<0.97	<0.47		
TCDD								<1.8	<1.7	<2.1		
2,3,7,8-TCDD								<1.8	<2	<2.7		
TCDF								<1.1	<1.7	<2.2		
1,2,4,5-Tetrachlorobenzene								<100	<47	<48		
1,1,1,2-Tetrachloroethane								<5	<12	<5	ND	
1,1,2,2-Tetrachloroethane		<1	<1	<0.5	<10	<10	<10	<5	<12	<5	ND	
Tetrachloroethene		4.8	<1	<0.5	<10	<10	<10	<5	<12	<5	ND	
2,3,4,6-Tetrachlorophenol								<200	<94	<96		
Tetrahydrofuran											ND	
Thionazin								<5	<9.7	<4.7		
Toluene		30.3	2.6	<0.5	<10	<10	<10	<5	240	<5	ND	
o-Toluidine								<100	<47	<48		
Toxaphene		<0.1	<0.1					<0.50	<2.40	<47		
1,2,4-Trichlorobenzene		<10	<10					<100	<47	<48		
1,1,1-Trichloroethane		<1	<1	<0 5	<10	<10	<10	<5	<12	<5	ND	
1,1,2-Trichloroethane		<1	<1	<0.5	<10	<10	<10	<5	<12	<5	ND	
Trichloroethene		3 2	<1	<0.5	<10	<10	<10	<5	20	<5	ND	
Trichlorofluoromethane				<0.5				<10	<25	13	20	
2,4,5-Trichlorophenol		<50	<50					<100	<47	<48		
2,4,6-Trichlorophenol		<10	<10					<100	<47	<48		
1,2,3-Trichloropropane								<5	<12	<5	ND	
1,1,2-Trichlorotrifluoroethane											ND	
o,o,o-Triethyl phosphorothioate								<5	<9.7	<4.7		
2,4,5-T, 2,4,5-Trichlorophenoxyacetic acid								<0.19	0.53	<0.19		
sym-Trinitrobenzene								NA	NA	NA		
Vinyl acetate								<5	<12	<5		
Vinyl chloride		<10	<10	<0.5	<10	<10	<10	<10	<25	<10	ND	
Xylene (total)		12.3	5.6					<5	85	<5	ND	
INORGANICS												
Aluminum												
Antimony				ND				<7	<7	<7		
Arsenic		18	37	8				12	33	19	<4	20
Barium				1000				340	500	140	NA	NA
Beryllium				<20				<2	<2	<2		
Boron												
Cadmium	20	<1	<1	<20				<5	<20	6 9	0.1	<1
Chromium	60			<60				<10	45	<10	<10	<10
Hexavalent Chromium		<30	<30									
Cobalt								<10	<40	<10		
Copper	200	72	57	<30				<20	<80	<20	<10	<10
Cyanide								11	20	22		
Cyanides (total)		<20	<20					10	20	20		

PARAMETER	CT-7(3)	IA-1	IA-2	MD (1)	MD (2)	MD (3)	MD (4)	KY	MA	MI	MN (1)	MN (2)
Iron	5500	49100	48500	46000				26000	27000	1400	20	1300
Filtered Iron												
Lead	110	13	40	<200				220	13	<3	<1	<3
Magnesium				120000							90000	460000
Mercury		0 5	0 5	<0.5				<0.2	<0.2	<0.2	<0 4	<0.2
Nickel	100	<50	99	<0 5				23	<80	<20		
Potassium		110000	3020	42000							5200	55000
Selenium		<10	<10	<5				<5	<5	<5		
Silver				<30				<10	<40	<10		
Thallium				<400				<5	<5	<5		
Tin								<600	<2400	<600		
Vanadium								<20	96	<20		
Zinc	610	403	135	84				810	300	23	10	<10
CONVENTIONAL PARAMETERS												
Alkalinity	1050000			1800000							410000	1450000
Ammonia	2000											
Ammonia, Nitrogen		18400	<1000	1400				44	40	1 1	660	1200
Bicarbonate												
Biological Oxygen Demand (BOD) (5-day)		170000	15000	11000				14000	110000	140000		
Biological Oxygen Demand (BOD) (20-day)												
Calcium				480000							310000	600000
Chemical Oxygen Demand (COD)	605000	130000	14000	180000				180000	4700000	390000	NA	NA
Chlorides	110000	153000	39800	100000				180000	410000	51000	160000	300000
Dissolved Oxygen (%)												
Fluoride												
Hardness by Calculation				2114000								
Manganese	1800			2200							80	9800
Nitrate	240	<1000	<1000	<1000							3500	<500
Nitrate/Nitrite												
Nitrite	10			<10							<100	<500
Organic Nitrogen	5000											
Total Kjeldahl Nitrogen		23500	17900									
Oil and Grease								1000	26000	1100		
Oxidation-Reduction Potential (a)											580	308
pH (b)		6.9	7 0	6 46				6 8	6 6	7.2	NA	NA
Phosphate		3900	<3000									
Phosphorus		1300	<1000	820								
Total Phosphorus								1000	1600	100		
Sodium				100000							31000	370000
Solids, volatile		170000	380000									
Specific Conductance (c)	24500			2240								
Sulfates				380000				15000	21000	770000	690000	1600000
Surfactants												

PARAMETER	CT-7(3)	IA-1	IA-2	MD (1)	MD (2)	MD (3)	MD (4)	KY	MA	MI	MN (1)	MN (2)
Tannin												
Total Dissolved Solids	3450000			1606000				1200000	6500000	3000000	1700000	5740000
Total Organic Carbon								52000	1900000	160000		
Total Organic Halogens								860	910	740		
Total Settled Solids (d)												
Total Suspended Solids	245000	6100000	140000					390000	91000	<10000	<4000	21000
Turbidity (NTU)				630								

PARAMETER	MN (3)	MN (4)	MN (5)	MN (6)	MN (7)	MN(8)	NY-1(1)	NY-1(2)	NY-1(3)	NY-1(4)	NY-1(5)	NY-1(6)
ORGANICS												
Acenaphthene							<10	2 (e)	<10	4 (e)	3	<10
Acetone							26 (j)	22 (j)	<10	31		
Acetonitrile												
Acetophenone												
2-Acetylaminofluorene												
Acrolein												
Acrylonitrile												
Aldrin							<0.054	<0.056	<0.052	<0.051	<0.1	
alpha-BHC							<0.54	<0.056	<0.052	<0.051	<0.1	
alpha-Chlordane							<0.54	<0.056	<0.052	<0.051		
alpha-Endosulfan							<0.1					
4-Aminobiphenyl												
Aniline												
Anthracene							<10	<10	<10	<10	<2	
Aramite												
Aroclor/PCB 1016							<0.54	<0.056	<1.0	<1.0	<1	
Aroclor/PCB 1221							<0.54	<0.056	<2.1	<2.1	<1	
Aroclor/PCB 1232							<0.54	<0.056	<1.0	<1.0	<1	
Aroclor/PCB 1242							<0.54	<0.056	<1.0	<1.0	<1	
Aroclor/PCB 1248							<0.54	<0.056	<1.0	<1.0	<1	
Aroclor/PCB 1254							<1.1	<1.1	<1.0	<1 0	<1	
Aroclor/PCB 1260							<1.1	<1.1	<1.0	<1.0	<1	
Benzene							<5	<5	<5	<5		
Benzo-a-anthracene							<10	<10	<10	<10	<2	
Benzo-a-pyrene							<10	<10 (e)	<10	<10	<2	
Benzo-b-fluoranthene							<10.	<10 (e)	<10	<10	<2	
Benzo(k)fluoranthene							<10	<10 (e)	<10	<10	<2	
Benzo-g,h-perylene												
Benzo-g,h,i-perylene							<10	<10 (e)	<10	<10	<2	
Benzo-k-perylene												
Benzoic acid							5 (e)	19 (e)	<50	<50	33	
Benzyl alcohol							2 (e)	<10	<10	<10	<2	
beta-BHC							<0.54	<0.056	<0.052	<0.051	<0.1	
beta-Endosulfan							<0.1					
Bis(2-chloroethoxy)methane							<10	<10	<10	<10	<2	
Bis(2-chloroethyl)ether							<10	<10	<10	<10	<2	
Bis(2-chloroisopropyl)ether							<10	<10	<10	<10	<2	
Bis(2-chloro-1-methyl)ether												
Bis(2-ethylhexyl)phthalate							4 (e)	<10	6 (e)(f)	<10	<2	
Bromodichloromethane							<5	<5	<5	<5		
Bromoform							<5	<5	<5	<5		
Bromomethane							<10	<10	<10	<5		

PARAMETER	MN (3)	MN (4)	MN (5)	MN (6)	MN (7)	MN(8)	NY-1(1)	NY-1(2)	NY-1(3)	NY-1(4)	NY-1(5)	NY-1(6)
4-Bromophenyl-phenylether							<10	<10	<10	<10	<2	
Butyl benzyl phthalate							<10	<10	<10	<10	<2	
Carbon disulfide							<5	<5	<5	<5		
Carbon tetrachloride							<5	<5	<5	<5		
Carbonate												
Chlordane							<0.1					
4-Chloroaniline							<10	<10	<10	<10	<2	
p-Chloroaniline												
Chlorobenzene							<5	<5	<5	<5		
Chlorobenzilate												
2-Chloro-1,3-butadiene, Chloroprene												
Chlorodibromomethane							<5					
2-Chloroethyl Vinyl Ether							ND					
Chloroethane .							<10	<10	<10	<5		
Chloroform							<5	<5	<5	<5	<0.1	<0.1
Chloromethane							<10	<10	<10	<5		
4-Chloro-3-methylphenol							<10	<10	<10	<10	<2	
4-Chlorophenyl phenyl ether							<10	<10	<10	<10	<2	
2-Chloronaphthalene							<10	<10	<10	<10	<2	
2-Chlorophenol							<10	<10	<10	<10	<2	
3-Chloropropene, Allyl Chloride												
Chrysene							<10	<10	<10	<10	<2	
m-Cresol												
Cumene												
2,4-D							<0.1					
4,4-DDD							<0.11	<0.11	<0.10	<0.10	<0.1	
4,4-DDE							<0.11.	<0.11	<0.10	<0.10	<0.1	
4,4-DDT							<0.10	<0.10	<0.1	<0.11	<0.11	
delta-BHC							<0.54	<0.056	<0.052	<0.051	<0.1	
Di-a-butyl phthalate												
Diallate												
Di-a-octyl phthalate												
Dibenzo(a,h)anthracene							<10	<10 (f)	<10	<10		
Dibenzofuran							<10	<10	<10	<10	<2	
Dibromochloromethane							<5	<5	<5			
1,2-Dibromo-d-chloropropane												
Dibromomethane												
1,2-Dibromoethane												
Dichloroacetonitrile												
1,2-Dichlorobenzene							<10	<10	<10	<10	<2	
1,3-Dichlorobenzene							<10	<10	<10	<10	<2	
1,4-Dichlorobenzene							<10	<10	<10	<10	<2	
3-3-Dichlorobenzidine							<20	<20	<20	<20	<2	

PARAMETER	MN (3)	MN (4)	MN (5)	MN (6)	MN (7)	MN(8)	NY-1(1)	NY-1(2)	NY-1(3)	NY-1(4)	NY-1(5)	NY-1(6)
trans-1,4-Dichloro-2-butene												
Dichlorodifluoromethane												
1,1-Dichloroethane							<5	<5	<5	<5		
cis-1,2-Dichloroethane												
1,2-Dichloroethane							<5	<5	<5			
1,1-Dichloroethene							<5	<5	<5	<5	<0.1	<0.1
1,2-Dichloroethene							<5	<5	<5			
cis-1,2-Dichloroethene												
trans-1,2-Dichloroethene							<5	<0.1	<0.1	4	1	<1
Dichlorofluoromethane												
2,4-Dichlorophenol							<10	<10	<10	<10	<2	ND
2,6-Dichlorophenol												
1,2-Dichloropropane							<5	<5	<5	<5		
1,3-Dichloropropane												
2,2-Dichloropropane												
1,1-Dichloropropene												
cis-1,3-Dichloropropene							<5	<5	<5	<5		
trans-1,3-Dichloropropene							<5	<5	<5	<5		
2,3-Dichloro-1-propene												
Dieldrin							<0.11	<0.11	<0.10	<0 10	<0.1	
Diethyl phthalate							<10	<10	<10	<10	<2	
Dimethoate												
p-(Dimethylamino)azobenzene												
7/12-Dimethylbenz(a)anthracene												
3,3-Dimethylbenzidine												
Dimethylphenethylamine												
2,4-Dimethylphenol							<10.	<10	<10	<10	<2	ND
Dimethyl phthalate							<10	<10	<10	<10	<2	
Di-n-butyl phthalate							<10	<10	<10	<10	<2	
1,3-Dinitrobenzene												
4,6-Dinitro-2-methylphenol							<50	<50	<50	<50	<2	
2,4-Dinitrophenol							<50	<50	<50	<50	<2	ND
2,4-Dinitrotoluene							<10	<10	<10	<10	<2	
2,6-Dinitrotoluene							<10	<10	<10	<10	<2	
Di-n-octyl phthalate							<10	<10 (e)	<10	<10	<2	
Dinoseb, DNBP												
1,4-Diomene												
Diphenylamine												
Disulfoton												
Endosulfan I							<0.54	<0.056	<0.052	<0.051		
Endosulfan II							<0.11	<0.11	<0.10	<0.10		
Endosulfan sulfate							<0.10	<0.10	<0.1	<0.11	<0.11	
Endrin							<0.11	<0.11	<0.10	<0.10	<0.1	

PARAMETER	MN (3)	MN (4)	MN (5)	MN (6)	MN (7)	MN(8)	NY-1(1)	NY-1(2)	NY-1(3)	NY-1(4)	NY-1(5)	NY-1(6)
Endrin aldehyde							<0.1					
Endrin ketone							<0.11	<0.11	<0.10	<0.10	<0.1	
Ethylbenzene							<5	<5	<5	<5		
Ethyl ether												
Ethylmethacrylate												
Ethyl methane sulfonate												
Ethyl parathion												
Famphur												
Fluoranthene							<10	<10	<10	<10	<2	
Fluorene							< 10	2 (e)	3 (e)	<10	<2	
Heptachlor							<0.054	<0.058	<0.052	<0.051	<0.1	
Heptachlor epoxide							0.074 (e)	0.065 (e)	<0.052	<0.051	<0.1	
Hexachlorobenzene							<10	<10	<10	<10	<2	
Hexachlorobutadiene							<10	<10	<10	<10	<2	
Hexachlorocyclopentadiene							<10	<10	<10	<10	<2	
Hexachloroethane							<10	<10	<10	<10	<2	
Hexachlorophene												
Hexachloropropene												
2-Hexanone							<10	<10	<10	<5		
Hx-CDD												
HxCDF												
Indeno(1,2,3-cd)pyrene							<10	<10 (e)	<10	<10	<2	
Iodomethane												
Isobutanol												
Isodrin												
Isophorone							<10	<10	<10	<10	<2	
2-Isophorone												
Isosafrole												
Kepone												
Lindane							<0.05 (j)	<0.05	<0.052	<0.051	<0.1	
Methacryonitrile												
Methapyrilene												
Methoxychlor							<0.54	<0.056	<0.052	<0.051	<0.1	
3-Methylcholanthrene												
Methylene chloride							<5	<5	<5	<5		
Methyl ethyl ketone (MEK)							<10	<10	<10	<5		
Methyl methacrylate												
Methyl methane sulfonate												
2-Methylnaphthalene							<10	<10	<10	<10	<2	
Methyl parathion; Parathion mehtyl												
4-Methyl-2-pentanone							<10	<10	<10	<5		
2-Methylphenol							<10	<10	<10	<10	<2	
(3&4)-Methylphenol												

PARAMETER	MN (3)	MN (4)	MN (5)	MN (6)	MN (7)	MN(8)	NY-1(1)	NY-1(2)	NY-1(3)	NY-1(4)	NY-1(5)	NY-1(6)
4-Methylphenol							<10	2 (e)	2	<10	<2	
Naphthalene							<10	<10	<10	<10	<2	
1,4-Naphthoquinone												
1-Naphthylamine												
2-Naphthylamine												
2-Nitroaniline							<50	<50	<50	<50	<2	
3-Nitroaniline							<50	<50	<50	<50	<2	
4-Nitroaniline							<50	<50	<50	<50	<2	
Nitrobenzene							<10	<10	<10	<10	<2	
5-Nitro-o-toluidine												
2-Nitrophenol							<10	<10	<10	<10	<2	
4-Nitrophenol							<50	<50	<50	<50	<2	
4-Nitroquninoline-1-oxide												
N-Nitrosodiethylamine							ND					
N-Nitrosodimethylamine												
N-Nitrosodimethylethylamine												
N'Nitroso-di-n-propylamine							<10	<10	<10	<10	<2	
N-Nitrosodiphenylamine							<10	<10	<10	<10	<2	
N-Nitrosodi-a-butylamine												
N-Nitrosomorpholine												
N-Nitrosopiperidine												
N'Nitrosopyrolidine												
PeCDD												
PeCDF												
Pentachlorobenzene												
Pentachloroethane												
Pentachloronitrobenzene												
Pentachlorophenol							<50	<50	<50	<50	<2	
Phenacetin												
Phenanthrene							<10	<10	<10	<10	<2	
Phenol							<10	<10	27	20	41	<10
Total Phenolics							30	460	23	35	60	80
Phenolphthalein Alkalinity												
p-Phenylemediamine												
Phorate												
2-Picoline												
Pronamide												
Propionitrile, Ethyl cyanide												
Pyrene							<10	<10	<10	<10	<2	
Pyridine												
Safrole												
Silvex, 2,4,5-TP												
Styrene							<5	<5	<5	<5		

PARAMETER	MN (3)	MN (4)	MN (5)	MN (6)	MN (7)	MN(8)	NY-1(1)	NY-1(2)	NY-1(3)	NY-1(4)	NY-1(5)	NY-1(6)
Sulfotepp												
TCDD												
2,3,7,8-TCDD												
TCDF												
1,2,4,5-Tetrachlorobenzene												
1,1,1,2-Tetrachloroethane												
1,1,2,2-Tetrachloroethane							<5	<5	<5	<5		
Tetrachloroethene							<5	<5	<5	<5		
2,3,4,6-Tetrachlorophenol												
Tetrahydrofuran												
Thionazin												
Toluene							<5	<5	<5	<5		
o-Toluidine												
Toxaphene							<1.1	<1.1	<5.2	<5.1	<0.1	
1,2,4-Trichlorobenzene							<10	<10	<10	<10	<2	
1,1,1-Trichloroethane							<10	<10	<5	<5	<0.1	<0.1
1,1,2-Trichloroethane							<5	<5	<5	<5		
Trichloroethene							<5	2.9	<0.1	<1	3	<1
Trichlorofluoromethane												
2,4,5-Trichlorophenol							<50	<50	<50	<50	<2	
2,4,6-Trichlorophenol							<10	<10	<10	<10	<5	
1,2,3-Trichloropropane												
1,1,2-Trichlorotrifluoroethane												
o,o,o-Triethyl phosphorothioate												
2,4,5-T, 2,4,5-Trichlorophenoxyacetic acid							0.12					
sym-Trinitrobenzene												
Vinyl acetate							<10.	<10	<10	<5		
Vinyl chloride							<10	<10	<10	<5		
Xylene (total)							<5	<5	<5	<5		
INORGANICS												
Aluminum							2800	6350	512	310	180	100
Antimony							<40	5.8 (f)	<40			
Arsenic	<2	NA	NA	NA	5	2	20.7	77.3	40.6	32	<5	<5
Barium	NA	NA	NA	NA	100	160	383	722	482	370		
Beryllium							<2	2.1 (f)	<2	<2		
Boron												
Cadmium	0.2	NA	NA	NA	<0.1	<0.4	<5	3.4	<5	<3	<3	15.8
Chromium	<10	NA	NA	NA	<1	<4	61.5 (e)	41.6	42.9 (e)	15	<25	<25
Hexavalent Chromium							<50	<50	<50	<50	<50	<50
Cobalt							19 2 (f)	60.9	13.3 (f)	<10		
Copper	10	NA	NA	NA	<10	<10	7.3 (f)	14.2 (f)	5.4 (f)	10	<25	<25
Cyanide							48.5	24.5	22.1			
Cyanides (total)							38					

PARAMETER	MN (3)	MN (4)	MN (5)	MN (6)	MN (7)	MN(8)	NY-1(1)	NY-1(2)	NY-1(3)	NY-1(4)	NY-1(5)	NY-1(6)
Iron	220	NA	NA	NA	9500	14000	9000 (e)	14000	8140 (e)	22000	730	52600
Filtered Iron												
Lead	<1	NA	NA	NA	<0.2	<0.2	<2	<4.2	<2	<2	2.9	<10
Magnesium	280000	NA	NA	NA	130000	160000	225000	180000	213000	89000	14000	203000
Mercury	<0.2	NA	NA	NA	<0.2	0.3	<0.02	<0.2	<0.02	<0.2	<0.2	<0.2
Nickel							109	57.8	45.9	<14		
Potassium	13000	NA	NA	NA	14000	15000	302000	270000	309000	120000	5300	<500
Selenium							4.6 B	5	2.2 (f)	<5	<5	<4
Silver							<5	<5	<5	<14	<10	<10
Thallium							<15	<10.0	<15	<4		
Tin												
Vanadium							15.5 (f)	52.7 (f)	14.6 (f)	<40		
Zinc	<10	NA	NA	NA	10	30	<22	47.9	<9.3	91	<37	100
CONVENTIONAL PARAMETERS												
Alkalinity	770000	NA	NA	NA	570	790	1800000	1100000	940000	130000	110000	1600000
Ammonia							170000	81000	91000	730	<500	120000
Ammonia, Nitrogen	820	NA	NA	NA	990	<50						
Bicarbonate												
Biological Oxygen Demand (BOD) (5-day)							26000	130000	67000	68000		
Biological Oxygen Demand (BOD) (20-day)												
Calcium	520000	NA	NA	NA	280000	340000	162,000	160000	180,000	100000	38000	187000
Chemical Oxygen Demand (COD)	NA	230000	180000	110000	110000	230000	1100000	540000	630000	50000	41000	960000
Chlorides	460000	NA	NA	NA	100000	100000	1300000	600000	580000	51000	38000	840000
Dissolved Oxygen (%)												
Fluoride												
Hardness by Calculation							1100000	620000	690000	150000	180000	1400000
Manganese	12000	NA	NA	NA	3100	3900	4120	3300	1800	2600	92	4660
Nitrate	<250	NA	NA	NA	280	910	<300	1300	750	510	550	<100
Nitrate/Nitrite							290					
Nitrite	<250	NA	NA	NA	<3	<3						
Organic Nitrogen												
Total Kjeldahl Nitrogen							120000	3730	15320	19000	37900	250000
Oil and Grease												
Oxidation-Reduction Potential (a)	440	NA	NA	NA	176	158	32.5	34.5	45.5	35.5		
pH (b)	NA	NA	6.8	6.9	7.1	6.9	7.2	7.1	6.3	6.2	7.3	6.9
Phosphate												
Phosphorus												
Total Phosphorus												
Sodium	230000	NA	NA	NA	100000	95000	566000	530000	622000	230000	19000	546000
Solids, volatile												
Specific Conductance (c)							3550	6000	400	465	1940	1660
Sulfates	170000	NA	NA	NA	730000	910000	29000	200000	320000	56000	76000	400000
Surfactants							135	<25	<25	<100	<100	1100

PARAMETER	MN (3)	MN (4)	MN (5)	MN (6)	MN (7)	MN(8)	NY-1(1)	NY-1(2)	NY-1(3)	NY-1(4)	NY-1(5)	NY-1(6)
Tannin												
Total Dissolved Solids	4600000	NA	NA	NA	2000000	2500000	4000000	2400000	1900000	350000	220000	3700000
Total Organic Carbon							340000	180000	160000	6100	2800	290000
Total Organic Halogens												
Total Settled Solids (d)												
Total Suspended Solids	65000	NA	4000	320000	23000	51000	87000					
Turbidity (NTU)							110	65	14	5.8	10	

PARAMETER	NY-1(7)	NY-1(8)	NY-1(9)	NY-1(10)	NY-1(11)	NY-1(12)	NY-1(13)	NY-1(14)	NY-1(15)	NY-1(16)	NY-1(17)	NY-1(18)
ORGANICS												
Acenaphthene	<10	<10	<10	<2								
Acetone												
Acetonitrile												
Acetophenone												
2-Acetylaminofluorene												
Acrolein												
Acrylonitrile												
Aldrin												
alpha-BHC												
alpha-Chlordane												
alpha-Endosulfan												
4-Aminobiphenyl												
Aniline												
Anthracene												
Aramite												
Aroclor/PCB 1016												
Aroclor/PCB 1221												
Aroclor/PCB 1232												
Aroclor/PCB 1242												
Aroclor/PCB 1248												
Aroclor/PCB 1254												
Aroclor/PCB 1260												
Benzene												
Benzo-a-anthracene												
Benzo-a-pyrene												
Benzo-b-fluoranthene												
Benzo(k)fluoranthene												
Benzo-g,h-perylene												
Benzo-g,h,i-perylene												
Benzo-k-perylene												
Benzoic acid												
Benzyl alcohol												
beta-BHC												
beta-Endosulfan												
Bis(2-chloroethoxy)methane												
Bis(2-chloroethyl)ether												
Bis(2-chloroisopropyl)ether												
Bis(2-chloro-1-methyl)ether												
Bis(2-ethylhexyl)phthalate												
Bromodichloromethane												
Bromoform												
Bromomethane												

PARAMETER	NY-1(7)	NY-1(8)	NY-1(9)	NY-1(10)	NY-1(11)	NY-1(12)	NY-1(13)	NY-1(14)	NY-1(15)	NY-1(16)	NY-1(17)	NY-1(18)
4-Bromophenyl-phenylether												
Butyl benzyl phthalate												
Carbon disulfide												
Carbon tetrachloride												
Carbonate												
Chlordane												
4-Chloroaniline												
p-Chloroaniline												
Chlorobenzene												
Chlorobenzilate												
2-Chloro-1,3-butadiene, Chloroprene												
Chlorodibromomethane												
2-Chloroethyl Vinyl Ether												
Chloroethane												
Chloroform	<1	<1	3	<1	<5	<5	<5	<20	<10	<5	<5	<5
Chloromethane												
4-Chloro-3-methylphenol												
4-Chlorophenyl phenyl ether												
2-Chloronaphthalene												
2-Chlorophenol												
3-Chloropropene, Allyl Chloride												
Chrysene												
m-Cresol												
Cumene												
2,4-D												
4,4-DDD												
4,4-DDE												
4,4-DDT												
delta-BHC												
Di-a-butyl phthalate												
Diallate												
Di-a-octyl phthalate												
Dibenzo(a,h)anthracene												
Dibenzofuran												
Dibromochloromethane												
1,2-Dibromo-d-chloropropane												
Dibromomethane												
1,2-Dibromoethane												
Dichloroacetonitrile												
1,2-Dichlorobenzene												
1,3-Dichlorobenzene												
1,4-Dichlorobenzene												
3-3-Dichlorobenzidine												

PARAMETER	NY-1(7)	NY-1(8)	NY-1(9)	NY-1(10)	NY-1(11)	NY-1(12)	NY-1(13)	NY-1(14)	NY-1(15)	NY-1(16)	NY-1(17)	NY-1(18)
trans-1,4-Dichloro-2-butene												
Dichlorodifluoromethane												
1,1-Dichloroethane												
cis-1,2-Dichloroethane												
1,2-Dichloroethane												
1,1-Dichloroethene	<1	3	<1	<1	<5	<5	<5	<20	<10	<5	<5	<5
1,2-Dichloroethene												
cis-1,2-Dichloroethene												
trans-1,2-Dichloroethene	<1	<5	<5	<5	<20	<10	<5	<5	<5	<5		
Dichlorofluoromethane												
2,4-Dichlorophenol												
2,6-Dichlorophenol												
1,2-Dichloropropane												
1,3-Dichloropropane												
2,2-Dichloropropane												
1,1-Dichloropropene												
cis-1,3-Dichloropropene												
trans-1,3-Dichloropropene												
2,3-Dichloro-1-propene												
Dieldrin												
Diethyl phthalate												
Dimethoate												
p-(Dimethylamino)azobenzene												
7/12-Dimethylbenz(a)anthracene												
3,3-Dimethylbenzidine												
Dimethylphenethylamine												
2,4-Dimethylphenol												
Dimethyl phthalate												
Di-n-butyl phthalate												
1,3-Dinitrobenzene												
4,6-Dinitro-2-methylphenol												
2,4-Dinitrophenol												
2,4-Dinitrotoluene												
2,6-Dinitrotoluene												
Di-n-octyl phthalate												
Dinoseb, DNBP												
1,4-Diomene												
Diphenylamine												
Disulfoton												
Endosulfan I												
Endosulfan II												
Endosulfan sulfate												
Endrin												

PARAMETER	NY-1(7)	NY-1(8)	NY-1(9)	NY-1(10)	NY-1(11)	NY-1(12)	NY-1(13)	NY-1(14)	NY-1(15)	NY-1(16)	NY-1(17)	NY-1(18)
Endrin aldehyde												
Endrin ketone												
Ethylbenzene												
Ethyl ether												
Ethylmethacrylate												
Ethyl methane sulfonate												
Ethyl parathion												
Famphur												
Fluoranthene												
Fluorene												
Heptachlor												
Heptachlor epoxide												
Hexachlorobenzene												
Hexachlorobutadiene												
Hexachlorocyclopentadiene												
Hexachloroethane												
Hexachlorophene												
Hexachloropropene												
2-Hexanone												
Hx-CDD												
HxCDF												
Indeno(1,2,3-cd)pyrene												
Iodomethane												
Isobutanol												
Isodrin												
Isophorone												
2-Isophorone												
Isosafrole												
Kepone												
Lindane												
Methacryonitrile												
Methapyrilene												
Methoxychlor												
3-Methylcholanthrene												
Methylene chloride												
Methyl ethyl ketone (MEK)												
Methyl methacrylate												
Methyl methane sulfonate												
2-Methylnaphthalene												
Methyl parathion; Parathion mehtyl												
4-Methyl-2-pentanone												
2-Methylphenol												
(3&4)-Methylphenol												

PARAMETER	NY-1(7)	NY-1(8)	NY-1(9)	NY-1(10)	NY-1(11)	NY-1(12)	NY-1(13)	NY-1(14)	NY-1(15)	NY-1(16)	NY-1(17)	NY-1(18)
4-Methylphenol												
Naphthalene												
1,4-Naphthoquinone												
1-Naphthylamine												
2-Naphthylamine												
2-Nitroaniline												
3-Nitroaniline												
4-Nitroaniline												
Nitrobenzene												
5-Nitro-o-toluidine												
2-Nitrophenol												
4-Nitrophenol												
4-Nitroquninoline-1-oxide												
N-Nitrosodiethylamine												
N-Nitrosodimethylamine												
N-Nitrosodimethylethylamine												
N'Nitroso-di-n-propylamine												
N-Nitrosodiphenylamine												
N-Nitrosodi-a-butylamine												
N-Nitrosomorpholine												
N-Nitrosopiperidine												
N'Nitrosopyrolidine												
PeCDD												
PeCDF												
Pentachlorobenzene												
Pentachloroethane												
Pentachloronitrobenzene												
Pentachlorophenol												
Phenacetin												
Phenanthrene												
Phenol	<10	<10	<10	<2								
Total Phenolics	30	<2	<10	<20	<10	64	51	330	37			
Phenolphthalein Alkalinity												
p-Phenylemediamine												
Phorate												
2-Picoline												
Pronamide												
Propionitrile, Ethyl cyanide												
Pyrene												
Pyridine												
Safrole												
Silvex, 2,4,5-TP												
Styrene												

PARAMETER	NY-1(7)	NY-1(8)	NY-1(9)	NY-1(10)	NY-1(11)	NY-1(12)	NY-1(13)	NY-1(14)	NY-1(15)	NY-1(16)	NY-1(17)	NY-1(18)
Sulfotepp												
TCDD												
2,3,7,8-TCDD												
TCDF												
1,2,4,5-Tetrachlorobenzene												
1,1,1,2-Tetrachloroethane												
1,1,2,2-Tetrachloroethane												
Tetrachloroethene												
2,3,4,6-Tetrachlorophenol												
Tetrahydrofuran												
Thionazin												
Toluene												
o-Toluidine												
Toxaphene												
1,2,4-Trichlorobenzene												
1,1,1-Trichloroethane	<1	<1	<1	<1	<5	<5	<5	<20	<10	<5	<5	<5
1,1,2-Trichloroethane												
Trichloroethene	<1	<5	<5	<5	<20	<10	<5	<5	<5	<5	<5	<5
Trichlorofluoromethane												
2,4,5-Trichlorophenol												
2,4,6-Trichlorophenol												
1,2,3-Trichloropropane												
1,1,2-Trichlorotrifluoroethane												
o,o,o-Triethyl phosphorothioate												
2,4,5-T, 2,4,5-Trichlorophenoxyacetic acid												
sym-Trinitrobenzene												
Vinyl acetate												
Vinyl chloride												
Xylene (total)												
INORGANICS												
Aluminum	360	590	160	150	200	193	160	290	130	<240	450	<60
Antimony												
Arsenic	<8	<8	11	40	9	37	57	32	63	42	39	<71
Barium												
Beryllium												
Boron												
Cadmium	<4	<1	<1	<0.8	<0.8	<10	<10	12	<1	24	14	21
Chromium	<25	<25	<10	<10	23	17	<50	<50	40	<40	<40	<100
Hexavalent Chromium	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50		
Cobalt												
Copper	<16	23	<10	<10	50	7	<6	28	25	<20	22	50
Cyanide												
Cyanides (total)												

PARAMETER	NY-1(7)	NY-1(8)	NY-1(9)	NY-1(10)	NY-1(11)	NY-1(12)	NY-1(13)	NY-1(14)	NY-1(15)	NY-1(16)	NY-1(17)	NY-1(18)
Iron	30000	12000	14000	9600	12000	11000	23000	720	19800	33000	18000	13000
Filtered Iron												
Lead	<4	<5	<5	<4	<4	<5	<5	<2	4	<2	12	3
Magnesium	230000	110000	18000									
Mercury	<0.4	<0.4	<0.2	<0.2	<0.2	<0 2	<0.2	<0.2	<0.2	<0.8	<0.8	<0.8
Nickel												
Potassium	292000	210000	160000	5300								
Selenium	<4	<5	<5	3	3	2	<2	<2	<8	<8	<20	<20
Silver	<10	<15	<10	10	16	10	<3	<5	9	<32	<32	<80
Thallium												
Tin												
Vanadium												
Zinc	<35	<35	140	220	62	35	27	200	27	45	100	<70
CONVENTIONAL PARAMETERS												
Alkalinity	398000	449000	54500	38200	1400000	1500000	1400000	1600000	1800000	1700000	2100000	
Ammonia	3470	15280	20300	41600	160000	140000	130000	140000	95000	110000	95000	480000
Ammonia, Nitrogen												
Bicarbonate												
Biological Oxygen Demand (BOD) (5-day)												
Biological Oxygen Demand (BOD) (20-day)												
Calcium	190000	200000	160000	240000	400000	190000	270000	270000	295000	250000	120000	235000
Chemical Oxygen Demand (COD)												
Chlorides	200000	160000	1140000	400000	1400000	740000	980000	1000000	580000	1000000	880000	1100000
Dissolved Oxygen (%)												
Fluoride												
Hardness by Calculation	900000	600000	1170000	1500000	1700000	1400000	1530000	790000	1600000	1400000	1400000	2200000
Manganese	7300	31000	22000	23000	17000	3900	5200	8800	5070	6700	4000	5000
Nitrate	<100	400	500	40	10	20	16	260	23	<200	220	180
Nitrate/Nitrite												
Nitrite												
Organic Nitrogen												
Total Kjeldahl Nitrogen	120000	140000	130000	60000	300000	35000	200000	210000	58000	40000		
Oil and Grease												
Oxidation-Reduction Potential (a)												
pH (b)	6.7	6.8	7.1	6.8	7.1	7.4	6.7					
Phosphate												
Phosphorus												
Total Phosphorus												
Sodium	460000	77000	36000	130000	130000	700000	520000	490000	1510000	480000	330000	497000
Solids, volatile												
Specific Conductance (c)	2700	4460	6600	5950	6550	1200	5000					
Sulfates	622000	870000	350000	370000	89000	280000	1100000	1000000	170000	370000	220000	48000
Surfactants	1100	27	68	35	329	480						

PARAMETER	NY-1(7)	NY-1(8)	NY-1(9)	NY-1(10)	NY-1(11)	NY-1(12)	NY-1(13)	NY-1(14)	NY-1(15)	NY-1(16)	NY-1(17)	NY-1(18)
Tannin												
Total Dissolved Solids	1570000	1150000	1810000	3064000	4340000	4180000	4340000	5000000	3800000	3800000	4300000	4300000
Total Organic Carbon	15000	60000	63000	96000	220000	260000	360000	460000	620000	380000	32000	400000
Total Organic Halogens												
Total Settled Solids (d)												
Total Suspended Solids												
Turbidity (NTU)												

PARAMETER	NY-1(19)	NY-1(20)	NY-1(21)	NY-1(22)	NY-1(23)	NY-1(24)	NY-2(1)	NY-2(2)	NY-2(3)	NY-2(4)	SC (g)	TX LO (h)
4-Bromophenyl-phenylether												
Butyl benzyl phthalate												
Carbon disulfide												
Carbon tetrachloride												
Carbonate												0
Chlordane												
4-Chloroaniline												
p-Chloroaniline												
Chlorobenzene												
Chlorobenzilate												
2-Chloro-1,3-butadiene, Chloroprene												
Chlorodibromomethane												
2-Chloroethyl Vinyl Ether												
Chloroethane												
Chloroform	<5											
Chloromethane												
4-Chloro-3-methylphenol												
4-Chlorophenyl phenyl ether												
2-Chloronaphthalene												
2-Chlorophenol												
3-Chloropropene, Allyl Chloride												
Chrysene												
m-Cresol												
Cumene												
2,4-D												
4,4-DDD												
4,4-DDE												
4,4-DDT												
delta-BHC												
Di-a-butyl phthalate												
Diallate												
Di-a-octyl phthalate												
Dibenzo(a,h)anthracene												
Dibenzofuran												
Dibromochloromethane												
1,2-Dibromo-d-chloropropane												
Dibromomethane												
1,2-Dibromoethane												
Dichloroacetonitrile												
1,2-Dichlorobenzene												
1,3-Dichlorobenzene												
1,4-Dichlorobenzene												
3-3-Dichlorobenzidine												

PARAMETER	NY-1(19)	NY-1(20)	NY-1(21)	NY-1(22)	NY-1(23)	NY-1(24)	NY-2(1)	NY-2(2)	NY-2(3)	NY-2(4)	SC (g)	TX LO (h)
ORGANICS												
Acenaphthene												
Acetone												
Acetonitrile												
Acetophenone												
2-Acetylaminofluorene												
Acrolein												
Acrylonitrile												
Aldrin												
alpha-BHC												
alpha-Chlordane												
alpha-Endosulfan												
4-Aminobiphenyl												
Aniline												
Anthracene												
Aramite												
Aroclor/PCB 1016												
Aroclor/PCB 1221												
Aroclor/PCB 1232												
Aroclor/PCB 1242												
Aroclor/PCB 1248												
Aroclor/PCB 1254												
Aroclor/PCB 1260												
Benzene												
Benzo-a-anthracene												
Benzo-a-pyrene												
Benzo-b-fluoranthene												
Benzo(k)fluoranthene												
Benzo-g,h-perylene												
Benzo-g,h,i-perylene												
Benzo-k-perylene												
Benzoic acid												
Benzyl alcohol												
beta-BHC												
beta-Endosulfan												
Bis(2-chloroethoxy)methane												
Bis(2-chloroethyl)ether												
Bis(2-chloroisopropyl)ether												
Bis(2-chloro-1-methyl)ether												
Bis(2-ethylhexyl)phthalate												
Bromodichloromethane												
Bromoform												
Bromomethane												

PARAMETER	NY-1(19)	NY-1(20)	NY-1(21)	NY-1(22)	NY-1(23)	NY-1(24)	NY-2(1)	NY-2(2)	NY-2(3)	NY-2(4)	SC (g)	TX LO (h)
trans-1,4-Dichloro-2-butene												
Dichlorodifluoromethane												
1,1-Dichloroethane												
cis-1,2-Dichloroethane												
1,2-Dichloroethane												
1,1-Dichloroethene	<5											
1,2-Dichloroethene												
cis-1,2-Dichloroethene												
trans-1,2-Dichloroethene												
Dichlorofluoromethane												
2,4-Dichlorophenol												
2,6-Dichlorophenol												
1,2-Dichloropropane												
1,3-Dichloropropane												
2,2-Dichloropropane												
1,1-Dichloropropene												
cis-1,3-Dichloropropene												
trans-1,3-Dichloropropene												
2,3-Dichloro-1-propene												
Dieldrin												
Diethyl phthalate												
Dimethoate												
p-(Dimethylamino)azobenzene												
7/12-Dimethylbenz(a)anthracene												
3,3-Dimethylbenzidine												
Dimethylphenethylamine												
2,4-Dimethylphenol												
Dimethyl phthalate												
Di-n-butyl phthalate												
1,3-Dinitrobenzene												
4,6-Dinitro-2-methylphenol												
2,4-Dinitrophenol												
2,4-Dinitrotoluene												
2,6-Dinitrotoluene												
Di-n-octyl phthalate												
Dinoseb, DNBP												
1,4-Diomene												
Diphenylamine												
Disulfoton												
Endosulfan I												
Endosulfan II												
Endosulfan sulfate												
Endrin												

PARAMETER	NY-1(19)	NY-1(20)	NY-1(21)	NY-1(22)	NY-1(23)	NY-1(24)	NY-2(1)	NY-2(2)	NY-2(3)	NY-2(4)	SC (g)	TX LO (h)
Endrin aldehyde												
Endrin ketone												
Ethylbenzene												
Ethyl ether												
Ethylmethacrylate												
Ethyl methane sulfonate												
Ethyl parathion												
Famphur												
Fluoranthene												
Fluorene												
Heptachlor												
Heptachlor epoxide												
Hexachlorobenzene												
Hexachlorobutadiene												
Hexachlorocyclopentadiene												
Hexachloroethane												
Hexachlorophene												
Hexachloropropene												
2-Hexanone												
Hx-CDD												
HxCDF												
Indeno(1,2,3-cd)pyrene												
Iodomethane												
Isobutanol												
Isodrin												
Isophorone												
2-Isophorone												
Isosafrole												
Kepone												
Lindane												
Methacryonitrile												
Methapyrilene												
Methoxychlor												
3-Methylcholanthrene												
Methylene chloride												
Methyl ethyl ketone (MEK)												
Methyl methacrylate												
Methyl methane sulfonate												
2-Methylnaphthalene												
Methyl parathion; Parathion mehtyl												
4-Methyl-2-pentanone												
2-Methylphenol												
(3&4)-Methylphenol												

PARAMETER	NY-1(19)	NY-1(20)	NY-1(21)	NY-1(22)	NY-1(23)	NY-1(24)	NY-2(1)	NY-2(2)	NY-2(3)	NY-2(4)	SC (g)	TX LO (h)
4-Methylphenol												
Naphthalene												
1,4-Naphthoquinone												
1-Naphthylamine												
2-Naphthylamine												
2-Nitroaniline												
3-Nitroaniline												
4-Nitroaniline												
Nitrobenzene												
5-Nitro-o-toluidine												
2-Nitrophenol												
4-Nitrophenol												
4-Nitroquninoline-1-oxide												
N-Nitrosodiethylamine												
N-Nitrosodimethylamine												
N-Nitrosodimethylethylamine												
N'Nitroso-di-n-propylamine												
N-Nitrosodiphenylamine												
N-Nitrosodi-a-butylamine												
N-Nitrosomorpholine												
N-Nitrosopiperidine												
N'Nitrosopyrolidine												
PeCDD												
PeCDF												
Pentachlorobenzene												
Pentachloroethane												
Pentachloronitrobenzene												
Pentachlorophenol												
Phenacetin												
Phenanthrene												
Phenol							11	13	32	<10		700
Total Phenolics												
Phenolphthalein Alkalinity												0
p-Phenylemediamine												
Phorate												
2-Picoline												
Pronamide												
Propionitrile, Ethyl cyanide												
Pyrene												
Pyridine												
Safrole												
Silvex, 2,4,5-TP												
Styrene												

PARAMETER	NY-1(19)	NY-1(20)	NY-1(21)	NY-1(22)	NY-1(23)	NY-1(24)	NY-2(1)	NY-2(2)	NY-2(3)	NY-2(4)	SC (g)	TX LO (h)
Sulfotepp												
TCDD												
2,3,7,8-TCDD												
TCDF												
1,2,4,5-Tetrachlorobenzene												
1,1,1,2-Tetrachloroethane												
1,1,2,2-Tetrachloroethane												
Tetrachloroethene												
2,3,4,6-Tetrachlorophenol												
Tetrahydrofuran												
Thionazin												
Toluene												
o-Toluidine												
Toxaphene												
1,2,4-Trichlorobenzene												
1,1,1-Trichloroethane	<5											
1,1,2-Trichloroethane												
Trichloroethene	<5											
Trichlorofluoromethane												
2,4,5-Trichlorophenol												
2,4,6-Trichlorophenol												
1,2,3-Trichloropropane												
1,1,2-Trichlorotrifluoroethane												
o,o,o-Triethyl phosphorothioate												
2,4,5-T, 2,4,5-Trichlorophenoxyacetic acid												
sym-Trinitrobenzene												
Vinyl acetate												
Vinyl chloride												
Xylene (total)												
INORGANICS												
Aluminum	<60											
Antimony												
Arsenic	41										120	17
Barium												1500
Beryllium												
Boron												1400
Cadmium	22	<20	54	7	<2	<2	<1	2050	<1	<1	11	20
Chromium	<15										70	100
Hexavalent Chromium												180
Cobalt												
Copper	8.6										51	140
Cyanide												<100
Cyanides (total)												

PARAMETER	NY-1(19)	NY-1(20)	NY-1(21)	NY-1(22)	NY-1(23)	NY-1(24)	NY-2(1)	NY-2(2)	NY-2(3)	NY-2(4)	SC (g)	TX LO (h)
Iron	4500	6500	14000	32000	7100	230	123	93400	17520	1490	5400	29000
Filtered Iron												240
Lead	29	<20	12	<2	<2	<2	2	669	25	11		220
Magnesium							1920	5290	40230	122000		92000
Mercury	<0.2											<2
Nickel												
Potassium							238	17600	77930	112000		118000
Selenium												<1
Silver	19											<10
Thallium												
Tin												
Vanadium												
Zinc	28										680	1700
CONVENTIONAL PARAMETERS												
Alkalinity							300000	663000	548000	1480000		1710000
Ammonia	460000	37000	250000				120	1170	1170	10600		
Ammonia, Nitrogen												30000
Bicarbonate												2090000
Biological Oxygen Demand (BOD) (5-day)												100000
Biological Oxygen Demand (BOD) (20-day)												
Calcium	210000	210000	300000	170000	100000	44000	<30	136000	124000	96400		148000
Chemical Oxygen Demand (COD)							78500	202400	200000	508000		3080000
Chlorides	1000000	630000	580000				100000	143000	77500	1150000	2400000	125000
Dissolved Oxygen (%)							4.8	3.9	4 6	0.3		
Fluoride											5000	<100
Hardness by Calculation	1400000						340000	840000	2420000			597000
Manganese	990	1800	4600	7400	110	1600	7610	258000	21990	17900	620	1000
Nitrate	170	<100					130	<10	<10	50		4000
Nitrate/Nitrite												
Nitrite												ND
Organic Nitrogen												
Total Kjeldahl Nitrogen												
Oil and Grease												18000
Oxidation-Reduction Potential (a)												
pH (b)							6.9	6.5	6 2	6.8		6 5
Phosphate												
Phosphorus												2500
Total Phosphorus												
Sodium	570000	560000	400000	340000	290000	18000	25700	100000	49200	233000		256000
Solids, volatile												
Specific Conductance (c)							1060	2010	1000	1600		2920
Sulfates	190000	440000	363000				211000	225000	310000	11700	2700000	<40000
Surfactants												

PARAMETER	NY-1(19)	NY-1(20)	NY-1(21)	NY-1(22)	NY-1(23)	NY-1(24)	NY-2(1)	NY-2(2)	NY-2(3)	NY-2(4)	SC (g)	TX LO (h)
Tannin												
Total Dissolved Solids	4300000	4600000	1400000				702000	1428000	1110000	2040000	8400000	2412000
Total Organic Carbon	380000	450000	240000				<1000	82000	105000	19000		76000
Total Organic Halogens												
Total Settled Solids (d)												
Total Suspended Solids												1000000
Turbidity (NTU)							0.74	3.9	25	7		

PARAMETER	TX HI (h)	WA(1)	WA(2)	WA(3)	WA(4)
ORGANICS					
Acenaphthene		<10	<10	<10	
Acetone		60	450	150	470 (i)
Acetonitrile					
Acetophenone					
2-Acetylaminofluorene					
Acrolein					
Acrylonitrile					
Aldrin					
alpha-BHC					
alpha-Chlordane					
alpha-Endosulfan					
4-Aminobiphenyl					
Aniline					
Anthracene		<10	<10	<10	
Aramite					
Aroclor/PCB 1016					
Aroclor/PCB 1221					
Aroclor/PCB 1232					
Aroclor/PCB 1242					
Aroclor/PCB 1248					
Aroclor/PCB 1254					
Aroclor/PCB 1260					
Benzene		<1	<10	<1	<1
Benzo-a-anthracene		<10	<10	<10	
Benzo-a-pyrene		<10	<10	<10	
Benzo-b-fluoranthene		<10	<10	<10	
Benzo(k)fluoranthene		<10	<10	<10	
Benzo-g,h-perylene					
Benzo-g,h,i-perylene		<10	<10	<10	
Benzo-k-perylene					
Benzoic acid		190	910	210	
Benzyl alcohol		<50	<50	<50	
beta-BHC					
beta-Endosulfan					
Bis(2-chloroethoxy)methane		<10	<10	<10	
Bis(2-chloroethyl)ether		<10	<10	<10	
Bis(2-chloroisopropyl)ether		<10	<10	<10	
Bis(2-chloro-1-methyl)ether					
Bis(2-ethylhexyl)phthalate		<10	<10	<10	
Bromodichloromethane		<0.3	<3	<0.3	<0.3
Bromoform		<2.5	<25	<2.5	<2.5
Bromomethane		<3.1	<31	<3.1	<3.1

PARAMETER	TX HI (h)	WA(1)	WA(2)	WA(3)	WA(4)
4-Bromophenyl-phenylether		<10	<10	<10	
Butyl benzyl phthalate		<10	<10	<10	
Carbon disulfide		1.8	<12	5.6	<1.2
Carbon tetrachloride		<0.9	<9	<0.9	<0.9
Carbonate	0				
Chlordane					
4-Chloroaniline		<30	<30	<30	
p-Chloroaniline					
Chlorobenzene		<0.9	<9	<0.9	<0.9
Chlorobenzilate					
2-Chloro-1,3-butadiene, Chloroprene					
Chlorodibromomethane					
2-Chloroethyl Vinyl Ether		<2.7	<27	<2.7	<2.7
Chloroethane		<3.3	<33	<3.3	<3.3
Chloroform		<1.1	<11	<1.1	<1.1
Chloromethane		<3.8	<38	<3.8	<3.8
4-Chloro-3-methylphenol		<20	<20	<20	
4-Chlorophenyl phenyl ether		<10	<10	<10	
2-Chloronaphthalene		<10	<10	<10	
2-Chlorophenol		<10	<10	<10	
3-Chloropropene, Allyl Chloride					
Chrysene		<10	<10	<10	
m-Cresol					
Cumene					
2,4-D					
4,4-DDD					
4,4-DDE					
4,4-DDT					
delta-BHC					
Di-a-butyl phthalate					
Diallate					
Di-a-octyl phthalate		<10	<10	<10	
Dibenzo(a,h)anthracene		<10	<10	<10	
Dibenzofuran		<10	<10	<10	
Dibromochloromethane		<0.7	<7	<0.7	<0.7
1,2-Dibromo-d-chloropropane					
Dibromomethane					
1,2-Dibromoethane					
Dichloroacetonitrile					
1,2-Dichlorobenzene		<10	<10	<10	
1,3-Dichlorobenzene		<10	<10	<10	
1,4-Dichlorobenzene		<10	<10	<10	
3-3-Dichlorobenzidine		<50	<50	<50	

PARAMETER	TX HI (h)	WA(1)	WA(2)	WA(3)	WA(4)
trans-1,4-Dichloro-2-butene					
Dichlorodifluoromethane					
1,1-Dichloroethane		<0.6	<60	<0.6	<0.6
cis-1,2-Dichloroethane					
1,2-Dichloroethane		<0.5	<5	<0.5	<0.5
1,1-Dichloroethene		<0.7	<70	<0.7	<0.7
1,2-Dichloroethene		<0.8	<8	<0.8	<0.8
cis-1,2-Dichloroethene					
trans-1,2-Dichloroethene					
Dichlorofluoromethane					
2,4-Dichlorophenol		<30	<30	<30	
2,6-Dichlorophenol					
1,2-Dichloropropane		<0.7	<7	<0.7	<0.7
1,3-Dichloropropane					
2,2-Dichloropropane					
1,1-Dichloropropene					
cis-1,3-Dichloropropene		<1.9	<19	<1.9	<1.9
trans-1,3-Dichloropropene		<1.8	<18	<1.8	<1.8
2,3-Dichloro-1-propene					
Dieldrin					
Diethyl phthalate		<10	<10	<10	
Dimethoate					
p-(Dimethylamino)azobenzene					
7/12-Dimethylbenz(a)anthracene					
3,3-Dimethylbenzidine					
Dimethylphenethylamine					
2,4-Dimethylphenol		12 (j)	<20	<20	
Dimethyl phthalate		<10	<10	<10	
Di-n-butyl phthalate		16	11	<10	
1,3-Dinitrobenzene					
4,6-Dinitro-2-methylphenol		<100	<100	<100	
2,4-Dinitrophenol		<100	<100	<100	
2,4-Dinitrotoluene		<50	<50	<50	
2,6-Dinitrotoluene		<50	<50	<50	
Di-n-octyl phthalate					
Dinoseb, DNBP					
1,4-Diomene					
Diphenylamine					
Disulfoton					
Endosulfan I					
Endosulfan II					
Endosulfan sulfate					
Endrin					

PARAMETER	TX HI (h)	WA(1)	WA(2)	WA(3)	WA(4)
Endrin aldehyde					
Endrin ketone					
Ethylbenzene		0.8 (j)	<8	<0.8	<0.8
Ethyl ether					
Ethylmethacrylate					
Ethyl methane sulfonate					
Ethyl parathion					
Famphur					
Fluoranthene		<10	<10	<10	
Fluorene		<10	<10	<10	
Heptachlor					
Heptachlor epoxide					
Hexachlorobenzene		<10	<10	<10	
Hexachlorobutadiene		<20	<20	<20	
Hexachlorocyclopentadiene		<50	<50	<50	
Hexachloroethane		<20	<20	<20	
Hexachlorophene		<3.3	<33	<3.3	<3.3
Hexachloropropene					
2-Hexanone		<3.2	<32	<3.2	4.8
Hx-CDD					
HxCDF					
Indeno(1,2,3-cd)pyrene		<10	<10	<10	
Iodomethane					
Isobutanol					
Isodrin					
Isophorone		<10	<10	<10	
2-Isophorone					
Isosafrole					
Kepone					
Lindane					
Methacryonitrile					
Methapyrilene					
Methoxychlor					
3-Methylcholanthrene					
Methylene chloride		<3.3	<33	<3.3	<3.3
Methyl ethyl ketone (MEK)		14	80	94	450 (i)
Methyl methacrylate					
Methyl methane sulfonate					
2-Methylnaphthalene		<10	<10	<10	
Methyl parathion; Parathion mehtyl					
4-Methyl-2-pentanone		<3.5	<35	8.9	59
2-Methylphenol		130	38	<10	
(3&4)-Methylphenol					

PARAMETER	TX HI (h)	WA(1)	WA(2)	WA(3)	WA(4)
4-Methylphenol		1500	670	74	
Naphthalene		3.8 (J)	<10	<10	
1,4-Naphthoquinone					
1-Naphthylamine					
2-Naphthylamine					
2-Nitroaniline		<50	<50	<50	
3-Nitroaniline		<50	<50	<50	
4-Nitroaniline		<50	<50	<50	
Nitrobenzene		<10	<10	<10	
5-Nitro-o-toluidine					
2-Nitrophenol		<50	<50	<50	
4-Nitrophenol		<50	<50	<50	
4-Nitroquninoline-1-oxide					
N-Nitrosodiethylamine					
N-Nitrosodimethylamine					
N-Nitrosodimethylethylamine					
N'Nitroso-di-n-propylamine		<10	<10	<10	
N-Nitrosodiphenylamine		<10	<10	<10	
N-Nitrosodi-a-butylamine					
N-Nitrosomorpholine					
N-Nitrosopiperidine					
N'Nitrosopyrolidine					
PeCDD					
PeCDF					
Pentachlorobenzene					
Pentachloroethane					
Pentachloronitrobenzene					
Pentachlorophenol		<50	<50	<50	
Phenacetin					
Phenanthrene		<10	<10	<10	
Phenol	2990	280	130	17	
Total Phenolics					
Phenolphthalein Alkalinity	0				
p-Phenylemediamine					
Phorate					
2-Picoline					
Pronamide					
Propionitrile, Ethyl cyanide					
Pyrene		<10	<10	<10	
Pyridine					
Safrole					
Silvex, 2,4,5-TP					
Styrene		1.1	<11	1.1	1.1

PARAMETER	TX HI (h)	WA(1)	WA(2)	WA(3)	WA(4)
Sulfotepp					
TCDD					
2,3,7,8-TCDD					
TCDF					
1,2,4,5-Tetrachlorobenzene					
1,1,1,2-Tetrachloroethane					
1,1,2,2-Tetrachloroethane		<2.7	<27	<2.7	<2 7
Tetrachloroethene		<0.5	<5	<0.5	<0.5
2,3,4,6-Tetrachlorophenol					
Tetrahydrofuran					
Thionazin					
Toluene		1	<8	1 (j)	2.3
o-Toluidine					
Toxaphene					
1,2,4-Trichlorobenzene		<10	<10	<10	
1,1,1-Trichloroethane		<0.6	<6	<0.6	<0.6
1,1,2-Trichloroethane		<0.7	<7	<0 7	<0.7
Trichloroethene		<0.6	<6	<0.6	<0.6
Trichlorofluoromethane					
2,4,5-Trichlorophenol		<50	<50	<50	
2,4,6-Trichlorophenol		<50	<50	<50	
1,2,3-Trichloropropane					
1,1,2-Trichlorotrifluoroethane					
o,o,o-Triethyl phosphorothioate					
2,4,5-T, 2,4,5-Trichlorophenoxyacetic acid					
sym-Trinitrobenzene					
Vinyl acetate		<3.1	<31	<3.1	<3.1
Vinyl chloride		<2	<20	<2	<2
Xylene (total)		2.3	<18	<1.8	<1.8
INORGANICS					
Aluminum					
Antimony					
Arsenic	75				
Barium	8000				
Beryllium					
Boron	3900				
Cadmium	30	2	2	2	
Chromium	250	5	5	18	
Hexavalent Chromium	4920				
Cobalt					
Copper	490	2	8	5	
Cyanide	<100				
Cyanides (total)					

PARAMETER	TX HI (h)	WA(1)	WA(2)	WA(3)	WA(4)
Iron	172000				
Filtered Iron	11000				
Lead	2130	30	30	30	
Magnesium	192000				
Mercury	9				
Nickel		10	20	50	
Potassium	618000				
Selenium	<1				
Silver	30				
Thallium					
Tin					
Vanadium					
Zinc	8630	17	24	1420	
CONVENTIONAL PARAMETERS					
Alkalinity	6520000				
Ammonia					
Ammonia, Nitrogen	184000				
Bicarbonate	7950000				
Biological Oxygen Demand (BOD) (5-day)	320000				
Biological Oxygen Demand (BOD) (20-day)					
Calcium	578000				
Chemical Oxygen Demand (COD)	11200000				
Chlorides	240000				
Dissolved Oxygen (%)					
Fluoride	400				
Hardness by Calculation	1516000				
Manganese	4900				
Nitrate	13000				
Nitrate/Nitrite					
Nitrite	ND				
Organic Nitrogen					
Total Kjeldahl Nitrogen					
Oil and Grease	47000	50000	40000	40000	
Oxidation-Reduction Potential (a)					
pH (b)	7.3				
Phosphate					
Phosphorus	3890				
Total Phosphorus					
Sodium	1290000				
Solids, volatile					
Specific Conductance (c)	6850				
Sulfates	<40000				
Surfactants					

PARAMETER	TX HI (h)	WA(1)	WA(2)	WA(3)	WA(4)
Tannin					
Total Dissolved Solids	4270000				
Total Organic Carbon	1080000				
Total Organic Halogens					
Total Settled Solids (d)		<100	<100	<100	
Total Suspended Solids	43000000				
Turbidity (NTU)					

CHAPTER 4
STATE REGULATORY REQUIREMENTS FOR CONSTRUCTION AND DEMOLITION LANDFILLS

In a 1992 study, EPA estimated that approximately 1,800 off-site C&D landfill facilities were in operation across the 50 states.[1] In another study conducted in 1994, EPA estimated that the number of C&D landfills in operation nationwide approximated 2,775. This estimate included, however, approximately 930 C&D landfills in the State of Georgia alone. The State includes in this figure a substantial number of on-site landfills used solely for the disposal of construction and land-clearing debris generated in the construction of new homes Discounting the Georgia estimate leaves approximately 1,845 C&D landfills in operation, or nearly the same number estimated in the 1992 study.[2] Both estimates compare to the approximate 5,000 or more permitted MSWLFs.

Another source of disposal for C&D waste is in on-site facilities. Typically, these sites are used only for the disposal of C&D waste generated at that site and are closed following completion of the activity. Because these sites are on privately-owned land and receive only waste generated at that site, little data exists on the number of these facilities nationwide. In fact, in EPA's 1994 study only one other state aside from Georgia could estimate the number of on-site landfills in that state. That number was one landfill.[3]

This chapter summarizes existing state statutes and regulations for C&D landfills. Specifically, the chapter focuses on similarities and differences between current state requirements for C&D landfills and Federal requirements for MSWLFs found at 40 CFR Part 258. This comparison enables EPA to gauge whether existing state requirements for C&D landfills are sufficient to protect human health and the environment.

To summarize existing state requirements, EPA gathered information on the most recent state C&D landfill requirements from state solid waste statutes and regulations presented in publications by The Bureau of National Affairs, Inc.[4] EPA summarized these state requirements vis-a-vis their relationship to 40 CFR Part 258. In summarizing, EPA differentiated between the requirements for on-site and off-site facilities, respectively. The first section of this chapter provides an overview of state regulatory classification schemes for C&D landfills. The second, third, and fourth sections, respectively compare state location standards, ground-water monitoring requirements, and corrective action requirements for C&D landfills with the requirements found at 40 CFR Part 258. The final section briefly discusses other requirements, such as permits and financial assurance, that states may have for C&D landfills.

OVERVIEW OF STATE REGULATORY SCHEMES FOR C&D LANDFILLS

States use a variety of schemes to classify and subsequently regulate C&D landfills. A breakdown of the schemes the 50 states use for both on-site and off-site C&D landfills is found in Attachment 4-A. These schemes can be divided into the following four categories:

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[1] "Construction Waste and Demolition Debris Recycling . . . A Primer," Gershman, Brickner and Bratton, Inc., October 1993.

[2] "List of Industrial Waste Landfills and Construction & Demolition Waste Landfills," EPA/OSW, September 1994.

[3] Ibid.

[4] Ohio has a definition for construction and demolition debris and a requirement for a C&D debris disposal facility license. However, the State currently does not have regulations for C&D debris management and permitting requirements but expects regulations to be finalized by the end of 1995.

- **States that require all C&D landfills to meet state sanitary landfill requirements.** A total of 11 states currently require both on-site and off-site C&D landfills to meet state sanitary landfill requirements or requirements that are substantially similar to state sanitary landfill requirements. These states are: Alaska, Arizona, Connecticut, Idaho, Iowa, Massachusetts, Nebraska, Nevada, North Dakota, Oklahoma, and Rhode Island. State sanitary landfill requirements are not always as stringent as the requirements in 40 CFR Part 258.

- **States that regulate all C&D landfills as a landfill unit separate from sanitary landfills.** A total of 24 states currently have separate, specific requirements for all C&D landfills, regardless of where sited. These states' requirements may also vary depending on the size of the landfill, the type of waste received, etc. These variations are identified in Attachment 4-A. These states are: Alabama, Arkansas, California, Delaware, Florida, Georgia, Indiana, Kansas, Maryland, Minnesota, Missouri, Montana, New Hampshire, New York, North Carolina, Ohio[5], South Carolina, South Dakota, Texas, Vermont, Virginia, Washington, Wisconsin, and Wyoming.

- **States with separate requirements for on-site and off-site C&D landfills.** In addition to the 24 states that regulate all C&D landfills as a landfill unit separate from sanitary landfills, eight states have defined further separate requirements applicable to on-site and off-site C&D landfills. These states are: Illinois, Kentucky, Maine, Michigan, New Jersey, Pennsylvania, Tennessee, and West Virginia.

- **States that exempt on-site C&D landfills from regulation.** A total of seven states exempt all on-site C&D landfills from regulatory requirements. These states are: Colorado, Hawaii, Louisiana, Mississippi, New Mexico, Oregon, and Utah. Five of these states have specific requirements for off-site facilities, while two currently require off-site facilities to meet state sanitary landfill requirements.

The following three sections discuss specific state requirements regarding location restrictions, ground-water monitoring, and corrective action in comparison to 40 CFR Part 258. Overall, 16 states have requirements for off-site C&D landfills in all three of these categories. These states are as follows:

- California
- Connecticut
- Delaware
- Georgia
- Illinois
- Kentucky
- Michigan
- Nevada
- New Jersey
- New Mexico
- New York
- Pennsylvania
- Rhode Island
- Virginia
- West Virginia
- Wisconsin

Most of these states' requirements, however, are less stringent than 40 CFR Part 258. For example, many of these states require ground-water monitoring, but not the same frequency or parameters identified in 40 CFR Part 258. Additionally, many of these states do not list all of the six specific location restrictions found at 40 CFR Part 258. Two of these states, however, have requirements in all three categories for off-site C&D landfills that are at least as stringent as 40 CFR Part 258. These states are Michigan and Nevada. Thus, relative to 40 CFR Part 258, these states have all six specified location restrictions, the same or more stringent ground-water monitoring frequencies and parameters, and the same or more stringent corrective action requirements.

[5] Ohio expects to have specific C&D management requirements effective by the end of 1995.

LOCATION STANDARDS

This section compares state location standards for C&D landfills to 40 CFR Part 258 and identifies other, common restrictions states may require.

Comparison of State Requirements to EPA's MSWLF Requirements

EPA's MSWLF regulations (40 CFR Part 258) place restrictions on facilities located in or near the following six areas: airports, floodplains, wetlands, faults, seismic impact zones, and unstable areas. The specific language relating to these six areas is found in Table 4-1.

This section highlights similarities and differences between current, mandatory state C&D landfill location restrictions and the Federal restrictions for MSWLFs. Table 4-1 indicates the number of states with mandatory C&D landfill restrictions that are substantially similar to or more stringent than 40 CFR Part 258 (e.g., some states prohibit C&D landfills in floodplains altogether, while Federal requirements only require that special consideration be given to not restricting flood flows)[6]. The number of states is divided into requirements for on-site and off-site C&D landfills.

TABLE 4-1
States That Currently Have Location Restrictions Similar to or More Stringent than 40 CFR Part 258

40 CFR Part 258 Requirement	Number of States	
	On-Site Facilities	Off-Site Facilities
Facilities located within 1) 10,000 feet of any airport runway end used by turbojet aircraft, or 2) 5,000 feet of any airport runway end used only by piston-type aircraft must demonstrate that the facility does not pose a bird hazard to aircraft New facilities within a five-mile radius of any airport runway used by turbojet or piston-type aircraft must notify the airport and the FAA.	16	21
Facilities located in 100-year floodplains must not restrict 100-year flood flow, reduce the temporary water storage capacity of the floodplain, or result in solid waste washout that poses a hazard to human health or the environment.	32 (8 prohibitions)	35 (9 prohibitions)
Facilities may not be located in wetlands, unless they successfully make several demonstrations to the Director of an approved state.	20	25
Facilities are banned within 200 feet of faults that have experienced displacement since the Holocene Epoch. Facilities in approved states may receive variance from this restriction.	6	10
In approved states, facilities may be located in a seismic impact zone if they are designed to resist the maximum horizontal acceleration in lithified material for the site	3	4
Landfills located in unstable areas must demonstrate that engineering measures have been incorporated into the unit's design to ensure that the integrity of the structural components (e.g., liners, leachate collection systems, final cover systems, run-on/run-off systems) will not be disrupted.	11	14

[6] Ohio expects to have specific C&D management requirements effective by the end of 1995.

Table 4-1 reveals a high degree of consistency between state C&D landfill location restrictions and Federal MSWLF location restrictions regarding airports, floodplains, and wetlands. This same level of consistency, however, does not apply to faults, seismic impact zones, and unstable areas. In general, although states may not include mandatory restrictions in their regulations, permit writers may incorporate them in facility permits. This chapter evaluates only requirements listed in statutes or regulations.

Other State Location Requirements

In addition to the location restrictions specified in 40 CFR Part 258, numerous states list other mandatory location restrictions for on-site and off-site C&D landfills. Examples of these additional requirements and the number of states requiring them include:

- Restrictions near ground and/or surface waters (18);
- Restrictions near habitats of endangered or threatened species (5);
- Restrictions near historically or archaeologically significant areas (4);
- Restrictions near residences (4); and
- Restrictions near Federal or state parks (3).

Other location criteria mentioned less frequently include restrictions within certain distances from schools, hospitals and highways, as well as prohibitions on sites near shoreland or over natural resources.

GROUND-WATER MONITORING REQUIREMENTS

The level of ground-water monitoring required at C&D landfills varies significantly from state to state. State ground-water monitoring requirements can be grouped into the following four categories:

- **States without ground-water monitoring requirements**. This category includes states that either specifically exempt C&D landfills from ground-water monitoring requirements or do not reference such a requirement in the regulations.

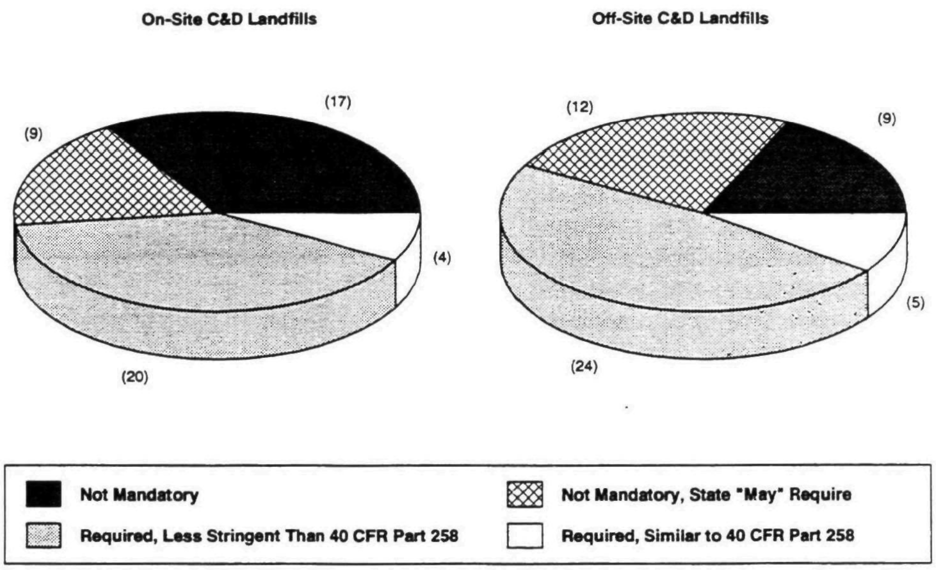
- **States that "may" require ground-water monitoring**. This category encompasses states that "may" require ground-water monitoring, usually at the regulatory authority's discretion, based on a review of the submitted site, facility design, and facility operation plans. If ground-water monitoring is required, the regulations reference ground-water monitoring requirements for other classes of landfills or indicate that procedures are to be incorporated into the permit.

- **States with ground-water monitoring requirements that are less stringent than 40 CFR Part 258**. This category includes states that require ground-water monitoring in all cases; however, the requirements are less stringent than those found in 40 CFR Part 258. For example, monitoring frequency and the number of parameters to be monitored may be reduced, or only background monitoring is required, while assessment monitoring may be required at the regulatory authority's determination. This category also includes: (1) states that require monitoring, but determine the frequency, procedures, and parameters based on a review of the permit application; and (2) states that may grant variances from mandatory monitoring based on site-specific characteristics.

- **States with ground-water monitoring requirements that are substantially similar to 40 CFR Part 258**. This category encompasses states that adopt, by reference, EPA's ground-water monitoring requirements for MSWLFs, and states that although not specifically referencing 40 CFR Part 258, have similar requirements for frequencies, procedures (mandatory background and assessment monitoring), and parameters.

Attachment 4-B lists states by each of these categories. Figure 4-1 summarizes these requirements.

FIGURE 4-1
State C&D Landfill Ground-Water Monitoring Requirements



Of the four categories of requirements, most states require ground-water monitoring that is less stringent than 40 CFR Part 258 (20 states have this requirement for on-site facilities, while 24 states have it for off-site facilities). Only four and five states have ground-water monitoring requirements for on-site and off-site C&D landfills, respectively, that are substantially similar to 40 CFR Part 258. Each of these categories is discussed in greater detail below.

States Without Ground-Water Monitoring Requirements

Seventeen states do not require ground-water monitoring for on-site C&D landfills. Additionally, nine of the 17 states also do not require ground-water monitoring for their off-site C&D landfills. Again, these states' regulations either specifically exempt these facilities from ground-water monitoring requirements, or do not reference such requirements.

States Without Ground-Water Monitoring Requirements

On-Site C&D Landfills Only

Colorado	Hawaii	Kentucky
New Jersey	New Mexico	Oregon
Tennessee	West Virginia	

Both On-Site and Off-Site C&D Landfills

Florida	Idaho	Indiana
Louisiana	Mississippi	Montana
Utah	Vermont	Washington

States That "May" Require Ground-Water Monitoring

Several states also do not mandate ground-water monitoring at C&D landfills. Rather, these states permit the regulatory agency to require ground-water monitoring at its discretion. Generally, the permit applicant submits information related to the site and facility, which the regulatory agency reviews. Should the agency require ground-water monitoring based on the review, either the regulations reference monitoring requirements or, in most cases, the agency specifies the requirements tailored to the facility in the facility permit. Nine states may designate ground-water monitoring for on-site facilities, while 12 states may designate requirements for off-site facilities.

States That "May" Designate Ground-Water Monitoring Requirements

Both On-Site and Off-Site C&D Landfills

Alabama	Alaska	Arizona
Arkansas	Kansas	Minnesota
North Carolina	North Dakota	Texas

Off-Site C&D Landfills Only

Hawaii	Oregon	Tennessee

States With Ground-Water Monitoring Requirements That Are Less Stringent Than 40 CFR Part 258

Forty percent of the states (20) mandate ground-water monitoring for both on-site and off-site C&D landfills[7]. An additional four states mandate ground-water monitoring for off-site C&D landfills only. Each of these state's ground-water monitoring requirements are less stringent than EPA's requirements for MSWLFs found at 40 CFR Part 258. For the most part, these states have developed their own requirements relating to frequency, parameters to be tested, and types of monitoring (i.e., background and/or assessment monitoring). These requirements differ significantly from state to state. Attachment 4-B details the requirements. The following is a summary of these requirements:

States With Ground-Water Monitoring Requirements That Are Less Stringent Than 40 CFR Part 258

Both On-Site and Off-Site C&D Landfills

California	Connecticut	Delaware
Georgia	Illinois	Iowa
Maine	Maryland	Massachusetts
Missouri	Nebraska	New York
Ohio	Oklahoma	Pennsylvania
South Carolina	South Dakota	Virginia
Wisconsin	Wyoming	

Off-Site C&D Landfills Only

Colorado	Kentucky	New Jersey
New Mexico		

- **Background Monitoring**. Six states (California, Connecticut, Georgia, Nebraska, South Carolina, and Wyoming) do not provide in their regulations procedures detailing their background monitoring requirements. In general, states determine these procedures on a case-by-case basis or through the use of guidance.

- **Assessment Monitoring**. All of the states, with the exception of Virginia, do not detail assessment monitoring procedures in their regulations. Typically, the regulatory authority determines the procedures for assessment monitoring, such as frequency and parameters to be tested, following the detection of a parameter above the background level.

- **Background Frequency of Monitoring**. For those states providing details in their regulations, ten require quarterly monitoring at least in the first year (two require less frequent monitoring in succeeding years). Three states require background monitoring at least semi-annually, while one state requires it annually. Another state requires some parameters to be monitored quarterly and others annually. Six states allow the regulatory authority to determine the frequency of background ground-water monitoring.

[7] Ohio currently does not have ground-water monitoring but monitoring is expected to be a requirement when C&D management regulations are finalized by the end of 1995.

- **Background Parameters**. Fifteen states list in their regulations background parameters to be tested. The number of parameters to be tested vary from state to state. In general, states require that owners/operators monitor for several of the metals and volatile organic compounds (VOCs) found in Appendix I of 40 CFR Part 258. In addition, the states require that owner/operators monitor for various characterization parameters, such as color, pH, odor, and turbidity.

Table 4-2 lists the states that include background parameters in their regulations.

TABLE 4-2
State Background Ground-Water Monitoring Parameters

State	Facility Type (On-Site/ Off-Site)	Parameters for Background Monitoring
Colorado	Off-Site	• Temperature, conductivity, pH, chloride, nitrate, nitrite, ammonia as nitrogen, sulfate, dissolved iron, cadmium, lead, mercury, dissolved zinc and manganese, total alkalinity, COD, TOC, calcium, sodium, potassium, and magnesium.
Delaware	Both	• Conductivity, TDS, TOC, chloride, pH, COD, and total iron.
Illinois	Off-Site	• 51 organic chemicals found at 40 CFR 141 40 (1988) and any other organic chemical for which a ground-water quality standard has been adopted pursuant to Section 14.4 of the Act or Section 8 of the Illinois Ground Water Protection Act.
Iowa	Both	• Arsenic, barium, cadmium, chromium, lead, mercury, magnesium, zinc, copper, benzene, carbon tetrachloride, 1,2-dichloroethane, trichloroethylene, 1,1,1-trichloroethane, 1,1-dichloroethylene, paradichlorobenzene, chloride, field test for specific conductance and pH, ammonia, nitrogen, iron, COD, temperature, total organic halogen, and phenols.
Kentucky	Off-Site	• Chloride, COD, TDS, specific conductance, pH, iron, sodium, arsenic, barium, cadmium, lead, mercury, nitrate, selenium, silver, pH, calcium, magnesium, potassium, sulfate, bicarbonate, carbonate, TOC, and chromium.
Maine	Both	• Conductivity, temperature, pH, depth to ground water, acidity, iron, TOC, COD, and chloride.
Maryland	Both	• pH, alkalinity, hardness, chloride, specific conductance, nitrate, COD, arsenic, barium, cadmium, chromium, zinc, lead, mercury, and volatile priority pollutants.
Massachusetts	Both	• pH, alkalinity, temperature, specific conductance, nitrate nitrogen (as nitrogen), TDS, chloride, iron, manganese, sulfate, arsenic, barium, cadmium, chromium (total & Cr^{+6}), copper, cyanide, lead, mercury, selenium, silver, and zinc; all of the organic compounds included in EPA Method 624, as amended, and methyl ethyl ketone, xylenes, methyl isobutyl ketone, and acetone.
Missouri	Both	• All metals found in Appendix I of 40 CFR Part 258, but none of the VOCs listed.
New Jersey	Off-Site	• Turbidity, color, odor, iron, mercury, arsenic, barium, cadmium, chromium (hexavalent Cr^{+6}), cyanide, fluoride, lead, selenium, silver, ABS/LAS (Alkyl-Benzene-Sulfonate & Linear-Alkyl-Sulfonate) or similar methylene blue reactive substances contained in synthetic detergents, chloride, copper, hardness (as $CaCO_3$), iron, manganese, nitrogen (including NO_3-N and NH_4-N), phenolic compounds (as phenol), sodium, sulfate, TDS, zinc, COD, BOD, TOC; scan for volatile organics, acid extractables, base neutral extractables, and pesticides/PCBs.

TABLE 4-2 (continued)
State Background Ground-Water Monitoring Parameters

State	Facility Type (On-Site/ Off-Site)	Parameters for Background Monitoring
New Mexico	Off-Site	• In the first year and every seventh year, the parameters are identical to those listed in Appendix I of 40 CFR Part 258 • After first year, parameters are: iron, manganese, nitrate, chloride, phenols, sulfate, ammonia, pH, conductance, TOC, COD, calcium, TDS, temperature, water elevation, hardness, alkalinity, magnesium, potassium, and sodium.
Oklahoma	Both	• pH, COD, and conductivity.
Pennsylvania	Both	• chloride, sulfate, COD, pH, specific conductance, TOC, total organic halogen, iron, and sodium.
Virginia	Both	• Hardness, sodium, chloride, iron, lead, conductance, pH, TOC, and TOX.
Wisconsin	Both	• VOC. and metals similar to 40 CFR Part 258

States With Mandatory Requirements Substantially Similar to 40 CFR Part 258

Some states that require C&D landfills to monitor ground water either adopt the 40 CFR Part 258 requirements by reference, or have their own requirements that are substantially similar to 40 CFR Part 258, i.e., both background and assessment monitoring procedures are listed and the parameters to be tested include most if not all of the parameters listed in 40 CFR Part 258 Appendices I and II.

In particular, four states require both on-site and off-site C&D landfills to monitor ground water according to the procedures identified in 40 CFR Part 258. These states include:

- Michigan
- New Hampshire
- Nevada
- Rhode Island

In addition, one state, West Virginia, requires that only off-site C&D landfills to monitor ground water according to the procedures identified in 40 CFR Part 258.

CORRECTIVE ACTION REQUIREMENTS

In addition to the ground-water monitoring requirements discussed above, 40 CFR Part 258 also requires MSWLFs to perform corrective action activities if contamination is detected by monitoring procedures. Within 90 days of finding ground-water contamination at a MSWLF, the owner/operator of said facility must initiate an assessment of corrective action measures ((40 CFR 258.56(a)).

Presently, 16 states have corrective action measures for both on-site and off-site C&D landfills. In addition to these states, six states require corrective action measures for their off-site C&D landfills only. These states take one of three approaches to corrective action:

- A corrective action plan must be submitted with the permit application. This plan probably discusses steps to be taken following a release.

- The facility owner/operator must develop a corrective action plan following a release to ground water and submit it to the regulatory authority for approval.

- The regulatory authority may require the facility owner/operator to undertake corrective action measures as necessary, typically following the regulatory authority's review of submitted ground-water monitoring data.

States With Required Corrective Action Measures

Both On-Site and Off-Site C&D Landfills

Alaska	California	Connecticut
Delaware	Georgia	Iowa
Maryland	Massachusetts	Michigan
Minnesota	Nevada	New York
Pennsylvania	Rhode Island	Virginia
Wisconsin		

Off-Site C&D Landfills Only

Hawaii	Illinois	Kentucky
New Jersey	New Mexico	West Virginia

OTHER STATE REQUIREMENTS

In addition to the requirements discussed above, states also mandate additional requirements for both on-site and off-site C&D landfills. Table 4-3 provides the total number of states that address permits, design and operating criteria, closure and post-closure, and financial assurance in their regulations.[8]

TABLE 4-3
States With Additional Mandatory Requirements for C&D Landfills

Requirement	On-Site Facilities	Off-Site Facilities
Permits		
A permit is required	38	45
Facility is permitted-by-rule	3	3
No permit or permit-by-rule required	9	2
Design and Operating Criteria		
Six inches of daily cover	14	19
Liner	15	22
Leachate collection system	13	18
24 inches of final cover	29	38
Less than 24 inches of final cover	7	6
Post-Closure Period		
At least 30 years	10	11
Less than 30 years	18	23

[8] Currently, Ohio requires a permit for C&D landfills and prohibits the disposal of hazardous waste in a C&D landfill. Because Ohio's C&D management regulations have not been finalized, it is unclear what other requirements will be included in the regulations.

TABLE 4-3 (continued)
States With Additional Mandatory Requirements for C&D Landfills

Requirement	On-Site Facilities	Off-Site Facilities
Financial Assurance		
For Closure	23	33
For Post-Closure	22	32
For Corrective Action	11	15
Waste Restrictions		
All hazardous waste prohibited	16	24
Regulations do not specifically prohibit all hazardous waste	13	14
Only inert waste can be disposed	3	3
Only C&D waste can be disposed	4	4
No waste restrictions identified	14	5

Table 4-3 indicates the following:

- **Permits**. A majority of states require both on-site and off-site C&D landfills to obtain a facility permit (38 states require permits for on-site landfills, while 45 require permits for off-site landfills). Twenty percent of states (nine) do not require on-site facilities to obtain a permit nor do these states permit these facilities by rule.

- **Final Cover**. The most common mandated design and operating requirement is the requirement that facilities provide at least 24 inches of final cover material. Thirty-eight states mandate this requirement for off-site C&D landfills, while an additional six states mandate final cover of less than 24 inches. Twenty-nine states mandate 24 inches of final cover for on-site facilities, while seven mandate less than 24 inches.

- **Daily Cover**. Nineteen states require off-site facilities to provide at least six inches of cover on a daily basis while the facility is in operation. An additional 26 states require off-site landfills to provide cover, at some time period less frequent than daily (e.g., weekly, monthly, semi-annually). Fourteen states require on-site facilities to provide at least six inches of cover on a daily basis, while 24 additional states require cover less frequently than daily.

- **Liners**[9]. Twenty-two states require a liner for off-site C&D landfills. Fifteen of these 22 states also extend these liner requirements to on-site C&D landfills. The type of material required for off-site facilities is as follows:

  -- Ten states require a soil/clay liner. Five of these states require a hydraulic conductivity of 1 x 10^{-7}, two require 1 x 10^{-6}, two require 1 x 10^{-5}, and two do not specify a hydraulic conductivity maximum.

  -- Five states require a composite liner. Two states require a hydraulic conductivity of 1 x 10^{-7}, one state requires 1 x 10^{-6}, and the remaining two do not specify a hydraulic conductivity maximum.

  -- Seven states review liner requirements on a case-by-case basis, typically allowing the owner/operator to select a liner with state approval based on site-specific characteristics.

  For the 15 states requiring liners for on-site landfills:

  -- Five require a soil/clay liner;

  -- Four require a composite liner; and

  -- Six review liner requirements on a case-by-case basis.

- **Leachate Collection Systems**. Eighteen and 13 states require some form of leachate collection system for off-site and on-site C&D landfills, respectively.

- **Post-Closure Period**. In sum, 34 states require some time period for post-closure care for off-site facilities. Of these 34 states, 11 require that the post-closure period be at least 30 years, while 23 require a period of less than 30 years, typically five years or less. Twenty-eight states require some time period for post-closure care for on-site facilities: ten require at least 30 years, while 18 require less than 30 years.

- **Financial Assurance**. With regard to financial assurance, over 60 percent of states require some form of financial assurance for both closure and post-closure for off-site facilities. Nearly one-half of the states require financial assurance for on-site facilities. Finally, 15 states require financial assurance for corrective action for off-site C&D landfills, while 11 do for on-site facilities.

- **Waste Restrictions**[10]. Twenty-four states specifically state in their regulations that all hazardous wastes are prohibited from disposal at off-site C&D landfills. In addition, three and four states require that only inert and C&D waste, respectively, be accepted for disposal at off-site C&D landfills. A total of 14 states do not specifically prohibit all hazardous waste from disposal at C&D landfills. For example, these states may prohibit only "regulated" or "controlled" hazardous waste, or they may require that "only waste listed in permit may be disposed." Finally, five states do not list any waste restrictions. With regard to on-site C&D landfills, 16 prohibit disposal of all hazardous waste, three require that only inert waste be disposed, and four require that only C&D waste be disposed. Finally, 13 states do not specifically prohibit all hazardous waste and 14 states do not list any waste restrictions for on-site C&D landfills.

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[9] Attachment 4-C discusses liner requirements in greater detail.

[10] Attachment 4-D discuss waste restrictions in greater detail.

ATTACHMENT 4-A. STATE REGULATORY CLASSIFICATION SCHEME FOR C&D LANDFILLS

State	On-Site	Off-Site
Alabama	Specific requirements apply to all C&D landfills (C/DLF) regardless of where sited.	
Alaska	State sanitary landfill requirements apply to all C&D landfills; no specific C&D requirements.	
Arizona	State sanitary landfill requirements apply to all C&D landfills, specific C&D requirements pending	
Arkansas	Specific requirements apply to all C&D landfills (Class III, IV) regardless of where sited.	
California	Specific requirements apply to all C&D landfills (Class III) regardless of where sited.	
Colorado	Exempt	State sanitary landfill requirements apply to off-site C&D landfills; specific off-site C&D landfill requirements pending.
Connecticut	Separate classification for all C&D landfills (Special Waste) regardless of where sited. However, requirements substantially similar to state sanitary landfill requirements	
Delaware	Specific requirements apply to all C&D landfills (Dry Waste) regardless of where sited.	
Florida	Specific on-site C&D landfill requirements.	Specific off-site C&D landfill requirements
Georgia	Specific requirements apply to all C&D landfills (C&D) regardless of where sited.	
Hawaii	Exempt	Specific off-site C&D landfill requirements (Demolition).
Idaho	State sanitary landfill requirements apply to all C&D landfills; specific C&D landfill requirements pending.	
Illinois	Specific on-site C&D landfill requirements (Inert Waste).	Specific off-site C&D landfill requirements (Inert Waste).
Indiana	Specific requirements apply to all C&D landfills (C&D) regardless of where sited.	
Iowa	Specific classification for all C&D landfills regardless of where sited, requirements substantially similar to state sanitary landfills requirements	
Kansas	Specific requirements apply to all C&D landfills (C&D) regardless of where sited.	
Kentucky	Specific on-site C&D landfill requirements; facilities permit-by-rule	Specific off-site C&D landfill requirements; facilities less than one acre are registered permit-by-rule, facilities greater than one acre are permitted.
Louisiana	Exempt	Specific off-site C&D landfill requirements (Type III).

State	On-Site	Off-Site
Maine	If facility is less than one acre in size, it is exempt. If facility is between one and six acres in size, must meet separate requirements for C&D landfills (Chapter 404). If facility is greater than six acres, must meet state sanitary landfill requirements	If facility is less than six acres, must meet separate C&D landfills requirements (Chapter 404). If facility is greater than six acres, must meet state sanitary landfill requirements
Maryland	Specific requirements apply to all C&D landfills (Rubble) regardless of where sited.	
Massachusetts	State sanitary landfill requirements apply to all C&D landfills, no specific C&D landfill requirements	
Michigan	Specific on-site C&D landfill requirements (Type III).	Specific off-site C&D landfill requirements (Type III).
Minnesota	If facility is less than 15,000 cubic yards in size and operates for less than 12 months, it is permitted by rule regardless of where sited. All other facilities must meet specific C&D landfill requirements (Demolition)	
Mississippi	Exempt	Specific off-site C&D landfill requirements (Rubbish).
Missouri	Specific requirements apply to all C&D landfills (Demolition) regardless of where sited	
Montana	Specific requirements apply to all C&D landfills (Class II) regardless of where sited.	
Nebraska	Separate classification for C&D landfills regardless of where sited, requirements substantially similar to state sanitary landfill requirements	
Nevada	State sanitary landfill regulations apply to all C&D landfills. State sanitary landfills requirements vary for facilities receiving greater than 20 tons per day.	
New Hampshire	Specific requirements apply to all C&D landfills regardless of where sited. Less stringent requirements apply if facility receives only inert demolition debris	
New Jersey	Specific on-site C&D landfill requirements (Class III).	Specific off-site C&D landfill requirements (Class III); requirements vary, however, for small-scale Class III landfills.
New Mexico	Exempt	Separate classification for C&D landfills (Class C); requirements substantially similar to state sanitary landfill requirements.
New York	Specific requirements apply to all C&D landfills regardless of where sited. Requirements vary depending on whether facility is greater than three acres in size.	
North Carolina	Specific requirements apply to all C&D landfills (Demolition) regardless of where sited.	
North Dakota	Specific classification for all C&D landfills (Special Use); requirements substantially similar to state sanitary landfills requirements.	
Ohio	When new regulations become effective, specific requirements will apply to all C&D landfills regardless of where sited.	
Oklahoma	Separate classification for C&D landfills (Type IV); requirements substantially similar to state sanitary landfill requirements.	

State	On-Site	Off-Site
Oregon	Exempt	Specific off-site C&D landfill requirements
Pennsylvania	Specific on-site C&D landfill requirements.	Specific off-site C&D landfill requirements.
Rhode Island	State sanitary landfill requirements apply to all C&D landfills; no specific C&D requirements.	
South Carolina	Specific requirements apply to all C&D landfills regardless of where sited.	
South Dakota	All C&D landfills may be issued a general permit based on certain requirements, otherwise, all state sanitary landfill requirements apply	
Tennessee	Exempt, if less than one acre in size. Specific requirements apply to all other C&D landfills (Class IV)	Specific requirements apply to all C&D landfills (Class IV).
Texas	Specific requirements apply to all C&D landfills (Type IV) regardless of where sited	
Utah	Exempt	Specific off-site C&D landfill requirements.
Vermont	All C&D landfills permitted by rule regardless of where sited.	
Virginia	Specific requirements for all C&D landfills (Construction, Demolition, and Debris) regardless of where sited.	
Washington	Specific requirements for apply to inert and demolition landfills regardless of where sited. Construction waste is co-disposed with MSW.	
West Virginia	Specific on-site C&D landfill requirements (Class D-2, D-3).	Specific off-site C&D landfill requirements (Class D-1).
Wisconsin	Specific requirements apply to C&D landfills regardless of where sited. Requirements vary depending on type of facility: (1) inert waste only, (2) one-time disposal, (3) less than 50,000 cubic yards, and (4) greater than 50,000 cubic yards.	
Wyoming	Specific requirements apply to all C&D landfills regardless of where sited.	

ATTACHMENT 4-B. STATE GROUND-WATER MONITORING REQUIREMENTS

The exhibit below summarizes, for each state, the state's ground-water monitoring requirements for both on-site and off-site C&D landfills. The categories are divided as follows:

Category (1) **State has no ground-water monitoring requirement.** This category includes states that either specifically exempt C&D landfills from ground-water monitoring requirements or do not reference such a requirement in the regulations for C&D landfills

Category (2) **State "may" require ground-water monitoring.** This category encompasses states that "may" require ground-water monitoring, usually at the regulatory authority's discretion, based on a review of the submitted site, facility design, and facility operation plans. If ground-water monitoring is required, the regulations reference ground-water monitoring requirements for other classes of landfills or indicate that procedures are to be incorporated into the permit.

Category (3) **State requires ground-water monitoring and the requirements are substantially similar to 40 CFR Part 258.** This category encompasses states that adopt, by reference, EPA's ground-water monitoring requirements for MSWLFs. This category also encompasses states that do not specifically reference 40 CFR Part 258, but have similar requirements for frequencies, procedures (mandatory background and assessment monitoring), and parameters, although not every parameter is similar to those listed in 40 CFR Part 258.

Category (4) **State requires ground-water monitoring, but the requirements are less stringent than 40 CFR Part 258.** This category includes states that require ground-water monitoring in any case. However, the state's requirements for ground-water monitoring are not as stringent as those listed at 40 CFR Part 258. For example, monitoring frequency may be less often, the parameters to be monitored may be fewer in number, or only background monitoring is required and assessment monitoring may be required at the determination of the regulatory authority. This category also includes states that require ground-water monitoring, but determine the frequency, procedures, and parameters to be monitored based on a review of the permit application. Also included are states that may grant a variance for mandatory monitoring to C&D landfills based on site-specific characteristics.

The frequencies and parameters for states classified as Category 4 (states with mandatory ground-water monitoring requirements that are less stringent than 40 CFR Part 258) also are listed in the exhibit.

State	Facility Type (On-Site/ Off-Site)	Category				Ground-Water Monitoring Requirements For States in Category (4)	
		(1)	(2)	(3)	(4)	Background	Assessment
Alabama	Both		✓				
Alaska	Both		✓				
Arizona	Both		✓				
Arkansas	Both		✓				
California	Both				✓	• Semi-annually or quarterly • Parameters determined by Regulatory board for each management unit	• Frequency and parameters determined by board
Colorado	On-Site	✓					
	Off-Site				✓	• Quarterly • (1) temperature, (2) conductivity, (3) pH, (4) chloride, (5) nitrate, nitrite and ammonia as nitrogen, (6) sulfate, (7) dissolved iron, cadmium, lead and mercury, (8) dissolved zinc and manganese, (9) total alkalinity, (10) COD, (11) TOC, (12) calcium, sodium, potassium and magnesium	
Connecticut	Both				✓	• Monitoring performed in accordance with the schedule in the facility plan and/or permit to construct	
Delaware	Both				✓	• Frequency approved by Department • Specific conductivity, TDS, TOC, chloride, pH, COD, total iron and other parameters specified by Department	

State	Facility Type (On-Site/ Off-Site)	Category				Ground-Water Monitoring Requirements For States in Category (4)	
		(1)	(2)	(3)	(4)	Background	Assessment
Florida	Both	✓					
Georgia	Both				✓	• Groundwater monitoring procedures follow state guidance found in "Manual for Groundwater Monitoring, September 1991"	
Hawaii	On-Site	✓					
	Off-Site		✓				
Idaho	Both	✓					
Illinois	On-Site				✓	• Quarterly • Parameters determined by background monitoring	
	Off-Site				✓	• Semi-annually for leachate samples • Once every 2 years for 51 organic chemicals found at 40 CFR 141 40 (1988) and any other organic chemical for which a ground-water quality standard has been adopted pursuant to Section 14.4 of the Act or Section 8 of the Illinois Ground Water Protection Act	
Indiana	Both	✓					

State	Facility Type (On-Site/ Off-Site)	Category				Ground-Water Monitoring Requirements For States in Category (4)	
		(1)	(2)	(3)	(4)	Background	Assessment
Iowa	Both				✓	• Quarterly for the first year, semi-annually thereafter • Check first year for. arsenic, barium, cadmium, chromium, lead, mercury, magnesium, zinc, copper, benzene, carbon tetrachloride, 1,2-dichloroethane, trichloroethylene, 1,1,1-trichloroethane, 1,1-dichloroethylene, paradichlorobenzene • After first year for: chloride, field test for specific conductance and pH, ammonia, nitrogen, iron, COD, temperature, and any additional parameters deemed necessary • Check annually for total organic halogen, phenols and any additional parameters deemed necessary by the department	• If a release is detected, additional sampling or a ground-water quality assessment plan may be required by the department
Kansas	Both		✓			.	

State	Facility Type (On-Site/ Off-Site)	Category				Ground-Water Monitoring Requirements For States in Category (4)	
		(1)	(2)	(3)	(4)	Background	Assessment
Kentucky	On-Site	✓					
	Off-Site				✓	• Semi-annually • Quality characterization parameters. chloride, COD, TDS, specific conductance, pH, iron, sodium, arsenic, barium, cadmium, lead, mercury nitrate, selenium, silver, pH, calcium, magnesium, potassium, sulfate, bicarbonate, carbonate • Monitoring parameters: (a) chloride, COD, TDS, TOC, specific conductance, pH, iron, sodium (b) arsenic, barium, cadmium, chromium, lead, mercury, nitrate, selenium • Reduce monitoring to Group (a) parameters if 4 consecutive quarterly monitoring periods show no exceedances	• Assessment plan required if parameters listed at 40 CFR 302 4, Appendix A (October 1988) are detected
Louisiana	Both	✓					
Maine	Both				✓	• Quarterly • Conductivity, temperature, pH, depth to ground water, acidity, iron, TOC, COD and chloride	

State	Facility Type (On-Site/ Off-Site)	Category				Ground-Water Monitoring Requirements For States in Category (4)	
		(1)	(2)	(3)	(4)	Background	Assessment
Maryland	Both				✓	• Frequency not specified • Background parameters: pH, alkalinity, hardness, chloride, specific conductance, nitrate, COD, arsenic, barium, cadmium, chromium, zinc, lead, mercury, volatile priority pollutants and other pollutants specified by the department	• If contamination occurs, department will select assessment frequency and parameters on a case-by-case basis
Massachusetts	Both				✓	• Frequency established in permit - at minimum semi-annually • Indicator parameters: pH, alkalinity, temperature, specific conductance, nitrate nitrogen (as nitrogen), TDS, chloride, iron, manganese, sulfate; Inorganics: arsenic, barium, cadmium, chromium (total & Cr^{+6}), copper, cyanide, lead, mercury, selenium, silver and zinc; all of the organic compounds included in EPA Method 624, as amended, and methyl ethyl ketone, xylenes, methyl isobutyl ketone and acetone; unknown peaks shall be identified; any additional priority pollutants as set forth under 40 CFR Part 141, as amended, or required by the department	• If chemical levels exceed background limits, Department determines assessment actions
Michigan	Both			✓			
Minnesota	Both		✓				
Mississippi	Both	✓					

State	Facility Type (On-Site/ Off-Site)	Category				Ground-Water Monitoring Requirements For States In Category (4)	
		(1)	(2)	(3)	(4)	Background	Assessment
Missouri	Both				✓	• Frequency is quarterly for some parameters and annually for others. • Metals to be monitored are similar to those listed in 40 CFR Part 258, however, no VOCs are identified	• To be determined by the regulatory authority
Montana	Both	✓					
Nebraska	Both				✓	• No references to frequency or parameters	
Nevada	Both			✓			
New Hampshire	Both			✓			

State	Facility Type (On-Site/ Off-Site)	Category				Ground-Water Monitoring Requirements For States in Category (4)	
		(1)	(2)	(3)	(4)	Background	Assessment
New Jersey	On-Site	✓					
	Off-Site				✓	• Monitor annually for background parameters and quarterly for detection parameters • Background parameters· turbidity, color, odor, mercury, arsenic, barium, cadmium, chromium (hexavalent Cr^{+6}), cyanide, fluoride, lead, selenium, silver, ABS/LAS (Alkyl-Benzene-Sulfonate & Linear-Alkyl-Sulfonate) or similar methylene blue reactive substances contained in synthetic detergents, chloride, copper, hardness (as $CaCO_3$), iron, manganese,. nitrogen (including NO_3-N and NH_4-N), phenolic compounds (as phenol), sodium, sulfate, TDS, zinc, COD, BOD, TOC; scan for volatile organics, acid extractables, base neutral extractables, and pesticides/PCBs • Detection parameters chloride, lead, iron, phenol compounds as phenol, TDS, sulfate, COD, BOD, TOC and others added by director based on site and waste characteristics • Sites may be waived from requirements based on site location, operations, geology and ground-water flow	• If background levels are exceeded, operator must develop a monitoring program more comprehensive than background testing

State	Facility Type (On-Site/ Off-Site)	Category				Ground-Water Monitoring Requirements For States In Category (4)	
		(1)	(2)	(3)	(4)	Background	Assessment
New Mexico	On-Site	✓					
	Off-Site				✓	• Monitor quarterly in first year and annually every seventh year for a list of parameters similar to Appendix I 40 CFR Part 258. • Monitor quarterly after first year for iron, manganese, nitrate, chloride, phenols, sulfate, ammonia, pH, conductance, TOC, COD, calcium, TDS, temperature, water elevation, hardness, alkalinity, magnesium, potassium, and sodium.	• May be required if background monitoring indicates that significant contamination has occurred
New York	Both				✓	• At least quarterly: once per year for background parameters, 3 times per year for routine parameters; may be reduced to semi-annually after first year • No parameters specified	• If contamination is detected, expanded parameter analyses are required
North Carolina	Both		✓				
North Dakota	Both		✓				
Ohio	Both				✓	• Regulations not finalized	• Regulations not finalized
Oklahoma	Both				✓	• Quarterly • Background parameters: pH, COD and conductivity	• If parameters are detected, department and operator shall determine additional monitoring requirements
Oregon	On-Site	✓					
	Off-Site		✓				

State	Facility Type (On-Site/ Off-Site)	Category				Ground-Water Monitoring Requirements For States in Category (4)	
		(1)	(2)	(3)	(4)	Background	Assessment
Pennsylvania	Both				✓	• Quarterly • Detection parameters. chloride, sulfate, COD, pH, specific conductance, TOC, total organic halogen, iron and sodium	• If parameters are detected, assessment plan must be prepared by hydrogeology expert; parameters for plan must be submitted to department for approval
Rhode Island	Both			✓			
South Carolina	Both				✓	• No specific mention of frequency or parameters	
South Dakota	Both				✓	• Quarterly • Sampling and analytical techniques must conform with: "Standard Methods for the Examination of Water and Wastewater, 16th ed., 1985," "EPA Methods, Methods for Chemical Analysis of Water and Wastes, 1983," "Techniques of Water Resource Investigation of the U.S. Geological Survey, (1982)," methods for monitoring published in 56 FR 3,578-3,597 (1/30/91) & 56 FR 30,266-30,281 (7/1/91), "National Handbook of Recommended Methods for Water-Data Acquisition, GSA-GS edition," and "Manual of Analytical Methods for the Analysis of Pesticide in Humans and Environmental Samples, 1980"	
Tennessee	On-Site	✓					
	Off-Site		✓				
Texas	Both		✓				

State	Facility Type (On-Site/ Off-Site)	Category				Ground-Water Monitoring Requirements For States In Category (4)	
		(1)	(2)	(3)	(4)	Background	Assessment
Utah	Both	✓					
Vermont	Both	✓					
Virginia	Both				✓	• Frequency. Quarterly for first year, after first year: annually for List 1 and semi-annually for List 2 • Background Parameters: List 1: hardness, sodium, chloride, iron, lead List 2· specific conductance, pH, TOC, TOX	• Assessment program needed in case of a significant in listed parameters • Phase II of program is substantially similar to 40 CFR 258, Appendix I. Phase III of program is substantially similar to 40 CFR 258, Appendix II
Washington	Both	✓					
West Virginia	On-Site	✓					
	Off-Site			✓			
Wisconsin	Both				✓	• Quarterly monitoring • VOC's and metals similar to 40 CFR Part 258	• Determined on a case-by-case basis following review of increase in background parameter by regulatory authority.
Wyoming	Both				✓	• Baseline, routine and detection monitoring will be specified by the department on a case-by-case basis	

ATTACHMENT 4-C. STATE LINER REQUIREMENTS

Twenty-two states require their off-site C&D landfills to include a liner in the landfill's design. In addition, 15 of these states extend these requirements to on-site C&D landfills. The liner requirements for these states fall into three main categories:

(1) **Soil/Clay**. States require a soil/clay liner material to be compacted to a certain depth.

(2) **Composite**. States require a compacted soil/clay liner with a synthetic liner overlaying the earthen material.

(3) **Site-specific**. States allow owner/operators to select a liner material from a list of materials specified in the regulations and approve or disapprove of this selection based on a case-by-case review of the site-specific characteristics.

The exhibit below lists those states requiring liners for off-site landfills and the material required. States that extend these requirements to on-site landfills are highlighted.

Descriptions of States With Site-Specific Requirements:

- **Colorado** requires that the engineer's report and operating report contain they type and quantity of material that the owner/operator proposes to use for the liner.
- **Georgia** requires owner/operator to submit proposed liner from those specified in the State's "Municipal Solid Waste Landfill Liner Design System Criteria, September 1991."
- **Michigan** requires C&D landfills to contain either a liner or a natural soil barrier. Liners can consist of: 1) compacted soil, 2) a composite design, 3) a flexible membrane at least 30 mils thick, or 4) other materials which possess demonstrated durability, permeability and resistance to sunlight and chemicals. Natural soil barriers must fulfill requirements for thickness and hydraulic conductivity which serve to impede the flow of leachate out of the fill interior. The choice of liner design appears to be at the discretion of the owner/operator.
- **New Hampshire** allows landfills accepting only C&D debris to use single liners. In landfills where waste characteristics cannot be determined (or where the waste poses a risk to ground water) double liners may be required. Allowable liners either consist of recompacted soil or a geomembrane at least 60 mils thick.
- **South Carolina's** regulations do not specify the type or quantity of liner.
- **South Dakota** requires either soil liners or flexible membrane liners with a thickness of 30 mils. Liner configuration and components are determined on a case-by-case basis.
- **Virginia** C&D landfill liners may be made of: 1) compacted clay, 2) a flexible membrane at least 30 mils thick, or 3) other clay/soils with similar thickness and hydraulic conductivity required for clay liners. Owners/operators seem to be able to choose which type of liner they wish to install.

STATE LINER REQUIREMENTS FOR C&D LANDFILLS				
Soil/Clay		Composite		Site-Specific
State	Maximum Hydraulic Conductivity	State	Maximum Hydraulic Conductivity	
Indiana	1×10^{-6}	Massachusetts	not specified	Colorado
Iowa	1×10^{-7}	Nevada	1×10^{-7}	Georgia
Kentucky	1×10^{-7}	New York	1×10^{-7}	Michigan
Louisiana	not specified	Oregon	1×10^{-6}	New Hampshire
New Jersey (*)	1×10^{-7}	Rhode Island	not specified	South Carolina
Oklahoma	1×10^{-5}			South Dakota
Tennessee	1×10^{-5}			Virginia
Texas (**)	1×10^{-7}			
West Virginia	1×10^{-6}			
Wisconsin	1×10^{-7}			
10 States Total		5 States Total		7 States Total

* If New Jersey C&D landfills are located in unstable area, then liners must be double composite with a geomembrane liner in contact with a clay/admixture liner below it.

** Composite liners with a flexible membrane are required for C&D waste disposal in trenches, excavation areas and other unprotected sites.

ATTACHMENT 4-D. CLASSIFICATION OF STATE WASTE RESTRICTIONS

State	Facility Type (On-Site/ Off-Site)	All Hazardous Waste Prohibited	Regulations Don't Specifically Prohibit All Hazardous Waste	Only Inert Waste Can Be Disposed	Only C&D Waste Can Be Disposed	No Waste Restrictions Identified
Alabama	Both		✓			
Alaska	Both					✓
Arizona	Both					✓
Arkansas	Both		✓			
California	Both	✓				
Colorado	On-Site					✓
	Off-Site	✓				
Connecticut	Both	✓				
Delaware	Both		✓			
Florida	Both	✓				
Georgia	Both	✓				
Hawaii	On-Site					✓
	Off-Site		✓			
Idaho	Both					✓
Illinois	On-Site			✓		
	Off-Site					✓
Indiana	Both				✓	
Iowa	Both	✓				
Kansas	Both	✓				
Kentucky	On-Site		✓			
	Off-Site	✓				

State	Facility Type (On-Site/ Off-Site)	All Hazardous Waste Prohibited	Regulations Don't Specifically Prohibit All Hazardous Waste	Only Inert Waste Can Be Disposed	Only C&D Waste Can Be Disposed	No Waste Restrictions Identified
Louisiana	On-Site					✓
	Off-Site	✓				
Maine	Both	✓				
Maryland	Both		✓			
Massachusetts	Both	✓				
Michigan	Both	✓				
Minnesota	Both	✓				
Mississippi	On-Site					✓
	Off-Site		✓			
Missouri	Both				✓	
Montana	Both			✓		
Nebraska	Both		✓			
Nevada	Both	✓				
New Hampshire	Both		✓			
New Jersey	On-Site			✓		
	Off-Site	✓				
New Mexico	On-Site					✓
	Off-Site	✓				
New York	Both				✓	
North Carolina	Both	✓				
North Dakota	Both	✓				
Ohio	Both	✓				

State	Facility Type (On-Site/ Off-Site)	All Hazardous Waste Prohibited	Regulations Don't Specifically Prohibit All Hazardous Waste	Only Inert Waste Can Be Disposed	Only C&D Waste Can Be Disposed	No Waste Restrictions Identified
Oklahoma	Both		✓			
Oregon	On-Site					✓
	Off-Site	✓				
Pennsylvania	Both	✓				
Rhode Island	Both		✓			
South Carolina	Both					✓
South Dakota	Both		✓			
Tennessee	On-Site					✓
	Off-Site	✓				
Texas	Both		✓			
Utah	On-Site					✓
	Off-Site	✓				
Vermont	Both					✓
Virginia	Both				✓	
Washington	Both			✓		
West Virginia	Both		✓			
Wisconsin	Both		✓			
Wyoming	Both	✓				