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Chapter 1. Introduction

The primary federal statutes that govern hazardous waste management in the United States are the Resource Conservation and Recovery Act (RCRA) of 1976, and the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) of 1980. CERCLA addressed the cleanup of inactive and abandoned hazardous waste sites. RCRA established rules that affect how hazardous waste is managed by generators, and set standards for treatment, storage, and disposal facilities (TSDFs). RCRA was amended in 1978, 1980, 1986, and by the Hazardous and Solid Waste Amendments (HSWA) of 1984.

A major change in the 1984 Resource Conservation and Recovery Act (RCRA) concerned the disposal of certain hazardous wastes on land because it was felt by many that there had been a bias toward land disposal in past hazardous waste programs. RCRA was amended by HSWA in part to prohibit land disposal of hazardous wastes unless the EPA Administrator (the Administrator) determined that the prohibition of one or more methods of land disposal of such wastes is not required in order to protect human health and the environment for as long as the waste remains hazardous. The portion of the amendments that prohibits untreated land disposal of many wastes is referred to as the Land Disposal Restrictions. The main goal of Congress in promulgating these restrictions was to require the EPA (also referred to as the Agency) to ban all untreated hazardous wastes from land disposal unless it can be demonstrated that the land disposal method will meet certain restrictive conditions.[1]

In the Land Disposal Restrictions, Congress laid out a specific timetable for the EPA to promulgate regulatory requirements for land disposal. In addition to establishing these deadlines, the 1984 amendments spelled out specific regulations that would automatically take effect unless EPA devised its own regulations by the required

deadlines. Unless EPA acted to establish conditions under which certain wastes could be disposed of in landfills, these wastes would automatically be banned permanently from such sites.

The authors of the 1984 amendments to RCRA hoped that waste generators would change production technologies and otherwise minimize the generation of hazardous wastes. However, some wastes will still be generated and these wastes will need to be handled by a mixture of waste management techniques.[1]

It is believed that the demand for incineration will increase in the coming years due to the implementation of HSWA, generators' increasing concerns with long-term liability, increased Superfund clean-up activities, and declining landfill capacity.[1,2]

The question of how to manage North Carolina's hazardous waste has been a topic of great interest and debate in the past few years. An indicator of the interest and concern was the creation of the Hazardous Waste Management Commission by the North Carolina General Assembly in 1989. The main functions of the Commission, as set forth by the Assembly, were to make periodic reviews of current and projected hazardous waste generation in the State, review the current and projected availability and adequacy of facilities for the management of hazardous waste within and outside the State, and to determine whether additional facilities for the management of hazardous waste may be needed.

This report presents an in-depth summary of the Land Disposal Restrictions, and an analysis of nonwastewater hazardous waste generation and off-site disposal methods in North Carolina. The purpose was to analyze the impact that the Land Disposal Restrictions would have on the need for incineration capacity, if any, for the State. It is important to realize that hazardous waste generation and management , both in the State and in the nation, are in a constant state of flux, and are subject to variables in reporting and in State and Federal regulations and policies. This report was based on the most recent information avai;able, which was 1990.

The next two chapters provide background material describing the details of the Land Disposal Restrictions. The intent was to present the regulations in a condensed and more easily understood format than the codified version. It is hoped that this summary will assist groups, such as the Commission or committees of the North Carolina General Assembly, who need a version of the regulation that can be easily understood. Chapter 4 briefly discusses incineration as a technology and as a treatment option. Chapter 5 presents an analysis of the generation and off-site management of wastes in North Carolina during 1990 as provided by the Hazardous Waste Section, and an analysis examining the potential impact of the Land Disposal Restrictions on the future of waste management in the State. The focus is on the potential need for greater incineration or fuel substitution capacity. The final chapter presents conclusions and recommendations based on this research. There are also six appendices. Appendix A presents details of the methodology used to calculate the effects of the Land Disposal Restrictions on North Carolina's need for greater incineration capacity. Appendices B-E present detailed accounts of the hazardous waste codes that were used in the analysis presented in Chapter 5, and appendix F lists the wastes that were regulated by the Land Disposal Restrictions for which incineration was either a required treatment technology, or the concentration-based standard was based on incineration, but were not generated in North Carolina in 1990.

Chapter 2. Land Disposal Restrictions

The Hazardous and Solid Waste Amendments (HSWA) of RCRA, enacted on November 8, 1984, contain regulations that prohibit the land disposal of many categories of hazardous wastes. The amendments specify dates when specific categories of hazardous wastes are prohibited from land disposal unless "it has been demonstrated to the Administrator, to a reasonable degree of certainty, that there will be no migration of hazardous constituents from the disposal unit or injection zone for as long as the wastes remain hazardous" [RCRA sections 3004(d)(1)]. Congress established a separate schedule for restricting the disposal by underground injection of solvent and dioxin containing wastes, wastes referred to as "California list" hazardous waste, and soil and debris resulting from CERCLA section 104 and 106 response actions and RCRA corrective actions, when the soil and debris contains listed spent solvent and dioxin hazardous wastes.

The amendments also required EPA to set "levels or methods of treatment, if any, which substantially diminish the toxicity of the waste or substantially reduce the likelihood of migration of hazardous constituents from the waste so that short term and long-term threats to human health and the environment are minimized" [RCRA section 3004(m)(1)][3] Wastes that meet the treatment standards established by EPA are not prohibited and may be land disposed.

Hazardous wastes land disposed after the applicable effective dates are subject to restrictions, but wastes land disposed prior to the effective dates are not required to be removed or exhumed for treatment. However, if wastes or contaminated media are excavated and removed due to cleanup activities, the wastes generated from these activities are subject to the Land Disposal Restrictions.[3]

The provisions of the Land Disposal Restrictions apply to hazardous wastes produced by generators of greater than 2200 pounds of waste or greater than 2.2 lbs of acutely hazardous wastes per month (large quantity generators), as well as small generators who generate 220 to 2200 lbs of waste or greater than 2.2 lbs of acutely hazardous waste per month. The Land Disposal Restrictions apply to all facilities subject to RCRA, including both interim-status and permitted facilities.

DEFINITIONS[3]

The following definitions are applicable to the Land Disposal Restrictions.

Hazardous Waste as defined by RCRA is "garbage, refuse, sludge or any other waste material". The waste may be a solid, semi-solid, a liquid, or a containerized gas. No matter what its form, to be considered hazardous, a waste must "because of its quantity, concentration, or physical, chemical, or infectious characteristics, cause, or significantly contribute to, an increase in mortality...or illness; or pose a substantial present or potential hazard to human health and the environment when improperly treated, stored, transported, or disposed of, or otherwise managed".

RCRA regulations identify hazardous wastes based on their characteristics and also provide a list of specific hazardous wastes (listed wastes). A waste is hazardous if it exhibits one or more of the following characteristics: ignitability, corrosivity, reactivity, or toxicity.

Corrosivity : Corrosive wastes include those that are acidic and those that are capable of corroding metal.

Ignitability : Ignitable wastes are those that can create fires under certain conditions. Examples include solvents and fuels.

Reactivity : Reactive wastes are unstable under normal conditions. They can create explosions and/or toxic fumes, gases, and vapors when mixed with water.

Toxicity : Toxic wastes are harmful or fatal when ingested or absorbed.

"D" Wastes are RCRA listed wastes that are considered hazardous because they exhibit one of the four characteristics of ignitability, corrosivity, reactivity, or toxicity.

"F" Wastes are RCRA listed wastes from common manufacturing and industrial processes (e.g. solvents from degreasing operations).

"K" Wastes are RCRA listed wastes that are generated by specific industries such as dry cleaning or wood preserving.

"P" and "U" Wastes are hazardous wastes that are specific commercial chemical products such as benzene or some pesticides. The difference between the two being that P wastes are acutely hazardous.

Land Disposal means placement in or on land and includes but is not limited to placement in a landfill, surface impoundment, waste pile, injection well, land treatment facility, salt dome formation, salt bed formation, underground mine or cave or placement in a concrete vault or bunker intended for disposal purposes.

Listed Wastes are hazardous wastes identified by EPA waste codes that are organized into lists published by EPA in RCRA. These listed wastes are organized into three categories: source specific wastes, generic wastes, and common chemical products.

SCHEDULED WASTES[3]

The 1984 HSWA amendments directed EPA to establish treatment standards for each of seven groups of RCRA hazardous wastes by specific dates according to a schedule set by Congress. The schedule, based on a ranking of the listed wastes that considers their inherent hazard and their volume, is to ensure that prohibitions and treatment standards are promulgated first for high-volume hazardous wastes with high intrinsic hazard before standards are set for low-volume wastes with low inherent hazard. These groups and their scheduled dates are presented in Table 2-1. There are three categories of scheduled wastes referred to as the First, Second, and Third Thirds,

which include all listed and characteristic hazardous wastes identified as of November 8, 1984. EPA ranked the scheduled wastes based on their toxicity and volume and placed the highest toxicity/volume wastes in the "First Third". The statutory deadlines are important because they are the dates on which RCRA wastes become "restricted" , although EPA has the authority to restrict a waste before its statutory deadline. Once a waste is restricted, it can not be land disposed without meeting the applicable treatment standards.

Table 2-1 Land Disposal Restriction Statutory Deadlines

WASTE	STATUTORY DEADLINE
Spent Solvent and Dioxin-Containing Waste	November 8, 1986
California List Wastes	July 8, 1987
First Third Wastes	August 8, 1988
Spent Solvent, Dioxin-Containing, and California List Soil and Debris From CERCLA/RCRA Corrective Actions	November 8, 1988
Second Third Wastes	June 8, 1989
Third Third Wastes	May 8, 1990
Newly Identified Wastes	Within 6 months of identification as a hazardous waste

SOFT HAMMER RESTRICTIONS[3]

If the EPA failed to set specific treatment standards for First or Second Third wastes by their specified statutory deadlines, the wastes became restricted under the "soft hammer" provisions until EPA set a treatment standard for them, or until May 8, 1990, when the "hard hammer" provisions were to go into effect.

The Land Disposal Restrictions' soft hammer provisions prohibit the disposal of wastes in surface impoundments or landfill units unless: 1) the receiving unit meets the RCRA minimum technology requirements (i.e., two or more liners, a leachate collection system, and a ground-water monitoring system); and 2) waste

generators certify that they have made good-faith effort to locate and to contract with treatment and recovery facilities for treatment that is "practically available". If there is no "practically available" treatment, the soft hammer wastes may be disposed of without treatment in units meeting the requirements listed in (1) above.

The Agency identified several treatment technologies that are generally considered appropriate for nonwastewater forms of "soft-hammered" wastes. These technologies include metal recovery, leaching/oxidation, metals stabilization, ash stabilization, chemical oxidation, biodegradation, incineration, and PCB incineration. The technologies identified are general categories of technologies that are reasonably applicable to the waste codes listed. The categories are not specific as to a particular type of technology (e.g. incineration can represent rotary kiln, or fluidized bed or other types of incinerators). The actual choice of technologies depends on the physical and chemical characteristics of the specific waste.

Tables were presented by EPA in the Federal Register to aid a generator seeking an appropriate technology to treat "soft-hammer" F and K listed wastes for each waste code. The technologies are listed in descending order of preference. The Agency emphasized that these tables are not to be seen as a strict requirement, but are soley provided to aid the generator.

TREATMENT STANDARDS[3]

The EPA established treatment standards under the Land Disposal Restrictions on the basis of the "best demonstrated available technology" (BDAT) rather than risk- or health-based standards. "Best" is defined as that technology which offers the greatest reduction of toxicity, mobility, or volume of the waste. To be "demonstrated", a treatment technology must be demonstrated to work at a full scale level. To be "available", a treatment technology must be commercially available.

Development of Treatment Standards

The agency used individual listed waste codes as the starting point for developing the waste treatability groups. Where EPA believed that the wastes represented by different codes could be treated to a similar concentration by identical techniques, the Agency combined the codes into one treatability group. EPA based its initial treatability group decisions primarily on whether the waste codes were generated by the same or by similar industries from similar processes. Such groupings were made because of the likelihood that the waste characteristics that affect treatment performance would be similar for these different waste codes.

The following is a summary of some of the principal elements of the BDAT methodology. EPA first determined which technologies had been "demonstrated" for a particular treatability group, and EPA then screened the available treatment data for a particular treatability group with regard to the design and operation of the system, the quality assurance/quality control analyses of the data, and the analytical tests used to assess treatment performance. After the initial screening test, EPA adjusted all treated data values based on the analytical recovery obtained, in order to take into account analytical interferences associated with the chemical makeup of the treated samples. After adjusting the data, EPA then averaged the performance levels achieved for the various treatment operations and compared the mean values using the analysis of variance test to determine if one technology performed significantly better. If this technology was also determined to be available, then that technology was selected as the Best Demonstrated Available Technology, or BDAT.

Transfer of Treatment Standards

Some treatment standards are not based on the testing of the treatment technology on the specific waste subject to the treatment standard. Instead, the Agency

determined that the constituent(s) present in the waste could be treated to the same performance levels as observed in other wastes for which EPA had previously developed treatment data.

Types of Treatment Standards

Three types of treatment standards were promulgated in the Land Disposal Restrictions: concentration levels in the waste that must be attained before the waste may be land disposed; concentration levels in the waste extract that must be attained before land disposal; and specified technologies which must be applied to the waste before the residuals may be land disposed.

To establish a concentration level(s) for a specific waste code the Agency selected a subset of the hazardous constituents found in the waste (known as the "BDAT constituents") and set treatment standards for each of these constituents. The waste may contain other hazardous constituents but only the treatment standards for the "BDAT constituents" must be met for the wastes to be land disposed.

Compliance with performance standards may be monitored by measuring the concentration level of the hazardous constituents (or in some circumstances indicator pollutants) in the waste, in the treatment residual or in the extract of the waste or treatment residual. There are two types of tests for evaluating compliance with the promulgated treatment standards: the Total Waste Analysis (TWA) which measures the total concentration levels of the hazardous constituents in the waste or treatment residuals; and the Toxicity Characteristic Leaching Procedure (TCLP) which measures concentration levels in the waste extract as a result of the TCLP test. The TCLP test is designed to identify wastes likely to leach hazardous constituents into groundwater if improperly managed.

When treatment standards are set as performance levels, the regulated community may use any technology not otherwise prohibited (such as impermissible

dilution) to treat the waste to meet the treatment standards. The regulations do not require application of BDAT, so long as a concentration level which reflects the performance achieved by BDAT is met prior to land disposal. The technologies identified in the text of the Federal Register as BDAT are only those technologies that the EPA utilized to develop the waste specific concentration based performance standards: the waste need not be treated by that specific technology. Any treatment including recycling or any combination of treatment technologies, unless specifically prohibited, may be used to achieve these concentration based standards as long as that technology is not defined as land disposal. The only requirement is that the concentration levels must be achieved prior to land disposal. Thus treatment is not limited to only those technologies considered in determining the treatment standards. However, when treatment standards are expressed as a specific technology, that technology must be employed before the waste may be land disposed.

In situations where the wastes subject to concentration-based standards are mixed with wastes subject to treatment standards for which there is a specified technology, the mixture would have to be treated by the specified BDAT method and would have to meet the concentration-based standards for any other prohibited constituents that are contained in the matrix.

Where treatment performance data are available, the Agency prefers to set concentration based standards rather than specify a method of treatment as the BDAT treatment standard. EPA prefers concentration based standards due to the greater flexibility in choosing a technology to achieve the standard and to the greater control afforded in ensuring efficient design and operation of the chosen technology. However, in the absence of analytical methods, the Agency believes that the logical alternative is to establish a method of treatment as the BDAT treatment standard.

"DERIVED FROM" WASTES

BDAT standard operations usually generate additional residues. The Agency emphasized that all residues from treating the original wastes are considered to be the treated waste by virtue of the "derived from" rule (40 CFR 261.3(c)(2). So all wastes that are generated in the course of treatment are prohibited from land disposal unless they comply with the treatment standard or are otherwise exempted through a no-migration petition or by a capacity variance, which are discussed below.

EXCEPTIONS FROM REGULATIONS

There are some circumstances where a prohibited waste may continue to be land disposed. A generator or TSD facility may petition for an extension of the effective date of a prohibition or they may petition for, and be granted, an exemption if they can prove that their particular waste stream or treatment method is different from the general example.

Wastes that are hazardous only because they exhibit a hazardous characteristic, and which are otherwise prohibited from land disposal, are not prohibited from land disposal if the wastes a) are disposed into a nonhazardous or hazardous injection well and b) do not exhibit a prohibited characteristic of hazardous wastes at the point of injection.

The following hazardous wastes are not subject to any provision of part 268: a) wastes generated by small quantity generators of <220 lbs of non-acute hazardous waste or <2.2 lbs of acute hazardous waste per month; b) waste pesticides that a farmer disposes of pursuant to section 262.7; and c) wastes identified or listed as hazardous after November 8, 1984, for which EPA has not promulgated land disposal prohibitions or treatment standards (also referred to as newly listed wastes).

Dilution Prohibition

No generator, transporter, handler, owner or operator of a treatment, storage, and disposal facility shall in any way dilute a restricted waste, or the residual from the treatment of a restricted waste, as a substitute for adequate treatment to achieve compliance with the treatment standards of the Land Disposal Restrictions.

Related to this, a facility is not allowed to dilute or perform partial treatment on a waste in order to switch the applicability of a nonwastewater standard to a wastewater standard or vice versa.

Surface Impoundment Treatment Exemption

The Land Disposal restrictions allow treatment of hazardous wastes in surface impoundments that meet minimum technology requirements. Treatment is permissible as long as the residues that do not meet the treatment standard(s), or applicable statutory prohibition levels where no treatment standards have been established, are "removed for subsequent management within one year of the entry of the waste into the surface impoundment" (section 268.4 of 40 CFR 268).

NATIONAL CAPACITY VARIANCE

The Agency has the authority to grant a National Capacity Variance from statutory effective dates for individual wastes, or groups of wastes, not to exceed two years, if there is insufficient alternative protective treatment, recovery, or disposal capacity for the wastes. To make capacity determinations, EPA compares the nationally available alternative treatment, recovery or disposal capacity at permitted and interim status facilities which will be in operation by the effective date, with the quantity of restricted waste generated. If there is a significant shortage of such capacity nationwide, EPA will establish an alternative effective date based on the earliest date

such capacity will be available. During the period in which capacity variance is in place, if waste is to be disposed in a landfill or surface impoundment, such disposal may only be in a unit meeting the minimum technology requirements stated in RCRA 3004(o).

Chapter 3. Summary of Specifics of Land Disposal Restriction

SOLVENT/DIOXIN AND CALIFORNIA LIST WASTES

On November 7, 1986, EPA promulgated the first series of the Land Disposal Restrictions which addressed solvent and dioxin bearing wastes. The Agency, after developing that rule, concluded that insufficient capacity was available nationwide to treat dioxin and solvent containing soil and debris, and for wastewaters contaminated with solvents. A two year extension of the effective date was granted until November 8, 1988.[2]

On July 8, 1987, the EPA published the second series of Land Disposal Restrictions that addressed the waste known as "California list" wastes. These regulations prohibited the disposal of certain liquid hazardous wastes containing metals, free cyanides and PCBs, low pH wastes, and liquid and non-liquid hazardous wastes containing halogenated organic compounds (HOC) above specified levels. A two year extension of the effective date of the prohibitions was granted for certain wastes containing HOC due to a perceived lack of incinerator capacity for these wastes, but this variance was rescinded November 8, 1988.[2]

FIRST THIRD FINAL RULE

The final rule of the Land Disposal Restrictions for First Third Scheduled Waste (Federal Register August 17, 1988) established treatment standards for wastes listed in 40 CFR 268.10 except for the P and U listed wastes. All treatment standards in this rule were expressed as concentration levels for the waste constituents. This final rule also clarified the relationship of California list wastes to the First Third wastes, as well as clarifying the applicability of the treatment standards to "derived from" wastes and waste mixtures. The treatment standards set forth in the First Third rule were not

applicable to First Third wastes that are disposed by deep-well injection: these wastes were dealt with in a later ruling.

The effective dates of the First Third Final rule were established based on the Agency's determination of whether sufficient national protective treatment (or recovery) capability was available to treat the restricted wastes. The effective date of this final rule was August 17, 1988.

Development of Treatment Standards

The treatment standards for the First Third wastes were developed by establishing treatability groups. Once these treatability groups were established, appropriate treatment standards were developed for each treatability group. These treatment standards established allowable concentrations, presented constituent-by-constituent, for wastewaters and non-wastewaters. The treatment standards apply to first generation wastes as well as all residual wastes resulting from the treatment of the original prohibited waste.

Identification of BDAT and Treatment Standards

EPA identified BDATs for the First Third wastes according to their standard procedure discussed in the previous chapter. The performance achieved by the BDATs was then used to establish the specific treatment standards which, in the First Third regulations, with the exception of treatment standards that prohibit land disposal, were expressed as concentration levels either in the waste or in an extract of the waste.

The treatment standards reflect the performance achieved by the BDAT. Compliance with the treatment standards required that the treatment level be reached before the waste could be land disposed. In the rule, specific technologies were identified as the ones on which the Agency based the BDAT. These technologies were simply existing technologies which EPA felt would meet the waste-specific

performance standards. The rule did not require that these methods be used for compliance.

Waste Analysis Requirements

In the rule, the EPA used both the Total Waste Analysis (TWA) and the Toxic Characteristic Leaching Procedure or TCLP analysis of the treated waste as measures of technology performance. Where the Agency had used treatment standards based on removal/recovery or destruction, whether metals or organics, the treatment standards were based on a TWA. Where treatment standards for metals were based on stabilization, EPA used TCLP as the measure of treatment technology performance. For wastes where treatment standards were based on sequential treatment procedures, due to the presence of metals and organics, the waste must meet both TWA concentrations for organics, and TCLP concentrations for metals prior to land disposal.

Soft Hammered First Third Wastes

In the final rule for the First Third Wastes, EPA did not set treatment standards for all of the wastes covered by the statutory requirements. EPA thus "soft-hammered" these wastes. In the rule EPA identified certain treatment technologies that it considered appropriate for the wastes, and that would have a reasonable probability of application to the waste codes listed.. These technologies included metal recovery, leaching/oxidation, metals stabilization, ash stabilization, chemical oxidation, cyanide destruction, biodegradation, incineration, and open detonation/open burning. Tables were presented to aid generators seeking appropriate technologies to treat "soft-hammer" F- and K-listed wastes. The Agency emphasized that these tables were not to be considered as strict treatment guidelines, but rather as an aid to generators in determining the best practical available technology.

In this final rule, the Agency also clarified the relationship of "soft-hammer" provisions to wastes on the California list. During the period in which the "soft-hammer" provisions were in effect, those wastes which were subject to the California list requirements would remain so, and thus might be prohibited from land disposal even though they are "soft-hammer" wastes. So for soft-hammer wastes that were subject to the applicable California list, the "soft-hammer" did not apply. The California list became effective November 8, 1988 , and the wastes in question were considered "soft-hammered" until that date.

Determination of Alternative Capacity for First Third, F001-F005 Spent Solvent and California List Wastes

EPA developed a new data base for treatment capacity that was comprised of information received from responses to the National Survey of Hazardous Waste Treatment, Storage, Disposal, and Recycling Facilities (the TSDR survey). EPA conducted the survey of commercial treatment, storage and disposal facilities (TSDFs) in 1987 and early 1988 to obtain comprehensive data on hazardous waste management capacity and on the volumes of waste being land disposed.

The capacity analyses for the First Third wastes for which EPA promulgated treatment standards were performed using TSDR survey data. EPA estimated the total quantity of the First Third wastes that were land disposed annually and would now have to have alternative treatment, based on the volumes presented in the TSDR survey. The results are shown in Table 3-1.

TABLE 3-1. TOTAL VOLUME OF LAND DISPOSED FIRST THIRD WASTES

[Million gallons/year]

Storage:		
Waste Piles	49	
Surface impoundments	6	
Treatment:		
Waste Piles	29	
Surface impoundments	328	
Disposal:		
Waste piles	302	
Land treatment	76	
Surface impoundments	71	
Total		861

(Federal Register August 17, 1988)

About 71 Million Gallons (MG) of First Third wastes were disposed of in surface impoundments annually and would require alternative treatment technologies. Six million gallons were stored and were eventually treated, recycled, or disposed of in other units. There were approximately 328 MG treated in surface impoundments that did not meet the minimum technology requirements, or were residuals that had been removed from those surface impoundments that did not meet the requirements.

Tables 3-2 and 3-3 subdivide the total amount of land disposed First Third wastes into two categories: wastes for which treatment standards were promulgated in this rule, and wastes for which treatment standards were not promulgated in this rule, but were "soft-hammered".

TABLE 3-2. VOLUME OF LAND DISPOSED FIRST THIRD WASTES FOR WHICH STANDARDS WERE PROMULGATED
[Million gallons/year]

Storage:	
Waste Piles	41
Surface impoundments	4
Treatment:	
Waste Piles	27
Surface impoundments	320
Disposal:	
Waste piles	274
Land treatment	76
Surface impoundments	70
Total	812

(Federal Register August 17, 1988)

TABLE 3-3. VOLUME OF LAND DISPOSED FIRST THIRD WASTES FOR WHICH STANDARDS WERE NOT PROMULGATED
[Million gallons/year]

Storage:	
Waste Piles	8
Surface impoundments	2
Treatment:	
Waste Piles	2
Surface impoundments	7
Disposal:	
Waste piles	22
Land treatment	<1
Surface impoundments	1
Total	43

(Federal Register August 17, 1988)

The Agency assessed the requirements for alternative treatment capacity resulting from the promulgation of the rule and estimated that the First Third rule alone could affect about 812 million gallons of First Third wastes annually. Of this total about 767 million gallons would require treatment with the remainder being stored.

Capacity Currently Available

Table 3-4 outlines the available capacity (based on the TSDR survey) of specific technologies that could be used as alternative treatments for the previously land disposed First Third Wastes, as well as what the estimates are for the capacity that will be needed.

TABLE 3-4. ALTERNATIVE COMMERCIAL TREATMENT/RECYCLING CAPACITY FOR FIRST THIRD WASTES
[Million gallons/Year]

Technology	Available	Required
Incineration:		
Liquids	274	<1
Solid/Sludge	7	6-160[1]
Solvent Extraction	1	0-154[1]
Stabilization	495	231
High Temperature Metals:		
Recovery	34	62
Wastewater Treatment:		
Chromium reduction, chemical precipitation, settling/filtration	260	40
Carbon adsorption, chromium reduction, chemical precipitation, settling/ filtration	12	1
Sludge Treatment:		
Acid leaching, chemical oxidation, sludge dewatering	0	4

[1]Both incineration and solvent extraction are alternative technologies suggested for K048-K052 wastes. Thus the capacity needed is indicated as a range.

(Federal Register August 17, 1988)

National Capacity Variances

In the First Third final rule the Agency granted a national capacity variance for certain contaminated soils for which the selected BDAT was based on solids incineration. The amount of waste impacted was only a partial estimate based on the amounts disposed in RCRA facilities in 1986. It was estimated that 26 MG/yr of soil contaminated with solvents, or dioxin contaminated soil, 4 MG/yr of California list contaminated soil, and 12 MG/yr of soil contaminated with proposed First Third

wastes, would be affected. The variance extended the deadline for landfilling these wastes until August 8, 1990.

SECOND THIRD FINAL RULE[5]

The final rule of the Second Third wastes established treatment standards for wastes listed in 40 CFR 268.11. In this rule, the Agency set treatment standards and effective dates for some of the Second Third wastes. Second Third wastes for which EPA did not establish treatment standards or effective dates are subject to the "soft-hammer" provisions which allow land disposal until May 8, 1990, or until treatment standards are promulgated, whichever is sooner.

The Agency also promulgated treatment standards for certain First Third wastes that had been subject to "soft-hammer" provisions, as well as certain Third Third wastes that became effective upon promulgation. The Third Third wastes included in this final rule were moved up in the schedule because of the similarity of the Third Third wastes to First or Second Third waste treatability groups for which treatment standards were being set.

The effective dates of the waste listed in the Second Third final rule were established based on the Agency's determination of whether sufficient protective treatment capability was available to treat the restricted wastes. The effective date of this final rule was June 8, 1989.

Development of Treatment Standards

The treatment standards for the Second Third wastes were developed in the same manner as the First Third wastes discussed earlier. Most of the treatment standards promulgated in the Second Third final rule are expressed as numerical concentration levels, but some are expressed as technology-based standards, and a few are expressed as "No Land Disposal Based on No Generation".

Identification of BDAT and Treatment Standards

EPA identified Best Demonstrated Available Technologies (BDATs) for the Second Third wastes according to their standard procedure discussed in the section on First Third wastes. All of the treatment standards expressed as concentrations of specific constituents in the waste reflected the performances achieved by the BDAT. Compliance with these standards require only that these concentrations are achieved prior to land disposal of the wastes. The technologies identified as BDAT in the Federal Register were simply those that EPA utilized to develop the waste specific concentration-based performance standards. Any treatment can be utilized to achieve these concentration-based standards unless it is prohibited, such as dilution or land disposal.

In situations where wastes subject to concentration-based standards are mixed with wastes subject to treatment standards that are specified technologies, the mixture would have to be treated by the specified BDAT method, and would have to meet the concentration-based standards for any other prohibited wastes that are contained in the matrix.

Waste Analysis Requirements

The waste analysis requirements for the Second Third Wastes are the same as those for the First Third wastes. Where BDAT is a destruction or removal technology, a total waste analysis (TWA) is required. Where BDAT is identified as an immobilization technology, such as stabilization, analysis of a TCLP waste extract is required. In cases where both types of technology are identified as BDAT, as is the case in treatment chains, both types of analysis are required.

Capacity Determination and Required Alternative Capacity

The capacity analyses for the wastes finalized in the Second Third final rule were performed using the 1987 TSDR survey discussed in the previous section, as was the case for the wastes under the First Third final rule. The TSDR survey indicated that about 623 million gallons of wastes for which standards were finalized in this rule were disposed of in or on the land in 1986. Table 3-5 indicates the volumes of wastes, found in the survey, which were being land disposed.

TABLE 3-5. VOLUME OF WASTES BY LAND DISPOSAL METHOD FOR WHICH STANDARDS ARE BEING ESTABLISHED
[Million gallons/year]

Storage:	
Waste Piles	1
Surface impoundments	3
Treatment:	
Waste Piles	5
Surface impoundments	<1
Disposal:	
Waste piles	10
Land treatment	<1
Surface impoundments	<1
Injected underground	604
Total	623

(Federal Register June 23, 1989)

EPA also assessed the requirements for alternative treatment capacity resulting from the Second Third final rule for surface land disposed wastes. Based on these assessments, EPA determined that about 619 of the 623 million gallons of waste affected by this rule would need alternative treatment capacity. Of this total, 15 million gallons were surface disposed and the remaining 604 million gallons were injected underground.

Table 3-6 presents an estimate of the volume of wastes that would require alternative treatment before land disposal to comply with the Second Third rule. The capacity that was available at commercial facilities at the time of the survey is also

presented. Available capacity is equal to the specific treatment system's maximum capacity less the amount used in 1986. In addition, the available capacity was adjusted to account for wastes previously restricted from land disposal.

TABLE 3-6. -- REQUIRED ALTERNATIVE COMMERCIAL TREATMENT/RECYCLING CAPACITY FOR SURFACE LAND DISPOSED WASTES
[Million gallons/year]

Technology	Available	Required
Incineration:		
Liquids	282	<1
Solid/Sludge	17	9
Wastewater Treatment:		
Alkaline chlorination	33	2
Electrolytic oxidation followed by alkaline chlorination	0	0
Carbon adsorption	2	0
Biological treatment	44	<1
Steam stripping followed by biological treatment	0	0
Stabilization	516	2

(Federal Register June 23, 1989)

Nationwide Extensions of the Effective Date

The effective date of the Second Third regulations was June 8, 1989, however due to lack of sufficient alternative capacity, EPA granted a national capacity extension for soil and debris contaminated with certain wastes covered by the final rule. A two-year extension until June 8, 1991 was granted for soil and debris contaminated with First, Second, or Third Third wastes for which the treatment standard was based on the performance of incineration.

A month long extension was granted for implementation of F006, F007, F008, and F009 waste (nonwastewater) standards to provide any time needed for generators to fine tune or adjust existing treatment systems, or to enter into contracts with commercial treaters. The BDAT for these wastes was based on the performance of

alkaline chlorination, followed by precipitation, settling, filtration, and stabilization of metals. The metal standards for the F006 waste had been established as part of the First Third rule.

THIRD THIRD FINAL RULE[6]

The final rule of the Land Disposal Regulations for Third Third scheduled wastes (Federal Register June 1, 1990) established specific treatment standards and effective dates for wastes listed in 40 CFR 268.12. Fully effective in May 1992, this rule is expected to require treatment of a total of 7 million tons of hazardous waste managed in RCRA regulated facilities. The Third Third standards established treatment standards for the characteristic wastes in one of four forms:

1) a concentration level equal to or greater than the characteristic level
2) a concentration level less than the characteristic level
3) a specific treatment technology which in many cases will result in treatment below the characteristic level, or
4) a treatment standard of "deactivation" to remove the characteristic with guidance on technologies that the agency believes will remove the characteristics.

The Third Third rule also established a national capacity variance for waste codes K048-K052 nonwastewaters, as well as for all the treatment standards for waste codes in this final rule. The Agency also promulgated standards and effective dates for hazardous wastes that exhibit one or more of the following characteristics: ignitability, corrosivity, reactivity, or EP toxicity (40 CFR 261.21-261.24). In addition the Agency promulgated treatment standards and effective dates for the First and Second Third wastes that had been subject to the "soft-hammer" requirements.

Development of Treatment Standards

The EPA segregated the waste treatability groups by waste code and identified a Best Demonstrated Available Technology or BDAT for each one. Treatment standards applicable to each treatability group are based on the performance level achievable by the BDAT identified for each group.

In some cases a waste may carry more than one waste code. In the Third Third final rule, the EPA clarified that wastes that carry more than one characteristic waste code must be treated to meet the treatment standard for each characteristic; listed wastes that also exhibit one or more hazardous characteristics must be treated to meet the treatment standard for each of the waste codes, unless the characteristic constituent or property is specifically addressed in the treatment standard for the listed waste.

National Capacity Variance

The effective dates for compliance with treatment standards for all waste codes in the final rule was extended until August 8, 1990 by granting a three month national capacity variance. It was delayed because the Agency realized that even where data indicate that sufficient treatment capacity exists, it is not immediately available. However, all Third Third wastes become restricted on May 8, 1992 and therefore subject to a number of Land Disposal Restriction provisions. For example, if hazardous wastes not treated in compliance with applicable treatment standards are disposed of in surface impoundments or landfills, such units must meet minimum technology requirements. Wastes for which treatment standards are being promulgated may be land disposed after their effective dates only if the applicable treatment standards are met, or if disposal occurs in units that satisfy the "no migration rule" standard.

The EPA also promulgated a two-year national capacity variance for about 30 waste codes due to lack of sufficient treatment or recovery capacity.

California List Prohibitions

When the Third Third regulations went into effect, almost all of the California list prohibitions were superseded by more specific prohibitions and treatment standards. The only continued applicability of the California lists is for liquid hazardous wastes that contain over 50 ppm PCBs; for HOC-containing wastes identified as hazardous by a characteristic property that does not involve HOCs; and for liquid hazardous wastes that exhibit a characteristic and also contain over 134 mg/l of nickel and/or 130 mg/l of thallium.

"Derived-from" rules for Characteristic Wastes

All residues from treating the original listed F,K,U, or P wastes are usually considered to be the listed waste by virtue of the derived-from rule found in 40 CFR 261.3(c)(2) (see First Third section). Therefore all wastes generated in the course of treatment are prohibited from land disposal unless they comply with treatment standards or are otherwise exempted from the prohibition. However, residuals from the treatment of characteristic wastes are not automatically considered characteristic wastes; these residuals are considered characteristic only if they still display the original characteristic or any other characteristic.

When EPA specified a specific treatment technology as the treatment standard, residuals resulting from the required treatment method are no longer prohibited from land disposal unless EPA should specify otherwise.

Multi-Source Leachate

One of the major issues addressed in the Third Third final rule was the subject of multi-source leachate and how it should be handled. Leachate is defined in 40 CFR 260.10 as "any liquid, including any suspended components in the liquid, that has percolated through or drained from hazardous waste". Leachate that is derived from the treatment, storage, or disposal of listed hazardous wastes is considered a hazardous waste by the "derived-from" rule. Multi-source leachate is leachate that is derived from the treatment, storage, or disposal of more than one listed hazardous waste.

EPA had looked at two options for regulating multi-source leachate: whether to apply to the multi-source leachate the treatment standards for the wastes from which the leachate is derived, or whether to designate such multi-source leachate as a separate treatability group with a separate treatment standard. In the final rule the Agency established a separate treatability group for multi-source leachate and gave it the Hazardous Waste No. F039. The EPA established one set of wastewater and nonwastewater treatment standards that has about 200 constituents. Before F039 can be landfilled it must meet the single treatment standard, rather than meet the treatment standards for each one of however many constituents it may contain. Not all multi-source leachate will have all of the BDAT list constituents, and determining which constituents to monitor is a site-specific determination. However, leachate derived exclusively from F020-F023 and F026-F028 dioxin-containing waste, is considered single-source leachate that must meet the treatment standards for the underlying waste codes, F020-F023 and F026-F028 due to their toxicity.

If another prohibited waste is mixed with multi-source leachate, that waste must still meet the treatment standard applicable to that waste. If the treatment standard for any constituent in that prohibited waste is stricter than the standard for that constituent in multi-source leachate, then the entire mixture must meet the stricter standard.

Radioactive Mixed Wastes

Another special category of wastes that were addressed in the Third Third regulations was radioactive mixed wastes. Radioactive mixed wastes are wastes that fit the definition of radioactive waste subject to the Atomic Energy Act (AEA) that also contain waste that is either listed as a hazardous waste or that exhibits any of the characteristics of ignitability, corrosivity, EP toxicity, or reactivity.

The hazardous portions of mixed wastes are subject to the RCRA regulations, while the radioactive component is regulated under the AEA. The land disposal restrictions apply to radioactive mixed wastes because the hazardous portions are subject to RCRA. The RCRA hazardous portion of all mixed waste must meet the appropriate treatment standards for all applicable waste codes before land disposal unless EPA has specifically established a separate treatability group for a specific category of mixed waste.

Alternate Treatment Standards for Lab Packs

Lab packs are typically used by industry to dispose of small quantities of U and P wastes and residuals from analytical samples. These lab packs may contain hundreds of restricted wastes, and, in the Second Third proposed rule, the agency proposed that the applicable treatment standards must be achieved for each waste code contained in the lab packs. Commentors stated that this was an unnecessary administrative burden.

In the Third Third final rule, the Agency added two appendices, IV and V, to 40 CFR part 268. The EPA promulgated an alternate treatment standard of incineration as the specified method for lab packs containing constituents in Appendix IV or V. For appendix IV lab packs, the incineration treatment standard was followed by a requirement to meet the treatment standards for the EP toxic metals also in the appendix. Lab packs containing hazardous wastes other than those specified in

appendices IV and V are not eligible for the treatment standards and must meet the applicable treatment standards for each waste code contained in the lab pack.

Capacity Determinations

The capacity analyses for treatment standards for wastes in the Third Third final rule were conducted using the TSDR survey (see discussion of First Third and Second Third final rules). The various land disposal methods used in 1986 and the quantities of wastes they handled are presented in Table 3-7. The data indicated that about 5.7 billion gallons of waste for which standards were finalized in this rule were disposed of in or on the land. This estimate includes 77 million gallons that were stored in waste piles for short-term purposes. These wastes will eventually be treated, recycled, or permanently disposed of. These figures are for both wastewater and nonwastewater forms of the wastes.

TABLE 3-7. VOLUME OF WASTES BY LAND DISPOSAL METHOD FOR WHICH STANDARDS ARE BEING ESTABLISHED
[Million gallons/year]

Storage:	
Waste Piles	77
Surface impoundments	2
Treatment:	
Waste Piles	30
Surface impoundments	22
Disposal:	
Land fills	430
Land treatment	81
Surface impoundments	52
Injected underground	5086
Total	5780

(Federal Register June 9, 1990)

EPA also assessed the requirements resulting from the Third Third final rule for alternative treatment capacity for surface-disposed wastes. EPA estimated that about 5.5 billion gallons will require treatment to meet the standards in this rule. They also

estimated that treatment of these surface-disposed and deepwell-injected wastes would generate approximately 82 million gallons of residuals requiring treatment before disposal.

Table 3-8 presents an estimate for each treatment technology of the volumes of wastes that would require alternative treatment before land disposal to comply with the standards finalized in this rule. Available capacity is equal to the specific treatment system's maximum capacity minus the amount used in 1986. The available capacity was also adjusted to account for wastes previously restricted in the other rulings by subtracting out the capacity required for them.

TABLE 3-8-- REQUIRED ALTERNATIVE COMMERCIAL TREATMENT/RECYCLING CAPACITY FOR SURFACE LAND DISPOSED WASTES
[Million gallons/year]

Technology	Available	Required
Acid Leaching followed by chemical precipitation	0	3
Alkaline chlorination	7	6
Alkaline chlorination followed by chemical precipitation	6	2
Biological treatment	47	<1
Biological treatment followed by chemical precipitation	14	<1
Chemical oxidation followed by chemical precipitation	28	7
Chemical oxidation followed by chromium reduction and chemical precipitation	2	2
Chemical precipitation	339	25
Chromium reduction followed by chemical precipitation	96	85
Combustion of liquids	237	16
Combustion of sludges/solids	41	213
Mercury retorting	<1	3
Neutralization	36	22
Secondary lead smelting	37	2
Stabilization	478	158
Thermal recovery	0	<1
Thermal recovery of cadmium batteries	<1	<1
Vitrification	0	22

The Third Third final rule affects approximately 277 million gallons of wastes per year. An additional 44 million gallons (per year) of multi-source leachate may also be affected by this final rule. Treatment practices in compliance with the Third Third final rule significantly redistribute the quantities of waste among management practices. The final rule results in a 26 percent reduction in the volume of Third Third wastes being land disposed under Subtitle C and a 25 percent reduction under Subtitle D.

Chapter 4. An Overview of Incineration

This chapter presents a brief discussion of incinerators and incineration technology as background for the chapters that will follow. It also includes some discussion of the potential for future demand for incineration and how incineration and land disposal compare as waste management tools.

TECHNOLOGY[7]

Incineration is the burning of substances by controlled flame in an enclosed area. The process 1) detoxifies hazardous waste by destroying organic compounds contained in the waste, 2) reduces the volume of the wastes, and 3) converts wastes to solids by vaporizing water and other liquids the wastes may contain.

The most common types of incinerators now in use are liquid injection and rotary kiln incinerators. Figures 4-1 and 4-2 present representative diagrams of each of these types of incinerators. The liquid injection incinerator is capable of incinerating a wide range of liquids, gases and slurries. The rotary kiln incinerator is used by most major commercial operators because of its versatility in handling solid, sludge, liquid, and gaseous wastes, either separately or simultaneously.

Wastes are fed into the incineration and combustion of the waste results in two main byproducts: solids, in the form of ash, and gases. The ash is cooled and collected from the incinerator. Ash is a nonreactive inorganic material made up of carbon, salts, and metals. Incineration of solid waste yields ash in amounts from 10 to 30 percent of the original waste quantity. The ash must either be disposed of in a hazardous waste landfill, or, if it proven to have no remaining hazardous constituents, may be used for a variety of other purposes.

Wastes suitable for incineration range from highly concentrated organic liquids to sludges and low concentration, but extremely hazardous, solids. Wastes with low

levels of metals and high organic content burn the most efficiently. Organic compounds burn over a broad range of temperatures. Most organic compounds found in hazardous wastes must be subject to high temperatures before they burn completely. Hazardous waste incinerators must maintain extremely high temperatures that range from 1800 ^{o}F to 2500 ^{o}F to ensure that virtually all organic compounds in the waste are destroyed.

The combustion gases are composed primarily of carbon dioxide and water, plus small quantities of carbon monoxide, and other gases that depend on the composition of the waste burned. The gases are cooled and removed by various types of pollution control devices.

The byproducts of incineration vary with the wastes that are burned. Many industrial processes generate liquid hazardous wastes containing halogenated materials, with chlorinated compounds being the most common. When chlorinated organic compounds are combusted, the products will include hydrogen chloride and small amounts of chlorine, as well as carbon dioxide and water. Other liquid hazardous wastes may contain metals, sulfur, or organically-bound nitrogen. When incinerated, they produce oxides of metals, sulfur and nitrogen.

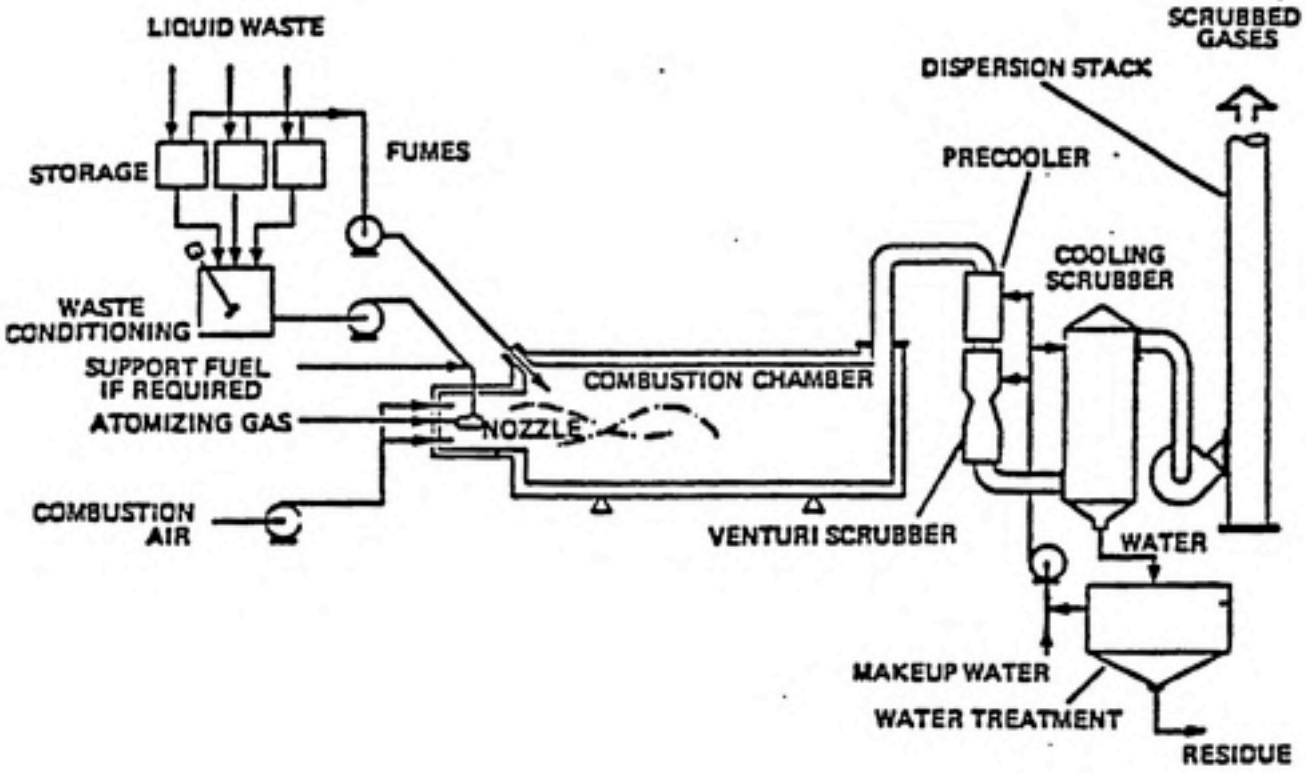
In addition to ash and gases, incineration will form small amounts of substances other than the expected products of the combustion reaction. These substances, known collectively as the products if incomplete combustion (PICs) may be similar to or very different in chemical structure from the original constituents of the compounds incinerated.

INCINERATION DEMAND

As was mentioned in the introductory chapter, demand for incineration is expected to increase due to the implementation of the 1984 RCRA amendments, as well as for other reasons. Based on the 1986 National Screening Survey conducted by the

Figure 4-1.

LAND-BASED
LIQUID INJECTION INCINERATOR



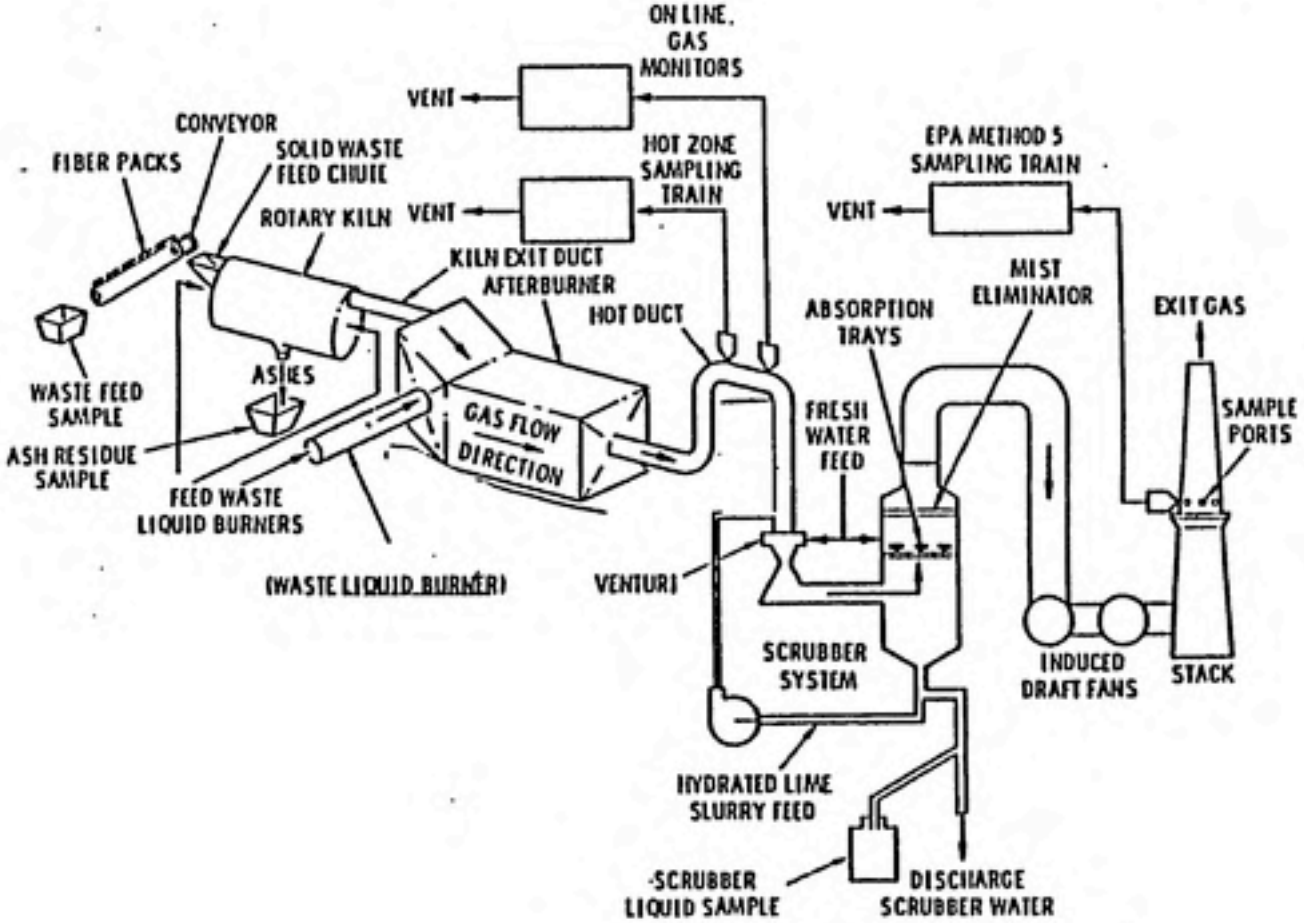


FIGURE 4-2

Rotary Kiln Incinerator
With Liquid Injection Capability

EPA Office of Solid Waste, there were about 2 million metric tons of hazardous waste incinerated offsite in the U.S., of a total 275 million metric tons generated. This study predicted that there would be an increase in the amount of waste incinerated in response to the Land Disposal Restrictions.[2]

INCINERATION vs LAND DISPOSAL

Incineration, since it is a method of treatment rather than disposal, has several advantages over land disposal methods as a method of waste management. Incineration breaks down organic compounds, permanently eliminating environmental hazards posed by them, while land disposal only controls the hazard as long as the waste remain contained in the disposal unit. Although incinerator ash requires disposal in a landfill, the process of incineration greatly reduces the volume of the material to be disposed. This is very valuable as space in landfills is becoming increasingly scarce. The ash consists mostly of inert material, whereas organic compounds may react with other compounds in the landfill to form acids that hasten deterioration of the liners that contain the wastes in the landfill.

Concerns about hazardous waste focus on the potential for improper storage or disposal that could lead to environmental and/or human exposure. Wastes placed in plain metal drums can cause corrosion and leak to the environment in unlined ponds, lagoons, and landfills over long periods of time leach into the soil and nearby water supplies.[1] The potential environmental hazards from incineration are those that could be created by poor design or management. There could be hazardous gases released from incineration if the pollution control devices are not designed or operated properly, or the ash could contain high levels of hazardous materials if the incinerator is not run at the proper temperature or wastes are mixed that have different temperature requirements.

Presently the principal disadvantage of incineration compared to land disposal is that of cost. Incineration is expensive compared to land disposal as a waste management option. It can range from $300 to $1000 a ton compared to costs as low as $50 per ton for landfilling the same waste[1]. However, as the land disposal restrictions instituted by HSWA begin to go into effect, the land disposal alternative will become more costly since producers of hazardous waste will have to treat wastes before they can be disposed on land. Land disposal costs will also increase over time as space becomes more scarce and landfills need to be upgraded to meet changes in RCRA requirements. The cost difference between land disposal and incineration may disappear for some wastes, and for many types of hazardous wastes incineration will become the least expensive treatment alternative.

Chapter 5. Hazardous Waste Generation and Treatment in North Carolina

The North Carolina Department of Environment, Health & Natural Resources, Division of Solid Waste Management, Hazardous Waste Section is authorized through RCRA to administer a hazardous waste program in North Carolina. One portion of this program is a yearly accounting of hazardous waste minimization, generation, treatment and disposal. Anyone who generates more than 2200 pounds per month, or stores, treats or disposes of hazardous waste must submit annual reports on their hazardous waste activities. Starting with the 1991 calendar year, generators who produce more than 220 pounds of hazardous waste per month will also have to submit annual reports. These reports cover activity from January 1 to December 31 of the past year and are due to the Hazardous Waste Section by March 1 of the current year.

The analysis presented in this chapter is based on information provided to the Hazardous Waste Section by North Carolina large quantity generators (those who generated 2200 lbs or more/month) in their 1990 annual reports. This analysis of hazardous waste management is focused on those wastes that were regulated under the Land Disposal Restrictions for which incineration was sited as BDAT for concentration-based standards, or as a technology standard. Appendix A presents a detailed account of the calculations used to generate the "capacity required". Appendices B through E contain detailed information on the generation and treatment of each type of hazardous waste covered by the Land Disposal Restrictions.

Each hazardous waste identified in RCRA is identified by a 4-digit EPA waste code that corresponds to either a hazardous characteristic or the reason for listing as a RCRA waste. The waste codes begin with a letter followed by three numbers.

Wastes exhibiting one of the four characteristics of ignitability, corrosivity, reactivity, or toxicity have codes beginning with the letter "D". Listed wastes are classified

depending on their source. The "F" series of waste codes represent wastes from non-specific sources. The "K" series represents wastes from specific sources such as K025, distillation bottoms from the production of nitrobenzene. The "P" and "U" waste codes represent discarded commercial chemical products.

WASTE GENERATION AND TREATMENT IN NORTH CAROLINA

Table 5-1 presents a summary of the generation of hazardous waste and treatment activity in North Carolina in 1990. The "total generated" column is the amount of hazardous waste, by specific waste code, generated in the state and the "LDR generated" is that portion of the total waste generated which was regulated by the Land Disposal Restrictions. This data is for nonwastewaters only. Nonwastewaters are defined as wastes containing greater or equal to 1 percent total organic carbon (TOC) and greater than or equal to 1 percent total suspended solids. Beginning in 1988, the N.C. Hazardous Waste Section separated hazardous waste which is generated in the form of wastewater, such as electroplating rinse water (managed under the National Pollution Discharge Elimination System of the Clean Water Act), and hazardous wastes generated and managed under RCRA (nonwastewater). In 1990 in North Carolina 224.3 million pounds of nonwastewater wastes and 2.8 million pounds of hazardous wastewater were generated.

Table 5-1 Summary of Total Hazardous Waste Generated and Volume of Waste Covered by Land Disposal Restrictions in North Carolina, 1990 (lbs)

Waste Type	Total Generated	LDR Generated*
D	55,111,110	33,061,685
F	53,164,541	30,329,179
K	100,763,563	85,775,418
P	388,947	236,502
U	14,991,198	33,143
TOTAL	224,339,359	149,485,927

*Land Disposal Restrictions apply

The hazardous waste data presented in North Carolina's annual reports are divided into three categories: wastes generated from one-time cleanups or Superfund actions; wastes generated from spill cleanups by large generators, and wastes generated from normal operating procedures (recurring). Of the 224.3 million pounds of waste generated in North Carolina in 1990, about 6 percent was from one-time or Superfund cleanups, about 37 percent was from large generator cleanups, and the remainder from normal operating procedures. Table 5-2 presents these data for both 1989 and 1990. Over 66 percent of the hazardous waste generated in North Carolina, and 64 percent of the waste treated in 1990 was, or will be in the future, subject to the Land Disposal Restrictions.

Table 5-2 Total Hazardous Waste Generated in North Carolina in 1989 & 1990 (lbs)

Type of Generation	1989	1990
One-Time or Superfund Cleanups	5,924,559	14,048,925
RCRA Large Generator Cleanups	3,535,010	81,954,443
Normal Operating Procedures	125,506,405	128,335,991
TOTAL	134,967,963	224,339,359

N.C. Hazardous Waste 1990 Annual Report, Division of Solid Waste Management, August 1991

Only 11 percent of the wastes shipped off-site for treatment, disposal, or storage were shipped to facilities in North Carolina. In 1990 the top five receiving states were Louisiana, South Carolina, Alabama, Pennsylvania, and Virginia.

CAPACITY ASSURANCE

The Superfund Amendments and Reauthorization Act 1986 (SARA) required that each governor certify to the EPA Administrator that the state had adequate capacity, either within its boundaries or through interstate agreements, to handle all of the hazardous waste generated within the state over the next 20 years. This report, the

Capacity Assurance Plan (CAP), was required by October 1989. North Carolina entered into a five-state regional agreement to meet these capacity requirements. The five states in this regional agreement were South Carolina, Kentucky, Tennessee, Alabama, and North Carolina. However, on January 1, 1991, North Carolina was ejected from this regional agreement due to the failure of North Carolina to begin permitting a hazardous waste incinerator. As part of the regional agreement, North Carolina was required to have begun permitting a commercial hazardous waste incinerator by January 1991. This was to provide the needed capacity for incineration for the region. New CAPs have been filed stating that a private effort is underway to site an incinerator and that the Hazardous Waste Management Commission is in place to act as a backup if this effort fails. This loss of regional capacity may, with the requirements of the Land Disposal Restrictions, induce North Carolina to seriously review its waste management practices.

IMPACT OF THE LAND DISPOSAL RESTRICTIONS ON INCINERATION CAPACITY IN NORTH CAROLINA

The Land Disposal Restrictions (LDR) established both technology and concentration based standards for selected RCRA wastes. The following analysis separates these standards, and the wastes regulated under them,into four main groupings: 1) hazardous wastes for which incineration was selected by EPA as the sole technology requirement (standard); 2) hazardous wastes for which incineration was only one of the treatment options which would meet the EPA technology standard; 3) hazardous wastes for which deactivation was selected as the required technology standard, and incineration is suggested as one of the treatment options which will achieve deactivation; and 4) hazardous wastes for which a concentration-based standard was established by the EPA and incineration was used as the technology (BDAT) to achieve this concentration standard. EPA promulgated separate standards for

wastewaters and nonwastewaters for treatment standards expressed as concentration levels. This analysis only addresses nonwastewaters as defined by EPA.

Incineration as Sole Treatment Technology

Table 5-3 summarizes the 1990 North Carolina hazardous waste types and volumes for which EPA has designated incineration as the only technology which will meet the BDAT required technology standard. A complete breakdown, by EPA waste code, of these wastes is presented in Appendix B.

Table 5-3 Summary of 1990 North Carolina Hazardous Wastes for Which LDRs Apply and Incineration is Required (lbs)

Waste Group	Treated in 1990		Total Treated	Stored End 1990	Required Capacity
	Incineration	Other			
D	4,061	15,176	19,237	15,928	35,165
F[a]	0	49,300	49,300	0	49,300
P	4466	0	4,466	9,242	13,708
U	11,350	5,718	17,068	4,540	21,608
Total	19,877	70,194	90,071	29,710	119,781

[a] F005 was excluded and will be discussed separately.

The required incinerator capacity of 119,781 pounds in Table 5-3 was calculated by adding the amount of restricted waste which was incinerated in 1990, the amount of restricted waste which had been treated by other methods in 1990, and the amount of restricted waste in storage at year-end in 1990. These amounts added together equal the amount of incineration capacity, in pounds, which would be required under the Land Disposal Restrictions. As was discussed in previous chapters, the waste in storage will eventually make it to the "amount treated" column as they can not be stored longer than 90 days according to the Land Disposal Restrictions.

Wastes With Incineration as One of the Required Treatment Standards

Some technology standards promulgated by EPA in the Land Disposal Restrictions will allow more than one treatment technology (e.g. incineration, fuel substitution, chemical oxidation, chemical reduction, wet air oxidation, organic recovery) for meeting technology-based standard requirements for some types of RCRA wastes. When more than one technology is allowed by EPA, neither takes preference over the other and either is acceptable for complying with the treatment standard. Appendix C provides detailed information on the individual waste codes in this category.

In 1990, all of the North Carolina hazardous wastes in this category were either incinerated (12, 262 lbs), treated by chemical (12,804 lbs) or biological (5,936 lbs) technologies, or shipped to storage (8,404 lbs). The amounts used to calculate the required incineration capacity for waste in this category included:

	Waste treated (lbs)*			
Waste	Treated in 1990			
Group	Incineration	Chemical	Biological	Comments
D	8,852	12,804	5,936	D wastes can not be treated biologically under LDR
P	2,563	0	0	All wastes incinerated
U	847	0	0	All wastes incinerated
Total				

* This table does not include wastes in storage at year-end

To estimate the amount of waste in storage at year-end which would eventually go to incineration, the percentage of wastes in each waste type which was treated by incineration in 1990 was computed. This percentage was applied, by waste type, to the wastes in storage at year-end. This percentage was also applied to the wastes which had previously been treated biologically to determine what percentage might go to incineration:

Waste Group	In Storage Year-end	Biologically Treated	1990 Incinerated	Required Capacity
D	7,671	5,936	8,852	13,217
P	108	0	2,563	2,671
U	625	0	847	1,472
Total lbs				17,360

The required incineration capacity for restricted hazardous waste which can be treated by multiple technologies was estimated to be 17,360 pounds. This assumes that waste in storage at year-end would be managed using the same treatment distribution percentage as in 1990, as would the waste that had previously been biologically treated.

Wastes for Which BDAT was Based on Incineration

In the background material in the notices published in the Federal Register for each of the three-Thirds , the EPA provided the information which they used to establish the Best Demonstrated Available Technology (BDAT) for each waste with a concentration-based standard. They also identified the technology which was used to establish the BDAT concentrations for each waste code. Table 5-4 summarizes the wastes in this category. A detailed analysis, by waste code, of these wastes is shown in Appendix D.

Table 5-4 Summary of 1990 North Carolina Wastes for Which LDRs Apply and Concentration Standards Have Been Established[a] (lbs)

Waste Group[b]	Type of Treatment			Total Treated	Total Stored
	Incineration	Landfill	Other		
D	13	0	0	13	2,160
K	73,052,782	4,953,019	7,385,517	85,391,318	0
P	264,376	0	5,080	269,456	74
U	175, 195	14, 017,320	248,043	14,440,556	357,275
Total	73,492,366	18,970,339	7,638,640	100,101,343	359,509

[a]Standards based on incineration as BDAT

[b]F005 waste amounts were excluded and will be discussed separately in the text.

The total amount of North Carolina hazardous wastes in this category in 1990 was 100,460,852 pounds, of which 100,101,343 lbs were treated and 357, 509 lbs were in storage at year-end.

Assuming that the same treatment choices would be made for the waste in storage at year-end and for the waste which was landfilled but is now restricted, the amount of this waste which would probably be incinerated can be estimated by calculating the percentage of the total waste being treated by incineration during 1990 in each waste category. This percentage can then be applied to the volumes of wastes in storage and to the wastes which were landfilled in 1990 but can no longer be landfilled without prior treatment. Based on these calculations, 2,160 lbs of "D" waste, 73 lbs of "P" waste, and 4,335 lbs of "U" waste which was in storage at year -end 1990 would eventually be treated by incineration. There is no way of confirming this assumption, but, it does provide a conservative estimate of the amount of incinerator capacity required in North Carolina.

Thus, the total incinerator capacity required for North Carolina wastes for which EPA has established a concentration-based standard based on incineration is shown in Table 5-5.

Table 5-5 Incinerator Capacity Required for N.C. 1990 Hazardous Waste for Which LDRs Apply and Concentration Standards Have Been Established (lbs)

Waste Group[a]	Incinerated 1990	Incinerated from Storage	Landfilled Waste[b] Treated by Incineration	Capacity Required
D	13	2,160	0	2,173
K	73,052,782	0	4,237,337	77,290,119
P	264,376	73	0	264,449
U	175,195	4,335	170,064	349,594
Total	Incinerator Capacity			77,906,335

[a] F005 wastes were excluded and are discussed separately in text

[b] Waste which can no longer be landfilled without prior treatment

Characteristic Wastes Which Require Deactivation

EPA required deactivation (DEACT) of certain ignitable, reactive, and corrosive wastes which were regulated in the Third Third lists of wastes restricted from land disposal. The Agency did not specify a specific technology (BDAT) for each of these wastes. The only requirements were that deactivation of the characteristic which made the waste a "hazardous"waste be removed and that the method of treatment could not be land disposal. In the rule, EPA did provide suggested appropriate technology(s) for each of the wastes.

The only North Carolina hazardous wastes in this category in 1990 were code "D" wastes. See Appendix E for a breakdown of each of these wastes and their treatment in 1990.

To determine the proportion of the wastes in storage at year-end and the wastes which were land disposed (now restricted) which would probably be incinerated, the percentage of the wastes in this category which were incinerated in 1990 was computed and applied to these wastes. These estimates were then added to the amounts of wastes actually incinerated to calculate the incinerator capacity required for wastes which must be deactivated. These estimates are shown in Table 5-6.

Table 5-6 Incinerator Capacity Required for N.C. 1990 Hazardous Waste Which Must be Deactivated to Meet Land Disposal Restrictions (lbs)

Waste Group	Incinerated 1990	Incinerated from Storage	Landfilled Waste[a] Treated by Incineration	Capacity Required
D001[b]	4,065,472	810,706	58,342	4,934,520
D002	44,454	2685	3,519	50,658
D003	19,614	19,350	398	39,362
Total	Incinerator Capacity			5,007,626

[a]Wastes which can no longer be landfilled (disposed) without prior treatment

[b]Ignitable compressed gases are excluded form this waste code. See Appendix C

If generators decided to send all the hazardous wastes in this category to incineration, the total incinerator capacity required would be 19,681,197 pounds. Costs, available capacity, liability, and other factors enter into these decisions. It is not possible to predict how much of the "D" wastes in this category would actually be incinerated, however, it is likely to be between 5,007,626 and 19,681,197 pounds.

F005 Wastes

Of all the hazardous waste covered by the Land Disposal Restrictions and generated in North Carolina, F005 wastes are unique. EPA established a concentration-based standard and a technology-based standard depending on what constituent(s) the waste is listed for. F005 wastes listed for 2-nitropropane or 2-ethoxyethanol, have a technology-based standard of incineration, while F005 wastes listed for benzene have a concentration-based standard based on incineration.

Estimating the incineration capacity for F005 wastes is full of uncertainties since generators do not report the listed constituents of a waste in their annual reports. To accurately calculate the amount of F005 waste in each category it would be necessary to go to the manifests prepared by the generators. Information on the waste will not always be available on the manifests. In estimating the incinerator capacity required for North Carolina's F005 wastes, two approaches were taken. First, it was assumed that all F005 waste treated was subject to the concentration based standards, and then it was assumed that all of it was subject to a technology-based treatment standard of incineration.

The percentage of the total waste treated which was incinerated was calculated and applied to the wastes in storage and to the waste which was land disposed These amounts were added to the amount actually incinerated in 1990. The amount of incinerator capacity required was determined to be 2,338,439 pounds.

If it is assumed that 100% of the F005 wastes were subject to a technology-based treatment standard, the required incineration capacity would be 26,660,177 pounds. Thus, the incinerator capacity for North Carolina's 1990 F005 wastes could range from 2,338,439 to 26,660,177 pounds.

SUMMARY

Table 5-7 summarizes the amount of incineration capacity which would have been required by North Carolina's generators if all the Land Disposal Restrictions had been in place in 1990.

Table 5-5 Summary of Incinerator Capacity Required by North Carolina Generators if LDRs Had Been in Place in 1990 (lbs)

Waste Code	Incinerated in 1990[b]	LDR Capacity Needed[c]
D	4,078,398	5,058,181
F[a]	0	49,300
F005	1,888,125	2,338,439 to 26,660,177
K	73,052,782	77,290,119
P	271,405	280,828
U	187,392	372,674
Totals	79,478,102	85,389,541 to 109,711,279

[a]excluding F005 wastes

[b]without consideration of Land Disposal Restrictions (LDR)

[c]capacity needed if all LDRs were in effect Jan. 1, 1990

In 1990, 81.4 million pounds of hazardous waste were shipped by North Carolina generators to offsite facilities (both in- and out- of state) for incineration, while 44.7 million pounds were shipped to landfills. Thus, 39.8 % of the total volume of hazardous waste shipped offsite for storage, recycling, treatment, or disposal, was incinerated. Based on the analysis presented in this report, an additional 5.9 to 30 million pounds of hazardous waste would have been incinerated if all the Land Disposal Restrictions had been in place in 1990.

Chapter 6. Conclusions and Recommendations

The U.S. hazardous waste management program is a fluid and dynamic system. Numerous changes and additions in rules and regulations have been made over the past decade. Two significant changes which have and will continue to impact the RCRA system in every State were the Land Disposal Restrictions and the requirement for capacity assurance.

For economic reasons and because of adequate nationwide capacity, a significant proportion of hazardous waste were disposed of, without prior treatment, in or on the land. Increasing concern over the potential contamination of surface and groundwaters led to the Land Disposal Restrictions. These restrictions, the last of which became effective in May of this year, will have significant impact on how generators mange hazardous waste in the future. According to EPA, the Land Disposal Restrictions are expected to require treatment of 7 million tons of hazardous waste disposed of on the surface, and another 34 million tons disposed of in deepwells.

Section 104(k) of the Superfund Amendments and Reauthorization Act of 1986 (SARA) requires each State to provide adequate assurance to the U.S. EPA that they have sufficient hazardous waste treatment and disposal capacity to deal with all hazardous waste expected to be generated within their borders for the next twenty years. This requirement places the onus squarely on each State to either provide adequate treatment and disposal facilities within the State, or to make arrangements with other states.

The analysis presented in this report is intended to provide an indicator of the impact a regulation such as the Land Disposal Restrictions can have on waste management needs in North Carolina, and to stress the importance of a continuing examination of the State's waste management needs. The Land Disposal Restrictions were intended to shift the focus away from land disposal, with its potential risks from

both leaks and liability for proper closure, to treatments that concentrate on destroying the hazardous constituents of the waste. EPA has determined that 220 types (waste codes) of hazardous waste which have been banned from land disposal are best treated by incineration or solvent recovery. Some waste will still be landfilled, but the waste entering landfills should be reduced in hazard and in volume. In 1990, about 44.7 million pounds of North Carolina waste was landfilled, making it the second largest off-site handling method, with incineration being the largest with 81.4 million pounds treated. This analysis estimates that the amount of hazardous wastes going to incineration could increase from 5.9 to 30 million pounds.

The Land Disposal Restrictions will have an impact on treatment methods other than incineration. Incineration is the focus of this analysis because it is the treatment technology which EPA has selected as one of the best available technologies fro treating many hazardous waste streamas, and their is inadequate incineration capacity in the Southestern United States.

It is important to note that this analysis does not include any wastes generated or treated by small quantity generators. In the 1991, small quantity generators who produce more than 220 pounds per month will have to submit annual reports in North Carolina, as well as the large quantity generators (those who generate more than 2200 lbs/month). While the volume of wastes from small generators will be insignificiant compared to the large generators, this information should provide a more complete picture of the hazardous waste treatment needs of the State.

In February of this year, the Hazardous Waste Management Commission did a study on the off-site treatment of hazardous waste generated in 1990. Part of their study examined reports from half of the small quantity generators in the state. They found that an additional 17.4 million pounds of waste was produced by these generators. They estimated that over 1.2 million pounds of this waste could have gone

to incineration, assuming that the waste underwent the same treatment as the waste generated by large quauntity generators.

Another area of uncertainty in future of North Carolina's need for hazardous waste management is the amount of waste that will be generated by cleanup activities. North Carolina has approximately 750 known inactive and illegal dump sites, and more are continually being added to the list. It is difficult to gauge the amounts or types of waste generated by cleanup activities or the types of treatment facilities needed for these wastes. In the past, most cleanup wastes in the state has been disposed of in landfills or in incinerators.

RCRA is up for reauthorization this year. Some of the potential changes focus on issues such as whether states should be able to enforce bans and capacity limits, or charge higher fees for waste imported from states without their own adequate treatment and disposal capacities. One other potential change is in the way that hazardous waste is defined, creating changes that could lead to a larger amounts of waste being placed in solid waste landfills.

It is important to emphasize that the analysis presented in this report is a "snapshot in time" of the hazardous waste management environment at both the State and national level. One important factor that will be different between this analysis and any future analyses is that this analysis was made when not all of the Land Disposal Restrictions were in effect. However, all of the restrictions were in effect as of May of this year, except for any case by case extensions.

As stated previously, hazardous waste management operates in a fluid environment of continually changing regulations and policies. The impact of the Land Disposal Restrictions will change as variables in reporting, and in government regulations and policies change. As was discussed earlier in this chapter, the addition of a reporting requirement for small quantity generators in North Carolina may have some impact on the amounts and types of hazardous waste that will need to be

managed. At both the State and national level there are wastes that are unknown, not reported fully, or are just coming under regulations. Another variable that affects North Carolina as well as other states, is the uncertainty of the amounts and types of hazardous waste cleanup activities, both by large quantity generators and by Superfund efforts. National changes such as the reauthorization of RCRA currently in progress, may also impact on the hazardous waste management needs of the State. The analysis presented was performed under a certain set of conditions, and it will be important that any future waste management planning be done in a manner that takes into account the constant flux of the hazardous waste management environment.

RECOMMENDATIONS

Hazardous waste management operates in a fluid environment of continually changing regulations and policies and there are many variables involved in planning for the hazardous waste management facility needs of North Carolina. I recommend that North Carolina continues to plan for the long-term needs for hazardous waste management. Efforts need to be made to ensure adequate capacity either in state, or in a regional compact, to safely and economically manage the State's hazardous waste needs.

Any waste management plan should not be based solely on the amount or types of waste generated in one year, but be flexible to adjust for both the regulatory and generation fluctuations that develop. Waste generation will fluctuate as waste reduction efforts by many facilities continues and as the cost and availability of waste management options change.

Potential areas for further efforts in hazardous waste management are:

1) Expanded public education on the issues that the State faces in regard to future waste management;

2) Continued encouragement of waste reduction and process change efforts, potentially including financial incentives;

3) Focus on the impacts of future regulations on the State's hazardous waste needs in capacity planning; and

4) Examine the potential impact of other State and Federal regulations (i.e. The Clean Air Act) on hazardous waste management.

REFERENCES

1. Public Policies for Environmental Protection. Portney, Paul R., Editor. Resources for the Future, Washington, D.C. 1990.

2. The Waste System. U.S. EPA. Office of Solid Waste and Emergency Response. Washington, D.C. 1988.

3. Code of Federal Regulations, 40 Part 268.

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5. U.S. Environmental Protection Agency Federal Register June 23, 1989. "Land Disposal Restrictions for Second Third Scheduled Wastes; Final Rule". U.S. Government Printing Office, Washington, D.C. 1989.

6. U.S. Environmental Protection Agency. Federal Register, June 1, 1990. "Land Disposal Restrictions for Third Third Scheduled Wastes; Rule". U.S. Government Printing Office, Washington, D.C. 1990.

7. *Hazardous Waste Incineration: Questions and Answers*. ICF Incorporated. Office of Solid Waste, Washington, D.C. 1988.

APPENDIX-A

Summary of Methods of Analysis

GENERAL METHODS

1. The data base that was received from the Hazardous Waste Section was sorted by hazardous waste code and by off-site treatment method.

2. The individual rulings were read in the Federal Register and the hazardous waste codes were identified that had a technology-based standard of incineration or concentration-based standards that were set based on the performance of incineration.

3. The waste codes identified were then compared to the waste codes generated in North Carolina in 1990. If the waste code was not generated in 1990, it can be found listed in the category it falls under in Appendix F.

4. If the hazardous waste code was generated in North Carolina in 1990 the amounts treated by each offsite handling code identified in the data base was calculated. This information can be found in Appendices B-E.

METHODS FOR EACH FOUR CATEGORIES PRESENTED IN CHAPTER 5

Incineration as Sole Technology

1. Sum up the each treatment and storage method for each waste code category (e.g. "D", "F", "K", "P", "U").
2. Determine total amount treated in each category.
3. Capacity required would be total amount treated, as incineration is the only allowable method of treatment.

Incineration as One of Required Treatment Technologies

1. Sum up the each treatment and storage method for each waste code category (e.g. "D", "F", "K", "P", "U").
2. Determine total amount treated in each category.
3. Calculate total volume of wastes incinerated.
4. Calculate percentage incinerated by taking total amount incinerated and divide by total amount treated.
5. Calculate total volume of wastes stored.
6. Calculate total volume of wastes landfilled.
7. Calculate total volume of wastes treated in a manner other than one of the required technologies.
8. Apply percentage calculated in (3) to volumes determined in steps 5, 6 and 7 to determine what percentage of these volumes would possibly go to incineration.

9. Add (8) to amount actually incinerated to calculate total capacity required.

Wastes That Concentration-based standards were Based on Incineration

1. Sum up the each treatment and storage method for each waste code category (e.g. "D", "F", "K", "P", "U").
2. Determine total amount treated in each category.
3. Calculate total volume of wastes incinerated.
4. Calculate percentage incinerated by taking total amount incinerated and divide by total amount treated.
5. Calculate total volume of wastes stored.
6. Calculate total volume of wastes landfilled.
7. Multiply percentage calculated in step (3) by volumes calculated in steps 5 and 6 to determine the potential volume of these wastes that could go to incineration.
8. Add volume calculated in (7) to amount actually treated by incineration to determine total incineration capacity required.

Wastes That Have Deactivation as Required Treatment Technology

1. Sum up the each treatment and storage method for each waste code category (e.g. "D", "F", "K", "P", "U").
2. Determine total amount treated in each category.
3. Calculate total volume of wastes incinerated.
4. Calculate percentage incinerated by taking total amount incinerated and divide by total amount treated.
5. Calculate total volume of wastes stored.
6. Calculate total volume of wastes landfilled.
7. Multiply percentage calculated in step (3) by volumes calculated in steps 5 and 6 to determine the potential volume of these wastes that could go to incineration.
8. Add volume calculated in (7) to amount actually treated by incineration to determine total incineration capacity required.

APPENDIX B

Table B-1 Hazardous Wastes Generated in North Carolina in 1990 with Incineration as Sole Treatment Standard*

WASTE CODE	AMOUNT GENERATED	RECEIVED FROM OFFSITE	AMOUNT TREATED OFFSITE	WASTE HANDLING METHOD, 1990		
				INCINERATION	SOLVENT RECOVERY	CHEMICAL TREATMENT
D000	34,640	0	35,165	4,061	0	15,136
F005 (a)	30,223,547	4,913,158	26,660,177	1,888,125	8,053,359	250,632
F039	105,632	56,332	49,300	0	0	0
P003	11265	680	10586	3,773	0	0
P016	60	0	60	60	0	0
P022	12	0	12	12	0	0
P028	2418	0	2418	0	0	0
P044	30	0	30	30	0	0
P054	4	0	4	0	0	0
P064	2	0	2	0	0	0
P070	555	0	555	555	0	0
P075	39	0	39	34	0	0
P093	1	0	1	1	0	0
P109	1	0	1	1	0	0
U006	3	0	3	3	0	0
U007	869	1	868	110	0	0
U008	150	0	150	150	0	0
U011	100	0	100	100	0	0
U014	320	50	270	0	0	0
U020	200	200	0	0	0	0
U021	27	0	27	10	0	0
U023	10	0	10	2	0	0
U035	3531	0	7062	7,062	0	0
U058	1570	0	1570	1,550	0	0
U059	4	0	4	4	0	0
U092	132	0	132	132	0	0
U113	7	7	0	0	0	0
U119	1	0	1	0	0	0
U122	3864	408	3456	1,685	0	0
U133	20	0	20	0	0	0

Table B-1 cont.

WASTE CODE	WASTE HANDLING METHOD, 1990 (cont.) LAND DISPOSAL	OTHER RECOVERY	OTHER TREATMENT	STORAGE	EFFECTIVE DATE
D000	0	0	40	15,928	Aug. 8, 1990
F005 (a)	3,965,776	8,332,533	1,777,122	2,392,630	Aug. 8, 1990
F039	0	0	49,300	0	Aug. 8, 1992
P003	0	0	0	6,813	Aug. 8, 1990
P016	0	0	0	0	Aug. 8, 1990
P022	0	0	0	0	Aug. 8, 1990
P028	0	0	0	2,418	Aug. 8, 1990
P044	0	0	0	0	June 8, 1989
P054	0	0	0	4	Aug. 8, 1990
P064	0	0	0	2	June 8, 1989
P070	0	0	0	0	Aug. 8, 1990
P075	0	0	0	5	Aug. 8, 1990
P093	0	0	0	0	May 8, 1992
P109	0	0	0	0	Aug. 8, 1990
U006	0	0	0	0	Aug. 8, 1990
U007	0	0	750	8	Aug. 8, 1990
U008	0	0	0	0	Aug. 8, 1990
U011	0	0	0	0	Aug. 8, 1990
U014	0	0	0	270	Aug. 8, 1990
U020	0	0	0	0	Aug. 8, 1990
U021	0	0	0	17	Aug. 8, 1990
U023	0	0	8	0	Aug. 8, 1990
U035	0	0	0	0	Aug. 8, 1990
U058	0	0	0	20	Aug. 8, 1990
U059	0	0	0	0	June 8, 1989
U092	0	0	0	0	Aug. 8, 1990
U113	0	0	0	0	Aug. 8, 1990
U119	0	0	0	1	Aug. 8, 1990
U122	0	0	0	1,771	Aug. 8, 1990
U133	0	0	10	10	Aug. 8, 1990

Table B-1 cont.

WASTE CODE	AMOUNT GENERATED	RECEIVED FROM OFFSITE	AMOUNT TREATED OFFSITE	WASTE HANDLING METHOD, 1990		
				INCINERATION	SOLVENT RECOVERY	CHEMICAL TREATMENT
U147	156	0	156	51	0	0
U154	15042	13223	2241	151	0	0
U197	1	1	0	0	0	0
U201	1919	151	1768	25	0	120
U213	2248	1	2247	19	0	0
U219	24	0	24	9	0	0
U221	1	0	1	1	0	0
U223	63	0	63	60	0	0
U236	1178	0	1178	0	0	0
U238	15	0	15	14	0	0
U240	240	0	240	200	0	0
U246	12	0	12	12	0	0

Table B-1 cont.

WASTE CODE	WASTE HANDLING METHOD, 1990 (cont.) LAND DISPOSAL	OTHER RECOVERY	OTHER TREATMENT	STORAGE	EFFECTIVE DATE
U147	0	0	0	105	Aug. 8, 1990
U154	0	0	0	2,090	Aug. 8, 1990
U197	0	0	0	0	Aug. 8, 1990
U201	1,340	0	250	23	Aug. 8, 1990
U213	0	2,062	0	166	Aug. 8, 1990
U219	0	0	0	15	Aug. 8, 1990
U221	0	0	0	0	Aug. 8, 1990
U223	0	0	0	3	Aug. 8, 1990
U236	0	1,178	0	0	Aug. 8, 1990
U238	0	0	0	1	Aug. 8, 1990
U240	0	0	0	40	Aug. 8, 1990
U246	0	0	0	0	Aug. 8, 1990

*Wastes from generators producing > 2200 lbs per month only
(a) F5 wastes have both concentration and technology based requirements depending on the constituent. See text for more detail.

APPENDIX C

Table C-1 Hazardous Wastes Generated in North Carolina in 1990 With Multiple Choices for Required Technology

WASTE CODE	AMOUNT GENERATED	RECEIVED FROM OFFSITE	AMOUNT TREATED OFFSITE	WASTE HANDLING METHOD, 1990		
				INCINERATION	SOLVENT RECOVERY	CHEMICAL TREATMENT
D001 ign. gases	37,573	2,310	35,263	8,852	0	12804
P001	80	0	80	0	0	0
P005	25	0	25	25	0	0
P006	25	0	25	0	0	0
P105	2533	0	2533	2,530	0	0
P108	8	0	8	8	0	0
U001	8	0	8	2	0	0
U003	702	47	655	655	0	0
U010	5	0	5	5	0	0
U055	160	0	160	160	0	0
U056	17	17	0	0	0	0
U057	1	1	0	0	0	0
U091	2	0	2	2	0	0
U095	1	0	1	0	0	0
U103	340	0	340	1	0	0
U114	2	0	2	2	0	0
U123	99	0	109	18	0	0
U124	2	0	2	2	0	0
U126	40	0	40	0	0	0
U135	90	40	90	0	0	0
U191	1	0	1	0	0	0
U218	16	0	16	0	0	0
U222	1	0	1	0	0	0
U248	40	0	40	0	0	0

Table C-1 cont.

WASTE CODE	WASTE HANDLING METHOD, 1990 (cont.) LAND DISPOSAL	OTHER RECOVERY	OTHER TREATMENT	STORAGE	REQUIRED TREATMENT (a)	EFFECTIVE DATE
D001 ign. gases	0	0	5,936	7,671	INCIN/FSUBS/RORGS	
P001	0	0	0	80	INCIN/FSUBS	June 8, 1989
P005	0	0	0	0	INCIN/FSUBS	Aug 8, 1990
P006	0	0	0	25	INCIN/FSUBS	Aug 8, 1990
P105	0	0	0	3	INCIN/FSUBS	Aug 8, 1990
P108	0	0	0	0	INCIN/FSUBS/CHOXD/CHRED	Aug 8, 1990
U001	0	0	0	6	INCIN/CHOXD/CHRED	Aug 8, 1990
U003	0	0	0	0	INCIN/FSUBS	Aug 8, 1990
U010	0	0	0	0	INCIN/FSUBS	Aug 8, 1990
U055	0	0	0	0	INCIN/FSUBS	Aug 8, 1990
U056	0	0	0	0	INCIN/FSUBS	Aug 8, 1990
U057	0	0	0	0	INCIN/FSUBS	Aug 8, 1990
U091	0	0	0	0	INCIN/FSUBS	Aug 8, 1990
U095	0	0	0	1	INCIN/FSUBS	Aug 8, 1990
U103	0	0	0	339	INCIN/FSUBS/CHOXD/CHRED	Aug 8, 1990
U114	0	0	0	0	INCIN/FSUBS	Aug 8, 1990
U123	0	0	0	91	INCIN/FSUBS	Aug 8, 1990
U124	0	0	0	0	INCIN/FSUBS	Aug 8, 1990
U126	0	0	0	40	INCIN/FSUBS	Aug 8, 1990
U135	0	0	0	90	INCIN/FSUBS/CHOXD/CHRED	Aug 8, 1990
U191	0	0	0	1	INCIN/CHOXD/CHRED	Aug 8, 1990
U218	0	0	0	16	INCIN/FSUBS	Aug 8, 1990
U222	0	0	0	1	INCIN/FSUBS	June 8, 1989
U248	0	0	0	40	CHOXD/WETOX/INCIN	Aug 8, 1990

(a) The order of the treatments does not reflect a preference by EPA

(b) The treatment codes are as follows: INCIN=incineration; FSUBS=fuel substitution; CHOXD= chemical oxidation; CHRED=chemical reduction; WETOX=wet air oxidation; RORGS=organic recovery

APPENDIX D

Table D-1 Hazardous Wastes Generated in North Carolina in 1990 that BDAT* was Based in Incineration (lbs)**

WASTE CODE	AMOUNT GENERATED	RECEIVED FROM OFFSITE	AMOUNT TREATED OFFSITE	WASTE HANDLING METHOD 1990				EFFECTIVE DATE of LDR
				INCINERATION	LANDFILL	STORAGE	OTHER TREATMENT	
D012	1	0	1	1	0	0	0	August 8, 1990
D013	50	0	50	10	0	40	0	August 8, 1990
D014	2,120	0	2,120	0	0	2,120	0	August 8, 1990
D016	2	0	2	2	0	0	0	August 8, 1990
F005 (a)	30,223,547	4,913,158	26,660,177	1,888,125	3,965,776	2,392,630	18,413,646	August 8, 1990
K001	78,710,469	15,750	78,694,719	73,017,939	4,749,020	0	927,760	August 8, 1988
K083	5,788,750	30,510	5,792,550	34,843	0	0	5,757,707	August 8, 1990
K085	46,799	0	46,799	0	46,799	0	0	August 8, 1990
K086	1,064,100	338,400	700,050	0	0	0	700,050	August 8, 1988
K101	39,400	8,000	31,400	0	31,400	0	0	August 8, 1992
K102	125,900	2,700	125,800	0	125,800	0	0	August 8, 1992
P020	269,441	0	269,441	264,360	0	1	5,080	August 8, 1990
P048	3	0	71	0	0	71	0	August 8, 1990
P050	10	0	10	10	0	0	0	August 8, 1990
P077	2	0	3	1	0	2	0	August 8, 1990
P089	1	0	1	1	0	0	0	June 8, 1989
P094	4	0	4	4	0	0	0	June 8, 1989
U002	452,987	0	452,987	7	452,980	0	0	August 8, 1990
U004	2	2	0	0	0	0	0	August 8, 1990
U009	1	0	1	0	0	0	1	August 8, 1990
U019	98,531	6	98,525	0	0	113	98,412	August 8, 1990
U028	24,588	200	26,169	26,169	0	0	0	June 8, 1989
U029	327	0	327	0	0	327	0	August 8, 1990
U031	829	1	828	420	0	408	0	August 8, 1990
U036	20,000	0	20,000	0	0	0	20,000	August 8, 1990
U039	10	0	10	0	0	10	0	August 8, 1990
U044	7,524	601	8,073	2,780	0	5,281	12	August 8, 1990
U048	22,161	2,101	21,860	0	0	17,610	4,250	August 8, 1990
U050	3,800	0	3,800	0	0	3,800	0	August 8, 1990
U051	11,618	5,000	6,618	1	0	17	6,600	August 8, 1990
U052	12	3	9	9	0	0	0	August 8, 1990

Table D-1 Cont.

WASTE CODE	AMOUNT GENERATED	RECEIVED FROM OFFSITE	AMOUNT TREATED OFFSITE	WASTE HANDLING METHOD 1990				EFFECTIVE DATE of LDR
				INCINERATION	LANDFILL	STORAGE	OTHER TREATMENT	
U060	6,386,340	0	6,386,340	0	6,386,340	0	0	August 8, 1990
U061	5,848,200	0	5,848,200	90	5,848,110	0	0	August 8, 1990
U066	16	0	16	16	0	0	0	August 8, 1990
U067	227	0	227	227	0	0	0	August 8, 1990
U069	124	0	124	113	0	11	0	June 8, 1989
U070	13	4	9	9	0	0	0	August 8, 1990
U071	20	0	20	20	0	0	0	August 8, 1990
U072	3	0	3	2	0	1	0	August 8, 1990
U075	55	0	161	161	0	0	0	August 8, 1990
U077	41,465	0	80,355	515	0	0	79,840	August 8, 1990
U078	751	0	751	751	0	0	0	August 8, 1990
U080	25,688	466	26,422	3,611	17,000	5,811	0	August 8, 1990
U081	1	0	1	1	0	0	0	August 8, 1990
U102	25	0	25	25	0	0	0	June 8, 1989
U107	28,359	0	28,359	28,351	0	8	0	June 8, 1989
U108	10	0	10	8	0	2	0	August 8, 1990
U112	1,369	0	1,369	40	0	1,329	0	August 8, 1990
U117	60	0	60	23	0	37	0	August 8, 1990
U127	1	1	0	0	0	0	0	August 8, 1990
U129	52	0	117	2	0	115	0	August 8, 1990
U138	71	0	71	1	0	70	0	August 8, 1990
U140	33	33	0	0	0	0	0	August 8, 1990
U142	2	0	2	0	0	2	0	August 8, 1990
U144	61	0	61	18	0	43	0	August 8, 1990
U158	12,495	1,231	13,554	0	0	13,554	0	August 8, 1990
U159	45,775	83	45,692	800	36,000	84	8,808	August 8, 1990
U161	471	459	1,013	554	0	459	0	August 8, 1990
U162	46	0	46	1	0	45	0	August 8, 1990
U165	178,374	0	178,379	31	0	178,348	0	August 8, 1990

Table D-1 Cont.

WASTE CODE	AMOUNT GENERATED	RECEIVED FROM OFFSITE	AMOUNT TREATED OFFSITE	WASTE HANDLING METHOD 1990				EFFECTIVE DATE of LDR
				INCINERATION	LANDFILL	STORAGE	OTHER TREATMENT	
U169	14,309	14	14,579	14,570	0	9	0	August 8, 1990
U185	321	0	321	321	0	0	0	August 8, 1990
U188	117,635	1,258	116,377	1,460	0	112,585	2,332	August 9, 1990
U196	1,152	0	2,257	2,241	0	16	0	August 9, 1990
U210	90,945	0	90,945	200	87,840	2,905	0	August 9, 1990
U211	512	12	500	30	0	470	0	August 9, 1990
U220	733,259	105,857	627,402	1,263	598,970	280	26,889	August 9, 1990
U225	50	2	48	13	0	35	0	August 9, 1990
U226	187,549	405	187,152	2,930	183,000	1,222	0	August 9, 1990
U227	10	0	10	10	0	0	0	August 9, 1990
U228	2,920	0	2,920	0	0	2,920	0	August 9, 1990
U239	514,157	9,760	504,489	87,201	407,080	9,308	900	August 9, 1990
U240	240	0	240	200	0	40	0	August 9, 1990

*Best Demonstrated Available Technology

** Waste from generators producing >2200 pounds per month

(a) F005 wastes have both concentration based requirements and technology based requirements depending on the constituent present. See text for more detail.

APPENDIX E

Table E-1 Hazardous Wastes Generated in North Carolina in 1990 with Deactivation as Required Treatment (lbs)*

WASTE CODE	AMOUNT GENERATED	RECEIVED FROM OFFSITE	AMOUNT SHIPPED OFFSITE	WASTE HANDLING METHOD, 1990	
				INCINERATION	CHEMICAL TREATMENT
All other					
D001 (a)	24,432,228	10,963,066	14,158,765	4,065,472	310,078
D002	7,090,666	2,009,274	5,289,679	44,454	595,603
D003	1,464,405	1,284,334	232,753	19,614	26,090

WASTE CODE	HANDLING METHOD , 1990				EFFECTIVE DATE
	LAND DISPOSAL	RESOURCE RECOVERY	OTHER TREATMENT	STORAGE	
All other					
D001 (a)	169,406	5,344,191	1,915,602	2,354,016	Aug.8, 1990
D002	394,858	422,126	3,531,299	301,339	Aug.8, 1990
D003	2,375	1,983	67,103	115,588	Aug.8, 1990

*Wastes from generators producing > 2200 lbs per month

(a) D001 wastes excluding ignitable compressed gases.
See Appendix B for ignitable compressed gases subcategory.

APPENDIX F

Wastes Covered by Land Disposal Restrictions not Generated in North Carolina in 1990

Wastes with Incineration as Required Treatment

F024	U014
F039	U015
K025	U026
K026	U033
K039	U034
K048	U038
K049	U041
K050	U042
K051	U046
K052	U049
P002	U062
P007	U073
P008	U074
P013	U087
P014	U093
P017	U097
P018	U110
P023	U116
P026	U130
P027	U132
P034	U143
P040	U148
P041	U149
P042	U150
P043	U153
P045	U156
P046	U163
P047	U164
P049	U167
P057	U168
P058	U171
P062	U173
P065	U176
P066	U177
P067	U178
P069	U184
P072	U191
P082	U193

Wastes with Incineration as Required Treatment (cont.)

P084	U194
P085	U200
P092	U202
P095	U206
P111	U234
P116	U237
P118	U244

U010

Wastes with Incineration as One of Required Treatments

P031 CHOXD/WETOX/INCIN
P033 CHOXD/WETOX/INCIN
P006 INCIN/CHOXD/CHRED
P096 INCIN/CHOXD/CHRED
U189 INCIN/CHOXD/CHRED
U249 INCIN/CHOXD/CHRED

K027	INCIN/FSUBS	U064	INCIN/FSUBS
K113	INCIN/FSUBS	U085	INCIN/FSUBS
K114	INCIN/FSUBS	U089	INCIN/FSUBS
K115	INCIN/FSUBS	U090	INCIN/FSUBS
K116	INCIN/FSUBS	U094	INCIN/FSUBS
P088	INCIN/FSUBS	U125	INCIN/FSUBS
P102	INCIN/FSUBS	U166	INCIN/FSUBS
U016	INCIN/FSUBS	U182	INCIN/FSUBS
U053	INCIN/FSUBS	U186	INCIN/FSUBS

P009	INCIN/FSUBS/CHOXD/CHRED	U096	INCIN/FSUBS/CHOXD/CHRED
P068	INCIN/FSUBS/CHOXD/CHRED	U098	INCIN/FSUBS/CHOXD/CHRED
P081	INCIN/FSUBS/CHOXD/CHRED	U099	INCIN/FSUBS/CHOXD/CHRED
P112	INCIN/FSUBS/CHOXD/CHRED	U109	INCIN/FSUBS/CHOXD/CHRED
U023	INCIN/FSUBS/CHOXD/CHRED	U160	INCIN/FSUBS/CHOXD/CHRED
U086	INCIN/FSUBS/CHOXD/CHRED		

D001 INCIN/FSUBS/RORGS

Wastes with Incineration Based Concentration Standards

D015	P059
D017	P060
F005	P071

Wastes with Incineration Based Concentration Standards (cont.)

F010	P097
F011	P101
F012	P110
F024	P123
F025	U005
K009	U018
K010	U022
K011	U024
K013	U025
K014	U027
K015	U030
K016	U043
K017	U047
K018	U050
K019	U063
K020	U068
K021	U076
K022	U079
K023	U082
K024	U083
K028	U084
K029	U088
K030	U101
K032	U105
K033	U106
K034	U109
K035	U111
K036	U118
K037	U120
K038	U121
K040	U128
K041	U131
K042	U137
K043	U141
K046	U145
K048	U146
K049	U152
K050	U155
K051	U157
K052	U172
K073	U174
K087	U179
K093	U180
K094	U181

Wastes with Incineration Based Concentration Standards (cont.)

K095	U183
K096	U187
K097	U192
K098	U203
K105	U207
P004	U208
P024	U209
P037	U235
P039	U243
P047	U247
P051	

Wastes With Deactivation as Required Treatment

K044
K045
K047