Trash, Ash and the Phoenix: A Fifth Anniversary Review of the Supreme Court’s City of Chicago Waste-to-Energy Combustion Ash Decision

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TRASH, ASH, AND THE PHOENIX: A FIFTH ANNIVERSARY REVIEW OF THE SUPREME COURT'S CITY OF CHICAGO WASTE-TO-ENERGY COMBUSTION ASH DECISION

Markus G. Puder*

In 1994, the U.S. Supreme Court held that ash generated by waste-to-energy (WTE) facilities was not exempt from Subtitle C hazardous waste management regulations under the Resource Conservation and Recovery Act (RCRA). As a result of City of Chicago v. Environmental Defense Fund, Inc., WTE installations are required to test their combustion ash and determine whether it is hazardous. The WTE industry and the municipalities utilizing WTE technologies initially feared that if significant amounts of their ash tested hazardous, the costs and liabilities associated with RCRA Subtitle C hazardous waste management requirements would pose a serious threat to the continued viability of the WTE concept. In this article, the author presents a review of the WTE industry in the five years following the decision, and finds that the specter of the decline of WTE has not materialized.

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INTRODUCTION

On May 2, 1994, the United States Supreme Court held that ash generated by certain municipal waste-to-energy (WTE) facilities that burn household wastes alone or in combination with nonhazardous wastes from industrial and commercial sources is not exempt from regulation as hazardous waste under Subtitle C of the Resource Conservation and Recovery Act (RCRA). The decision required the En-

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2 The WTE concept emerged when local governments took a second look at their municipal solid waste (MSW) and recognized that "waste is something more than an undesirable by-product of urban life which is to be dumped as quickly as possible." Joseph Ferrante, Jr., Nonhazardous Municipal Solid Waste: Another Problem—Another Solution, 9 CAP. U. L. REV. 567, 567 (1980). WTE installations were promoted in the 1970s to respond to two national emergencies: the energy crisis and the garbage (scarcity of landfill) crisis. See James V. DeLong, Sackcloth and Ash: City of Chicago v. Environmental Defense Fund, 2 Envtl. L. Rep. (Envtl. L. Inst.) 10,536 (Sept. 1994). The annual MSW generation, more than 210 million tons, almost equals the rate for RCRA-regulated hazardous waste of 214 million tons, which has been steadily declining over the last years. For general information pertaining to MSW generation, see U.S. ENVTL. PROTECTION AGENCY, CHARACTERIZATION OF MUNICIPAL SOLID WASTE IN THE UNITED STATES: 1996 UPDATE, EPA530-R-97-015 (1997) (hereinafter EPA 1996 UPDATE ON MSW). For general information pertaining to hazardous waste generation, see U.S. ENVTL. PROTECTION AGENCY, NATIONAL BIENNIAL RCRA HAZARDOUS WASTE REPORT (BASED ON 1995 DATA), EPA530-R-97-022 (1997). MSW is constituted from household, commercial, institutional, light industrial, and small quantities of special wastes, such as from hospitals and laboratories. An industry of MSW combustion and/or processing for recovery of valuable components, including energy, has emerged. For a description of the early developments of the WTE industry, see H. TAYLOR, ENERGY RECOVERY FROM MUNICIPAL WASTE (1984). Facilities that burn waste to produce steam or electricity are generally called WTE plants. WTE installations sometimes are called resource recovery facilities, but the term is somewhat misleading; "resource recovery" actually refers to the recovery of all resources from waste, both materials and energy. WTE plants, which burn nearly 32 million tons of trash, about 15% of America's MSW, can reduce waste volume by 60% to 90% and weight—on a wet basis—by 75% while recovering energy from discarded products. See GREGG RIGO & MARIA ZANES, THE 1997–1998 IWSA WASTE-TO-ENERGY DIRECTORY OF UNITED STATES FACILITIES (1997). WTE facilities generate 2775 megawatts of electricity and nearly 1.2 million pounds of steam, thus generating the energy equivalent to meet the power needs of 2.4 million homes across the United States. See id. Moreover, nearly 775,000 tons of steel are recovered for recycling each year at WTE plants. See id. An additional 135,000 tons each year of glass, plastics, white goods, batteries, paper, cardboard, metals, and garden waste is recycled onsite at WTE facilities. See id. Also, these plants help to alleviate the problem of shrinking landfill capacities. Within four decades, burning MSW for energy will have significantly changed the mix of methods of management and MSW disposal. Burning MSW for energy was not pursued in 1960; however, by the year 2000, a quarter of MSW may be burned for energy. Concurrently, the share of landfilling may decline from a range of two-thirds to three-quarters, as registered between 1960 and 1988, to about one-half projected for the year 2000. See Keith Schneider, Incinerator Operators Say Ruling Will Be Costly, N.Y. TIMES, May 3, 1994, at A18 (presenting data provided by the National Solid Wastes Management Association). As combustion of MSW has increased in recent years, so has the concern over the management of municipal waste combustion (MWC) ash.

3 See Solid Waste Disposal Act, 42 U.S.C. §§ 6901–6992k (1994). RCRA was enacted in 1976,
environmental Protection Agency (EPA or the Agency) to revise its prior position that the ash was exempt from hazardous waste regulation. As a result, WTE combustion ash has the same status as other solid wastes. Generators must determine whether their waste is hazardous under EPA's hazardous waste identification rules. EPA has not listed WTE combustion ash as hazardous waste, however, the ash may exhibit hazardous waste characteristics. When generators find the ash to be hazardous, they must comply with applicable RCRA Subtitle C regulations governing the full lifecycle of hazardous waste from inception to final disposition, or from "cradle to grave."

The City of Chicago v. Environmental Defense Fund, Inc. decision and EPA's implementation strategy sparked a vivacious debate on the case's potential impacts, unresolved issues, and the future of the WTE industry in general. Several alternative regulatory options were discussed. While environmental groups maintained that WTE combustion ash was toxic, and therefore should be managed under RCRA's hazardous waste provisions, WTE representatives originally asserted that sky rocketing ash management costs and liabilities resulting from City of Chicago would effectively wipe out the industry. The broad spectrum of discussions reflects the potentially conflicting policy goals embedded in RCRA itself. The Act, generally speaking, strives to balance the protection of health and the environment with the conservation of resources.

This article describes how the contrasting visions of the impact of City of Chicago have played out in the five years since the Supreme Court handed down its decision. Part I provides general information on WTE combustion ash. Part II highlights WTE ash management policy within the framework of RCRA. Part III reviews the ramifications of the Supreme Court decision. Finally, the article concludes that


4 See City of Chicago, 511 U.S. at 339.
5 See id.
9 See Solid Waste Disposal Act, 42 U.S.C. § 6902(a) (1994) (stating that "[t]he objectives of this chapter are to promote the protection of health and the environment and to conserve valuable material and energy resources").
in light of the *City of Chicago* decision and EPA's strategy for implementing the holding, the original ominous predictions for the future of the WTE industry have not materialized.

I. FACTS ON WTE COMBUSTION ASH

This part introduces the *City of Chicago* decision by presenting a general definition of WTE combustion ash, outlining the distinguishing characteristics of bottom and fly ash, and estimating annual ash residues.

A. WTE Combustion Technologies

WTE plants burn municipal solid waste (MSW) to produce steam for heating or electricity generation.\(^{10}\) The most common technology—mass burn—accepts trash after minimal pre-processing.\(^ {11}\) A slowly moving grate carries the MSW through the combustion chamber. Air is injected above and below the grate and temperatures reach between 1100 and 1375 degrees Celsius. Noncombustible materials and ash residue pass through for collection. Other WTE technologies include rotary kiln and fluidized-bed combustion processes. An alternative approach removes noncombustible material and reduces the size of the combustible material, which is sometimes formed into pellets.\(^ {12}\) The resulting refuse-derived fuel or process-engineered fuel can then be burned onsite, at a separate WTE facility, or as an additive at a coal-fired plant.

Every WTE installation that incinerates either raw MSW or prepared refuse-derived fuel generates an ash residue. The incineration process can reduce the volume of the waste stream by 60% to 90%, and its weight by 75%.\(^ {13}\) Ash is produced from the combustion of all fuels, including MSW and prepared refuse derived fuels. This ash is composed of the following two general types of components: (1) noncombustible inorganic materials that are present in the fuel, including metals, glass, and stones; and (2) complex organic materials that are formed primarily from carbon atoms that escape combustion and, in small quantities, form part of the small soot residue.\(^ {14}\)

\(^{10}\) See generally RIGO & ZANNES, supra note 2.

\(^{11}\) See id.

\(^{12}\) See id.


\(^{14}\) See KEEP AMERICA BEAUTIFUL, INC., OVERVIEW OF INTEGRATED WASTE MANAGEMENT 22 (1996) [hereinafter KEEP AMERICA BEAUTIFUL].
B. Bottom Ash and Fly Ash

Two types of ash are created by WTE facilities: bottom ash and fly ash.15 Bottom ash and fly ash are usually mixed by generators, because the combination is more easily stored, handled, and transported than the fly ash by itself.16 Moreover, uniting the two ash streams tends to dilute the concentration of harmful substances and reduce leaching.17

Bottom ash is the large and moderate-sized unburnable matter left after the waste has passed through the combustion chamber.18 It is the coarse, relatively dense (forty to seventy lbs/ft³ dry weight basis) ash remaining on the furnace grate.19 This type of ash comprises about 75% to 90% of the total WTE combustion ash residue, depending on the technology employed.20

Fly ash is a powdery material suspended in the flue gas stream, collected in the air-pollution-control equipment.21 It is the light (usually less than 20 lbs/ft³ dry weight basis) flue gas-entrainable particle material carried off the furnace grate during combustion by the updrafting of underfire air.22 Depending on the facility design, these flue gas-entrained particles, volatilized elements and compounds, and gaseous fractions will be partially collected in post-combustion fly ash hoppers mostly in solid particle form, with some smaller gaseous fractions entrapped in gaseous form.23 Fly ash tends to have higher concentrations of metals and organic materials than bottom ash. It represents between 10% and 25% of the overall ash created by a facility.24

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16 See Keep America Beautiful, supra note 14, at 22.
17 See id. at 20; Ujihara & Gough, supra note 15, at 22.
18 See 60 Fed. Reg. at 6666.
20 See Keep America Beautiful, supra note 14, at 22; see also 60 Fed. Reg. at 6666 (reporting 75% to 80%).
21 See 60 Fed. Reg. at 6666, 6670.
22 See Sampling & Analysis, supra note 19, at app.
23 See id.
24 See Keep America Beautiful, supra note 14, at 22; see also 60 Fed. Reg. at 6667 (providing 20% to 25%).
C. Amounts of Ash Generated by WTE Plants

Post-combustion wet ash weighs on average about a quarter of the incoming MSW.\textsuperscript{25} Mass burning and modular facilities, which burn their wastes without preprocessing, in most cases, tend to have a relatively higher ash to input waste ratio.\textsuperscript{26} Assuming that the combustion process generates ash that weighs 25\% of the original incoming trash, Table 1 in the Appendix estimates the ash residue based on daily and annual overall plant capacities of U.S. WTE facilities.\textsuperscript{27}

In 1993, WTE plants processed 30.9 million tons of MSW, thus generating approximately 7.73 million tons of ash per year. In 1998, 112 WTE facilities were estimated to combust 31.8 million tons of trash and produce 7.95 million tons of ash. Table 2 in the Appendix derives from these numbers the generation ranges for bottom and fly ash, assuming that the former comprises between 75\% and 90\% and the latter between 10\% and 25\% of the overall ash residue.\textsuperscript{28}

In 1993, 125 WTE installations thus produced between 5.8 and 6.96 million tons of bottom ash and between 0.77 and 1.93 million tons of fly ash. The annual generation for plants operating in 1998 may range between 5.96 and 7.16 million tons of bottom ash and 0.78 and 1.99 million tons of fly ash.

II. WTE Ash Management Policy Within the Framework of RCRA

This part provides the statutory and regulatory developments of RCRA law as it relates to WTE ash management, discusses the Supreme Court's \textit{City of Chicago} decision, presents EPA's implementation strategy, and highlights alternative administrative and legislative options.


\textsuperscript{26} See id.


\textsuperscript{28} The annual bottom ash and fly ash ranges have been calculated by the author based on 1993 and 1997/1998 industry data. For 1993 data, see Kiser \\& Bridges, \textit{supra} note 27. For 1997/1998 data, see Rigo \\& Zannes, \textit{supra} note 2.
A. Statutory and Regulatory Developments

Responding to America's limited landfill capacity and the potential dangers involved in landfilling hazardous wastes, Congress enacted RCRA in 1976. The Act describes a series of legislative goals, including: (1) protecting human health and the environment; (2) regulating hazardous waste from creation to disposal; (3) establishing guidelines for disposal of nonhazardous waste; and (4) promoting resource conservation and resource-recovery systems. The following sections describe the RCRA statutory regime and detail the early developments in ash regulation.

1. The RCRA Regime

Only solid wastes are governed by RCRA. EPA regulates any discarded material not otherwise excluded by regulation or by a variance as a solid waste. Discarded materials encompass abandoned, recycled, or inherently waste-like substances. Abandoned materials include substances that are "disposed of; or burned or incinerated; or accumulated, stored, or treated (but not recycled) before or in lieu of being abandoned by being disposed of, burned, or incinerated." MSW meets this definition because it is comprised of abandoned materials. RCRA divides solid wastes into two categories. Unless partially or totally exempted, hazardous solid wastes must be managed under Subtitle C, and nonhazardous solid wastes are governed by Subtitle D.

30 See id. § 6902(a), (b).
31 See id. § 6903(27). Section 6903(27) defines solid waste as any garbage, refuse, sludge from a waste treatment plant, water supply treatment plant, or air pollution control facility and other discarded material, including solid, liquid, semisolid, or contained gaseous material resulting from industrial, commercial, mining, and agricultural operations, and from community activities, but does not include solid or dissolved material in domestic sewage, or solid or dissolved materials in irrigation return flows or industrial discharges . . . .

Id.
33 See id. § 261.2(a)(2).
34 Id. § 261.2(a)(2)(i), (b)(1)-(3).
35 See id.; Jane Ellen Werner, Note, The Household Waste Exclusion Clarification; 42 U.S.C. Section 6921(i): Did Congress Intend to Exclude Municipal Solid Waste from Regulation as Hazardous Waste under Subtitle C?, 16 W. NEW ENG. L. REV. 149, 153 (1994) (explaining that, because "municipal ash must be discarded or abandoned as a last step in the waste management process," solid waste regulations govern this "disposed-of material").
36 See 42 U.S.C. §§ 6921-6939e (containing hazardous waste provisions).
37 See id. §§ 6941-6949a (presenting provisions governing nonhazardous solid waste).
RCRA does not prescribe a method for determining whether a substance is hazardous but delegates this authority to EPA. According to EPA regulations, barring certain exclusions, any person who generates a solid waste must determine if that waste is a hazardous waste. If the solid waste is not listed by EPA as hazardous, then the generator must characterize it. The four characteristics for determining whether a solid waste is hazardous are ignitability, corrosivity, reactivity, and toxicity. In general, the regulations provide two possible ways for assessing whether a nonexempt, unlisted waste exhibits a characteristic. The determination may be based on running the waste through an approved testing procedure or by "applying knowledge of the hazard characteristic of the waste in light of the materials or the processes used." For a solid waste that exhibits a hazardous characteristic, various Subtitle C requirements may apply.

38 See id. § 6921(a) (charging EPA with developing and promulgating criteria for hazardous waste).
39 See 40 C.F.R. § 261.11 (providing criteria for listing hazardous waste); see also id. § 261.30 (presenting "f-listed," "k-listed," and "P" or "U" wastes).
40 See id. §§ 261.10-.11 (providing criteria for identifying the characteristics of hazardous waste and for listing of hazardous waste).
41 Id. §§ 261.21-.24.
42 See id. § 262.11(c).
43 See id. § 262.11(c)(1).
44 40 C.F.R. § 262.11(c)(2).
45 See ROBERT V. PERCIVAL ET AL., ENVIRONMENTAL REGULATION: LAW, SCIENCE, AND POLICY 205-21 (2d ed. 1996) (reviewing the history of the RCRA program and describing the structure and purposes of Subtitles C and D). In summary, the following RCRA rules for hazardous waste generation, transportation, and treatment, storage, and disposal facilities (TSDFs) may apply to hazardous waste. Generator requirements, which are governed by 40 C.F.R. pt. 262, are more labor and management intensive than technically difficult or prohibitively costly. They include a hazardous waste determination; completion of forms to obtain an EPA identification number and a manifest; proper waste handling and preparation for transportation; onsite storage restrictions; biennial reporting; and implementation of a waste-minimization program. Offsite transportation rules, under 40 C.F.R. pt. 263, require compliance with Department of Transportation (DOT) provisions on labeling, marking, placarding, proper container use, and spill reporting; completion and maintenance of manifests; delivery of hazardous wastes only to designated TSDFs; and clean-up responsibility for accidental spills or discharges. TSDF requirements, which are controlled by 40 C.F.R. pt. 264, attach to various types of facilities such as container-storage areas, waste treatment or storage tanks, landfills, waste piles, and surface impoundments. If a hazardous waste generator elected to develop a hazardous waste management facility onsite, the plant would become subject to TSDF requirements. Otherwise, a third-party TSDF may undertake the job. Specific requirements involve obtaining a permit; unit-specific standards for each type of treatment or disposal facility; emergency preparedness and contingency plans; record-keeping and reporting; closure and post-closure requirements; Land Disposal Restrictions (LDRs), which prohibit hazardous waste disposal in or on the land unless it has been treated according to EPA standards; and corrective action requirements when hazardous waste is improperly handled and goes beyond facility boundaries.
Subtitle D regulates the disposal of nonhazardous solid wastes. It is primarily administered by the states and focuses on regulating recycling activities and providing minimum federal requirements for state programs.\(^{46}\) Initially, Subtitle D prohibited open dumps and provided criteria for states to follow in operating sanitary landfills.\(^{47}\) Congressional amendments\(^{48}\) have required EPA to craft rules on location, design, operation, corrective action, closure, and long-term financial security of municipal landfills.\(^{49}\)

2. Early Developments in Ash Regulation

In 1980, EPA promulgated a rule exempting\(^{50}\) household wastes from classification as RCRA hazardous wastes.\(^{51}\) In the preamble to the rule, EPA indicated that this exemption would apply to residuals from the treatment of household wastes, including ash from the incineration of household wastes.\(^{52}\) Ash resulting from the combustion of household wastes combined with nonhazardous commercial and industrial wastes was not addressed.\(^{53}\) In 1984, Congress amended RCRA, adding the “Clarification of Household Waste Exclusion,” which es-

\(^{46}\) See Hill, supra note 3, at 10,273.
\(^{49}\) See 40 C.F.R. pt. 257, 258 (1998); Hillary A. Sale, Note, Trash, Ash, and Interpretation of RCRA, 17 HARV. ENVTL. L. REV. 409, 415 (1993) (stating that EPA prescribes synthetic liners, or the equivalent, over layers of clay at the bottom of the site for all new landfills and, in addition, groundwater monitoring and leachate protection systems for MSW landfills); see also Kathleen Farrelly, Comment, The New Federal Standards for Municipal Solid Waste Landfills: Adding Fuel to the Regulatory Fire, 3 VILL. ENVTL. L.J. 383, 394 (1992) (explaining that, if monitoring levels reveal extensive contamination, the operator must perform corrective measures until the facility achieves compliance for three consecutive years).
\(^{50}\) In addition to codifying criteria for determining hazardous wastes, EPA established exemptions for substances that may be hazardous. Such exemptions apply to the handling of the particular waste from its generation to its disposal. See 40 C.F.R. § 261.4 (providing a detailed list of exclusions).
\(^{51}\) See id. § 261.4(b)(1). The “household waste exclusion” provides
\section{Solid wastes which are not hazardous wastes. The following solid wastes are not hazardous wastes:
\begin{enumerate}
\item Household waste, including household waste that has been collected, transported, stored, treated, disposed, recovered (e.g., refuse-derived fuel) or reused. "Household waste" means any material (including garbage, trash and sanitary wastes in septic tanks) derived from households (including single and multiple residences, hotels and motels 
\end{enumerate}

Id.
\(^{52}\) See 45 Fed. Reg. 33,084, 33,099 (1980).
\(^{53}\) See id.
sentially provided that a resource recovery facility burning MSW was excluded from hazardous waste regulations that controlled “treating, storing, or otherwise managing hazardous waste.” However, the general reference to “household wastes” made no mention of municipal ash regulation.

Subsequently, EPA promulgated new household and nonhazardous waste regulations under the amendment. In the preamble accompanying this rule, EPA announced that it interpreted the statute and the rule to exempt the facilities, not the ash, from Subtitle C. Specifically, the Agency noted that residues from incineration might well “exhibit a characteristic of hazardous waste even if no hazardous wastes are burned.” However, EPA cautioned that it had no evidence confirming that ash residues were hazardous and that further regulation of resource recovery facilities would “have to await consideration of the important technical and policy issues” if serious questions about the toxicity of the ash arose. In the aftermath of its rule, EPA did not publish any statement informing owners and operators of facilities managing ash of any deadline for obtaining RCRA permits.

In the late 1980s, various EPA officials indicated that the Household Waste Exclusion of RCRA could be interpreted to exempt ash from Subtitle C, and that ash could be safely managed in nonhazardous waste disposal facilities. Also, Congress considered several bills that

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54 Hazardous and Solid Waste Amendments of 1984, 42 U.S.C. § 6921(i) (1994). RCRA section 3001(i) reads as follows

(i) Clarification of household waste exclusion

A resource recovery facility recovering energy from the mass burning of municipal solid waste shall not be deemed to be treating, storing, disposing of, or otherwise managing hazardous wastes for the purposes of regulation under this subchapter, if—

(1) such facility—

(A) receives and burns only—

(i) household waste (from single and multiple dwellings, hotels, motels, and other residential sources), and

(ii) solid waste from commercial or industrial sources that does not contain hazardous waste identified or listed under this section, and

(B) does not accept hazardous wastes identified or listed under this section, and

(2) the owner or operator of such facility has established contractual requirements or other appropriate notification or inspection procedures to assure that hazardous wastes are not received at or burned in such facility.

55 See Werner, supra note 35, at 157.
56 See 40 C.F.R. § 261.4(b)(1).
58 Id.
59 Id.
60 See generally Resource Conservation and Recovery Act—Oversight Hearings Before the
would have explicitly exempted ash from Subtitle C requirements.\textsuperscript{61} In November 1990, Congress enacted an amendment to the Clean Air Act prohibiting EPA from regulating ash as a hazardous waste under RCRA for a period of two years.\textsuperscript{62} In response, a number of states authorized by EPA to manage Subtitle C programs in lieu of the Agency's direct program implementation began exempting WTE combustion ash.\textsuperscript{63} Some interpreted their own regulations as identical to the provisions of RCRA.\textsuperscript{64} Others promulgated specific ash exemptions, which, in many instances, were accompanied by detailed regulations for the management of ash as a nonhazardous waste.\textsuperscript{65}

\section*{B. The City of Chicago Decision}

1. Facts and Prior Proceedings

Since 1971, the City of Chicago has owned and operated the North-west WTE facility, which combuts trash and recovers energy, leaving a residue of municipal waste combustion (MWC) ash.\textsuperscript{66} The plant burns approximately 350,000 tons of trash each year and produces energy that is used within the facility and sold to other entities.\textsuperscript{67} The City disposed of 110,000 to 140,000 tons per year of MWC ash residue at landfills unlicensed to accept hazardous wastes.\textsuperscript{68}

\textsuperscript{61} For a representative bill, which would have codified the exemption of MWC ash from RCRA's hazardous waste provisions, see Hearing on H.R. 2162, supra note 60, at 5.


\textsuperscript{64} See id.

\textsuperscript{65} See Letter from Frank Moscone, President, Recomp of Washington, to Bruce Weddle, Director, Municipal and Industrial Solid Waste Division, Office of Solid Waste, U.S. Envtl. Protection Agency (May 19, 1994) (on file with author).


\textsuperscript{67} See id.

\textsuperscript{68} See id.
In 1988, the Environmental Defense Fund, Inc. (EDF) filed a complaint under the citizen suit provision of RCRA\(^69\) against the City of Chicago and its mayor, alleging that the City was violating RCRA.\(^70\) EDF contended that the MWC ash generated by the facility was toxic enough to qualify as "hazardous waste" under EPA's regulations, and therefore management of the ash had to comply with Subtitle C requirements.\(^71\) It was uncontested that, with respect to the management of the ash, the City had not adhered to RCRA's Subtitle C requirements.\(^72\) However, the City asserted that the MWC ash was excluded from these requirements by virtue of the Household Waste Exclusion of RCRA.\(^73\) The District Court for the Northern District of Illinois held for the City,\(^74\) and EDF appealed.

The Court of Appeals for the Seventh Circuit reversed the judgment of the district court, concluding that the "ash generated from the incinerators of municipal resource-recovery facilities is subject to RCRA Subtitle C regulation."\(^75\) Meanwhile, in another case involving EDF and Wheelabrator, Inc., a WTE operator and manufacturer of WTE components, the Court of Appeals for the Second Circuit held that ash produced from the incineration of municipal solid waste was not subject to Subtitle C.\(^76\) As a consequence of the split between the circuit courts, different requirements would have been imposed by a single federal statute on similarly-situated communities.\(^77\) This would

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\(^{72}\) See Environmental Defense Fund, 727 F. Supp. at 421.

\(^{73}\) See id.; 42 U.S.C. § 6921(i).


\(^{75}\) Environmental Defense Fund, Inc. v. City of Chicago, 948 F.2d 345, 352 (7th Cir. 1991). The Seventh Circuit reasoned, \(inter alia\), that the plain language of the statute did not include MWC ash within the Household Waste Exclusion. See id. at 351–52.


have meant that municipalities in the Seventh Circuit would have had to manage their ash differently than those in the Second Circuit. The City of Chicago appealed to the Supreme Court, and the Supreme Court invited the Solicitor General to present the views of the United States. On September 18, 1992, while the invitation was outstanding, the EPA Administrator issued a memorandum to EPA Regional Administrators. The memorandum directed them, in accordance with the Agency's view of the Household Waste Exclusion of RCRA, to consider MWC ash as exempt from RCRA Subtitle C. Thereafter, the Supreme Court vacated the Seventh Circuit's decision in City of Chicago, and remanded the case back to the Seventh Circuit for further consideration in light of EPA's memorandum.

On remand, the Seventh Circuit reinstated its previous holding that, because the statute's plain language was clear in not exempting MWC ash that tests hazardous from RCRA Subtitle C provisions, EPA's memorandum did not affect its analysis. The City of Chicago again appealed to the Supreme Court, which granted the writ of certiorari.

2. Holding and Reasoning of the Court

Justice Scalia delivered the opinion of the Court, in which Chief Justice Rehnquist and Justices Blackmun, Kennedy, Souter, Thomas, and Ginsburg joined. The Court stated that the "task in this case"
was to determine whether, under the amendments to the "Clarification of Household Waste Exclusion," the MWC ash created by the petitioner's facility was subject to regulation as hazardous waste under Subtitle C of RCRA.\(^7\) The Court concluded that it was.\(^8\)

Looking at the statutory language, the Court stated that "so long as a facility recover[ed] energy by incineration," the plant was not a treatment, storage, and disposal facility (TSDF) falling under Subtitle C.\(^9\) However, the waste that a facility produces (as opposed to the waste it receives) was not even mentioned in the statute, and thus, there was no textual basis to invoke a waste stream exemption for WTE ash.\(^\)\(^0\)

The Court presented several lines of reasoning to counter the contention that the "practical effect" of the statutory language was to exempt the ash by virtue of exempting the plant.\(^9\) It noted that it was "the facility, not the ash, that 'shall not be deemed' to be subject to regulation under Subtitle C."\(^\)\(^9\) The Court then referred to RCRA's declaration that "waste that is . . . generated should be treated, stored, or disposed of so as to minimize the present and future threat to human health and the environment," a policy that would not permit ash toxic enough to qualify as hazardous to be disposed of in ordinary landfills.\(^\)\(^9\) The Court supported the observation of the court of appeals that the statutory language did not even exempt the facility in its capacity as a generator of hazardous waste, because the Household Waste Exclusion of RCRA only provided that the exempted facility shall not be deemed to be "treating, storing, disposing of, or

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\(^8\) See id. at 339.
\(^9\) Id. at 334.
\(^\)\(^0\) See id. at 334–35.
\(^1\) Id. at 335.
\(^9\) City of Chicago, 511 U.S. at 335.
\(^\)\(^3\) Id. (quoting 42 U.S.C. § 6902(b)).
\(^\)\(^4\) See id.
otherwise managing” hazardous waste, while omitting from the catalogue the word “generating.”95 Also, the exclusion did not define the four activities to encompass the production of hazardous waste.96 The Court concluded from the carefully constructed text of the Household Waste Exclusion of RCRA that, while a resource-recovery facility’s management activities were excluded from Subtitle C regulation, its generation of ash was not.97

The Court reasoned that because the text of the statute did not reference generation, such omission overrode a passage in the Senate Committee Report stating that “all waste management activities of such a facility, including the generation, transportation, treatment, storage and disposal of waste shall be covered by the exclusion.”98 In view of the argument that the activity by which the facilities “treat” MSW would be the very same activity by which they “generate” ash, the Court found “nothing extraordinary” about an activity being exempt for some purposes and nonexempt for others.99 Thus, the Court concluded, the incineration of MSW is exempt from TSDF regulation, but subject to regulation as hazardous waste with regard to ash generation.100

In the Superfund Amendments and Reauthorization Act of 1986, Congress provided that an “owner and operator of equipment used to recover methane from a landfill shall not be deemed to be managing, generating, transporting, treating, storing, or disposing of hazardous or liquid wastes within the meaning of” Subtitle C.101 In contrast to the Household Waste Exclusion of RCRA, this provision expressly mentions “generation.”102 In light of the principle that congressional intent is presumed when Congress includes particular language in one section of a statute but omits it in another,103 the Court found that

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95 Id. at 336. But see LaSalle, supra note 86, at 361 & n.115 (arguing that both terms “treating” and “otherwise managing” could be used to cover the creation of MWC ash).
96 See City of Chicago, 511 U.S. at 336.
97 See id. at 337.
98 Id. (quoting S. REP. No. 98-284, at 61 (1983)). For an analysis of Justice Scalia's strict, plain meaning approach, see Lawless, supra note 86, at 130-36 (explaining that, in general, Justice Scalia appears to be critical of the use of legislative history). But see LaSalle, supra note 86, at 362-65 (emphasizing that the statute should be read against the background of the 1980 regulation and the Committee Report, thus conserving the waste stream exclusion for MWC ash).
99 City of Chicago, 511 U.S. at 337.
100 See id.
102 See id.
Congress knew how to draft a waste-stream exemption in RCRA when it wanted to do so.\textsuperscript{104}

The Court disagreed with the assertion that it should defer to EPA's interpretation because the Court found no ambiguity in the text of the Clarification of the Household Waste Exclusion.\textsuperscript{105} The Court further rejected the contention that its interpretation would turn RCRA's Household Waste Exclusion into an "empty gesture," since it was "not nothing" to enact an exemption of household waste that had previously been subject to revision by administrative regulation.\textsuperscript{106}

The Court reiterated that the Household Waste Exclusion of RCRA should not be read to contain the cost-saving waste stream exemption sought by the petitioners.\textsuperscript{107} While the Court acknowledged RCRA's twin goals of preventing contamination and promoting resource recovery, it stated that it was not "unusual for legislation to contain diverse purposes that must be reconciled, and the most reliable guide for that task is the enacted text."\textsuperscript{108}

Justice Stevens filed a dissenting opinion, joined by Justice O'Connor.\textsuperscript{109} The dissent reasoned that the 1984 amendment was intended to be a clarification and not a modification or renunciation.\textsuperscript{110} In contrast to the majority, Justice Stevens found that the text of the Clarification of Household Waste Exclusion was ambiguous, and therefore the Court should have deferred to EPA's view as expressed in the Agency's memorandum of September 18, 1992.\textsuperscript{111}

\begin{footnotes}
\item[104] See City of Chicago, 511 U.S. at 337.
\item[105] See id. at 339 (citing Chevron U.S.A. v. Natural Resources Defense Council, 467 U.S. 837 (1984)). But see Lasalle, supra note 86, at 367-68 (advocating that absent express congressional direction to bring MWC ash under Subtitle C, general deference should have been given to EPA in this case because, in accordance with the Chevron principle, the Agency was "more appropriately granted to make policy choices and better suited to make those choices than the courts").
\item[106] See City of Chicago, 511 U.S. at 338.
\item[107] See id.
\item[108] Id. at 339. A counter-argument is that regulating MWC ash under Subtitle C would "effectively eliminate any incentive for resource recovery." Lasalle, supra note 86, at 364.
\item[109] See City of Chicago, 511 U.S. at 340 (Stevens, J., dissenting).
\item[110] See id. at 343-45 (citing S. Rep. No. 98-984, at 61 (1983)). Justice Stevens emphasized that the Senate Committee Report had included "generation" in the statute, and criticized the majority for not giving any weight to the Report. See id.
\item[111] See id. at 343-48.
\end{footnotes}
C. EPA Implementation Strategy

Under the Supreme Court's rules, the Court's decisions take effect when the Court formally notifies lower courts. The Court must wait at least twenty-five days before issuing such a notification. In City of Chicago, the notification date was May 27, 1994. Less than two months after the decision was handed down, EPA released a draft document on sampling and analysis of municipal refuse incinerator ash, issued a memorandum to EPA Regional Administrators on the implementation strategy for bringing WTE facilities affected by the Supreme Court decision into compliance with RCRA Subtitle C as quickly as possible, and published a Federal Register Notice of Extension of Date for Submission of Part A Permit Applications for Facilities Managing Ash from WTE Plants. Subsequently, within the first half of 1995, the Agency published a notice of statutory interpretation pertaining to the point of RCRA Subtitle C jurisdiction for WTE ash, revised its implementation strategy, and finalized its guidance on WTE combustion ash sampling and analysis.

1. Draft Document on Sampling and Analysis of Municipal Incinerator Ash

In the first guidance manual issued in the wake of City of Chicago, EPA emphasized that the guidance did not amount to a regulation, nor did it replace existing requirements or guidance developed by the appropriate regulators. Ideally, sampling and analysis plans should

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112 See EPA Moving Rapidly to Develop Hazardous Ash Guidance, ENV'T WK., May 26, 1994, at 21 (describing EPA's "aggressive compliance schedule"); see also Municipal Incinerator Ash Policy Challenged in Court, PESTICIDE & TOXIC CHEMICAL NEWS, Aug. 31, 1994, at 44 (reporting that in Integrated Waste Servs. Ass'n v. EPA, CA DC 94-1584 (Aug. 22, 1994) the Integrated Waste Services Association and three WTE facilities had petitioned a federal appeals court to review EPA's implementation strategy, the guidance document for ash sampling and testing, and EPA's denial to allow a temporary exemption from the definition of hazardous waste under RCRA Subtitle C or from the TC rule for resource-recovery facility ash). But see Telephone Interview with Maria Zannes, President of the Integrated Waste Services Association (July 26, 1998) (notes on file with author) (discussing subsequent settlement of the petition).

113 For the draft guidance, which was subsequently superceded, see U.S. ENVTL. PROTECTION AGENCY, SAMPLING AND ANALYSIS OF MUNICIPAL REUSE INCINERATOR ASH, DRAFT, EPA530-R-94-020 (1994). See SAMPLING & ANALYSIS, supra note 19. But see EPA Requests Comments on Draft About How To Test Incinerator Ash, SLUDGE, July 5, 1994, at 1 (reporting that industry has criticized the draft for its inconsistency with previous EPA guidance documents and lack of clarity and fairness); EPA's Incinerator Ash Guidance Plays to Mixed Reviews from Owners, HAZARDOUS WASTE NEWS, May 30, 1994, at 1 (alleging that "[t]he [Agency clearly wants solid waste chaos in America").

114 See OFFICE OF SOLID WASTE & EMERGENCY RESPONSE, U.S. ENVTL. PROTECTION
be tailored to site-specific conditions. According to EPA, the document was intended to assist municipal combustor owners and operators in designing plans to determine whether any ash constituent exceeds the levels specified in EPA's Toxicity Characteristic (TC).\textsuperscript{115} The document has the following sections: quality assurance and quality control, sampling and analysis, and strategies for evaluating samples.\textsuperscript{116}

a. \textit{Quality Assurance and Control}

Prior to starting a sampling and testing program, the guidance manual suggested that facilities should prepare a detailed quality assurance project plan describing the steps and controls to be followed.\textsuperscript{117} In addition, a knowledgeable person should be appointed to oversee the program and ensure that all procedures are followed.\textsuperscript{118}

b. \textit{Sampling and Analysis}

The guidance manual provided a sampling process, which included all the relevant steps: determining the most convenient location for sampling, constructing a sampling device, collecting two eight-hour composites, crushing the composite, and passing it over screens specified in size.\textsuperscript{119} The manual stipulated that in order to determine whether the ash exhibits the TC, 1000 gram aliquots of each eight-hour composite are to be tested, and the extract analyzed for maximum concentration of contaminants specified by EPA.\textsuperscript{120} EPA also prescribed the Toxicity Characteristic Leaching Procedure (TCLP) for determining whether incinerator ash is toxic.\textsuperscript{121}

The TCLP measures the possibility that a waste may leach toxic metals above a designated concentration level under certain assumed disposal conditions, and so it is a measure of the potential mobility of

\textsuperscript{115} See \textit{Sampling & Analysis}, supra note 19, at 1.

\textsuperscript{116} See id. at 2.

\textsuperscript{117} See id. at 13.

\textsuperscript{118} See id.

\textsuperscript{119} See id. at 5–6.

\textsuperscript{120} See \textit{Sampling & Analysis}, supra note 19, at 6.

\textsuperscript{121} See id. at 8.
toxic metals in a waste. The test is designed to simulate the conditions in a MSW landfill and to determine if the waste could become soluble and leach to the surrounding water supply. Liquid extracts from waste are tested for forty specific types of constituents, including lead and cadmium. If the extract contains constituents that exceed the maximum levels set by EPA, then the waste has exhibited a toxicity characteristic and is classified as hazardous. MWC combustion ash fails the TCLP if it leaches contaminant constituents, including lead or cadmium, above the levels set by EPA.

The TCLP consists of mixing 100 grams of sample with an acetic acid extraction fluid in a liquid-to-solid ratio of twenty-to-one. The sample is agitated end-over-end for eighteen hours and filtered. The filtrate is then prepared for analysis to determine the presence of the contaminants specified by EPA.

Prior to analysis of the extracts using atomic absorption spectrometry, inductively coupled plasma (ICP) spectroscopy, or gas chromatography, the extracts must be prepared using appropriate methods. EPA recommends several such methods. The analysis itself focuses on both metals and organics. Analytical techniques for trace-metal determinations include the following: ICP, direct aspiration flame atomic absorption, graphite furnace atomic absorption, hydride generation atomic absorption, and cold vapor atomic absorption.

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123 See Ujihara & Gough, supra note 15, at 20.
125 See id.
126 See 59 Fed. Reg. 29,374 (1994). The permissible level for lead is five milligrams per liter and for cadmium is one milligram per liter. See 40 C.F.R. § 261.24 tbl. 1 (1998); David C. Wartinbee, Incinerator Ash May Not Be a Hazardous Waste, but the Story Doesn’t End There!, 9 T.M. Cooley L. Rev. 115, 118 (1992) (explaining that contact with low dosages of lead may cause destructive neurological effects and that cadmium is classified as a carcinogen).
127 See Sampling & Analysis, supra note 19, at 8.
128 See id.
129 See id.
130 See id.
131 See id.
c. Strategies for Evaluating Samples

EPA's guidance manual recommended an approach for evaluating the data to determine whether the ash passes or fails the TC. The WTE facility should assess: (1) the mean TC concentration of the samples for each regulated analyte; (2) the standard deviation of the data employed to calculate the mean; and (3) the upper bound of the 90% confidence interval for the mean for each analyte.\(^{132}\) If the upper bound of the interval is below the applicable threshold for all analytes specified by EPA, then the waste passes the TC.\(^{133}\) If the upper bound of the interval is greater than or equal to the applicable regulatory threshold, then the waste fails the TC.\(^{134}\) According to the guidance manual, facilities should recharacterize their ash regularly, in light of the variability inherent in the ash generation process.\(^{135}\)

2. First Memorandum to the Regional Administrators: Implementation Strategy for Bringing WTE Facilities into Compliance

Under the EPA implementation strategy first communicated to Regional Administrators, WTE facilities had to implement a program for determining whether their ash exhibits a hazardous characteristic.\(^{136}\) Ash was to be tested four times a year.\(^{137}\) If the ash displayed a hazardous characteristic, and the WTE facility had "interim status,"\(^{138}\) a RCRA permit, or met the requirements of accumulation-time regulations,\(^{139}\) the facility would be allowed to treat the ash onsite.

\(^{132}\) See SAMPLING & ANALYSIS, supra note 19, at 14.
\(^{133}\) See id.
\(^{134}\) See id.
\(^{135}\) See id. at 3–4.
\(^{136}\) See U.S. ENVTL. PROTECTION AGENCY, IMPLEMENTATION STRATEGY OF U.S. SUPREME COURT DECISION IN CITY OF CHICAGO v. EDF FOR MUNICIPAL WASTE COMBUSTION ASH, EPA530-F-94-021 (1994) [hereinafter IMPLEMENTATION STRATEGY].
\(^{137}\) See Coalition of Environmental Groups Faults Ash Legislation, EPA Regulatory Approach, Daily Env't. Rep. (BNA) A1 (Aug. 30, 1994) (reporting that EPA's strategy rejected proposals which had further advocated daily as opposed to quarterly testing and had called for the participation of regulatory agencies in carrying out the testing).
\(^{138}\) Solid Waste Disposal Act, 42 U.S.C. § 6925(e) (1994); 40 C.F.R. § 270.1(b) (1998). To qualify for interim status, a hazardous waste management facility must meet the criteria set out in RCRA section 3005(e), which include filing a permit application. See 42 U.S.C. § 6925(e)(1)(C).
\(^{139}\) See 40 C.F.R. § 262.34. Generators are allowed to accumulate their own hazardous wastes onsite without a RCRA permit for storage under two circumstances. See id. Generators may accumulate up to 55 gallons of hazardous wastes at or near the point of generation in satellite...
and eliminate the characteristic in lieu of having to make arrange-
ments for the proper disposal of its ash at an approved Subtitle C
facility.\footnote{140}

EPA also advised the Regions to bring enforcement actions if: (1) ash man-
agement at a facility amounted to an imminent and substanta-
tial endangerment;\footnote{141} (2) the Agency had received information of an
ongoing or past release of hazardous waste or hazardous constituents
from a facility managing hazardous ash;\footnote{142} or (3) other indicators of
environmentally irresponsible management of hazardous ash were
present.\footnote{143}

3. Federal Register Notice

EPA's Federal Register notice stated that there had been "substan-
tial confusion" as to whether owners and operators of facilities man-
aging ash (from 100% household waste as well as from combined
sources) generated by WTE plants were required to file applications
for RCRA hazardous waste permits.\footnote{144} Therefore, EPA exercised its
authority\footnote{145} to extend the deadline within which owners and operators
of facilities that treat, store, or dispose of WTE ash determined to be
hazardous waste could file their RCRA permit applications until De-
cember 7, 1994.\footnote{146} This gave potentially-affected ash management fa-
cilities an additional six-month window of time to apply for hazardous
accumulation areas. See id. The containers have to be marked and main-
tained. See id. The waste must be moved into storage once the 55-gallon ceiling is reached. See id. § 262.34(c)(2). In
addition, generators may store hazardous wastes onsite prior to shipment for a period of up to
90 days in tanks or containers, provided that certain standards are met. See id. § 262.34(a). A
small quantity generator may store wastes for a longer period of time. See id. § 262.34(d)-(f).

\footnote{140}{See Implementation Strategy, supra note 136, at 2, 3.}
\footnote{141}{See 42 U.S.C. § 6973(a).}
\footnote{142}{See id. § 6928(h)(1).}
\footnote{143}{See id. § 6928(a). Such indicators include: (1) failure to manage ash that is a hazardous waste in solid waste management units; (2) failure to implement or have in place, within 90 days of the effective date of the Supreme Court decision, a method to determine whether or not the ash produced at the facility exhibits a hazardous waste characteristic (the facility being allowed to sample and test combined fly and bottom ash if they are mixed within the combustion unit); (3) failure to have controls on fugitive emissions during storage and transportation of ash that is a hazardous waste (e.g., quenching or wetting ash to minimize dust, transporting it in leak-resistant containers or trucks, and controlling run-on and run-off from ash-handling areas); and (4) reuse in any manner of ash that is a hazardous waste. See Implementation Strategy, supra note 136, at 3.}
\footnote{145}{See 40 C.F.R. § 270.10(e)(2) (1998).}
\footnote{146}{See 59 Fed. Reg. at 29,375.}
waste management permits, although, when City of Chicago took effect, hazardous ash would need to be managed in compliance with all applicable hazardous waste regulations.

In the same notice, EPA reemphasized that with the exception of RCRA Land Disposal Restrictions (LDR) compliance dates, the Agency would interpret the hazardous waste provisions of RCRA to apply to hazardous ash from WTE facilities. LDRs prohibit land disposal of hazardous wastes unless these wastes are first treated to reduce substantially the toxicity or mobility of their hazardous constituents, so as to minimize threats to human health and the environment. RCRA further stipulates dates on which particular groups of wastes are prohibited from land disposal unless they are treated. For wastes which are “newly identified or listed” after November 8, 1984, EPA must promulgate treatment standards within six months of the identification or listing.

EPA stated that ash from WTE facilities was “newly identified” for the purpose of applying the LDRs. The Agency noted that, although technically ash would be identified as hazardous under the existing TC rather than a new characteristic rule, the City of Chicago decision brought ash into the Subtitle C system for the first time (for ash from 100% household waste) or returned it to the system after a period of uncertainty (for ash from combined sources). This meant that then-existing LDRs would not apply to WTE combustion ash and that EPA had six months from the date of the identification of combustion ash as a “newly identified waste” to promulgate regulations for management and treatment of the ash.

Addressing hazardous waste regulations other than LDRs, EPA’s Federal Register Notice stated that facilities generating, transporting, treating, storing, or disposing of hazardous ash still would have to comply with the pertinent regulations on the effective date of the City of Chicago decision. EPA reminded generators, transporters, and treatment, storage, and disposal facilities that they thus had to obtain promptly EPA identification numbers. EPA also noted, how-

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147 See id. at 29,374–75; see also 42 U.S.C. § 6924(g)(4).
148 42 U.S.C. § 6924(d),(e),(g),(m).
149 Id. § 6924(d),(e),(g).
150 Id. § 6924(g)(4).
152 See id.
153 See id. at 29,376.
154 See id.; see also 40 C.F.R. § 262.12 (1998).
ever, that by following certain waste management practices, some facilities would not need interim status or a RCRA permit. For example, generators of hazardous ash may accumulate and treat ash onsite in tanks or containers for up to ninety days without obtaining hazardous waste permits.

EPA also advised persons handling ash to determine whether a state's base program contained an authorized exemption for ash, and whether the entity authorized to implement the TC and TCLP had extended its permit deadline. The Agency emphasized that its characterization of WTE combustion ash as a "newly identified waste" was nondelegable and, therefore, effective in all states.

4. EPA Interpretive Notice

Prior to EPA's interpretation of the issue, interested parties discussed several approaches to determine the point in time when RCRA jurisdiction attaches to combustion ash. A rather intense debate arose based on the consideration that fly ash alone would likely fail the TC, while bottom ash and fly ash combined was expected to pass. This meant that if RCRA jurisdiction attached to the ash before it was combined, WTE facilities would potentially face the full brunt of RCRA Subtitle C hazardous waste management requirements. This question was not resolved by the City of Chicago decision.

Environmental groups, including EDF, sought to require WTE owners and operators to make separate toxicity determinations for bottom and fly ash. This would have meant setting an early point for RCRA Subtitle C jurisdiction, namely inside the combustion building at multiple locations.

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156 See id.
158 See id.
160 See id. at 6667 (describing the interpretations that were considered by EPA).
162 See 60 Fed. Reg. at 6669.
163 Advocates of this approach maintained that fly and bottom ash should be separately tested under all circumstances; and if they are mixed prior to disposal, then the mixture, too, should be tested. See Letter from Richard A. Denison, Senior Scientist & Karen Florini, Senior Attorney, Environmental Defense Fund, to Bruce Weddle, Director, Municipal and Industrial Solid Waste Division, Office of Solid Waste, U.S. Env'tl. Protection Agency (May 18, 1994) (on
A status quo proposal was floated by some industry supporters as an interim approach. This proposal advocated deferring any decision until EPA proposed ash management standards in Phase V of the Agency's LDRs, while retaining the policy of allowing bottom ash and fly ash to be mixed prior to toxicity testing.\textsuperscript{164}

An alternative option advanced by industry groups and local governments proposed allowing WTE owners and operators to combine bottom ash and fly ash outside the combustion facility and test for toxicity at that point.\textsuperscript{165} This approach pushed back the point in time for RCRA jurisdiction, offering two alternatives: later RCRA jurisdiction, outside the property boundaries, or earlier RCRA jurisdiction, at the exit of the combustion building following combustion and air pollution control processes.

In its notice of statutory interpretation, EPA agreed with the latter alternative, considering RCRA Subtitle C jurisdiction to attach after ash left the combustion building.\textsuperscript{166} EPA thus provided a relatively

\textsuperscript{164} See Telephone Interview with Andrew Teplitzky, supra note 63.

\textsuperscript{165} Separate testing was viewed as a serious threat to combustion as a waste management alternative. See \textit{Point of Generation Debate Highlights Industry, EPA Disagreements Over Ash}, 219 Daily Envt'l. Rep. (BNA) AA1 (Nov. 16, 1994) [hereinafter \textit{Generation Debate}] (reporting, based on industry sources, that the costs for separate testing could amount to as much as $1 to $3 million per plant); see also Letter from Maribeth Flowers, City of Chicago, to Bruce Weddle, Director, Municipal and Industrial Solid Waste Division, Office of Solid Waste, U.S. Envtl. Protection Agency (May 18, 1994) (on file with author) (asserting that for combined ash handling systems, the point of generation is the collection point for the combined ash and disputing EPA's authority for such a requirement under RCRA); Letter from Harold Himmelman, Attorney, Beveridge & Diamond, to Bruce Weddle, Director, Municipal and Industrial Waste Division, Office of Solid Waste, U.S. Envtl. Protection Agency (May 16, 1994) (on file with author) (invoking environmental benefits based on the management of a single ash stream, and arguing that management of a single combined stream could reduce the potential for release of particulates from fly ash streams and create a cement-like matrix more resistant to leaching). Industry's strong opposition to separate testing of bottom ash and fly ash was based on the fear that EPA would assert its control within the "four walls" of a facility. See \textit{Generation Debate}, supra note 165, at AA1 (reporting industry concerns that intrusion inside the four walls of a facility to declare materials wastes could set precedents for testing a variety of materials that have not yet been discarded); see also Letter from David W. Gatton, The United States Conference of Mayors, to Bruce Weddle, Director, Municipal and Industrial Waste Division, Office of Solid Waste, U.S. Envtl. Protection Agency (May 17, 1994) (on file with author) (contending that ash should be tested at the point at which it is discarded, which, in the case of WTE combustors, would be at the end of a continuous, onsite ash management processing system of the resource-recovery facility).

\textsuperscript{166} See 60 Fed. Reg. at 6666.
late point in the WTE process for the attachment of RCRA jurisdiction, which often had the practical effect of giving generators the ability to combine bottom and fly ash, thus increasing the likelihood of TC passage. In the reasoning supporting its notice, EPA explained that it was responding to numerous requests for resolution of the issue by announcing its interpretation of the Household Waste Exclusion of RCRA.167

In the notice, the Agency supported its decision with several arguments. It first stated that the term “resource recovery facility”168 should be construed as the building that houses the combustion device (as opposed to multiple locations within the combustion building or all structures within the property boundaries), and that Congress intended RCRA’s Household Waste Exclusion to exempt all handling of any hazardous waste within that building.169 Furthermore, Congress sought to remove obstacles to the profitable operation of commercially viable resource recovery facilities, including the logistical problems and increased costs associated with any earlier point in time for RCRA jurisdiction.170 However, consistent with the City of Chicago decision, a type of total exemption for WTE combustion ash would not be created.171 Finally, the level of environmental regulation controlling ash would not be compromised.172

5. Second Memorandum to Regional Administrators: Revised Implementation Strategy for Bringing WTE Facilities into Compliance

In EPA’s second memorandum to Regional Administrators, dated March 22, 1995,173 the Agency selected the week of April 17, 1995, to begin enforcing management standards for MWC ash.174 According to the memorandum, EPA would “very likely regard as an indicator of irresponsible management of hazardous ash” failures by WTE facilities to make appropriate changes and test fly ash and bottom ash

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167 See id.
169 See 60 Fed. Reg. at 6668.
170 See id.
171 See id.
172 See id. MSW landfills have to meet regulatory safety requirements under 40 C.F.R. pt. 258.
174 See id. at 6; see also Solid Waste Disposal Act, 42 U.S.C. § 6928(h) (1994).
separately when necessary. According to the second memorandum, these arrangements had to be made within seventy-five days of the Agency's February 3, 1995, interpretive notice.


The final guidance manual, released in June of 1995, generally confirmed the content of the draft document. The guidance reiterated its nonbinding nature and EPA's interpretation as to when RCRA Subtitle C jurisdiction attaches—when the ash exits the combustion building.

7. Observations

EPA's overall implementation strategy and response to City of Chicago appears to reflect the Agency's attempt to serve two somewhat conflicting policy goals embedded in RCRA, namely environmental protection and energy conservation. The steps taken by EPA in the immediate aftermath of the Supreme Court's decision suggest that the Agency was emphasizing the environmental protection prong. However, EPA's February 3, 1995, notice of statutory interpretation focused on ensuring the continued viability of the WTE concept. By fixing a relatively late point in time for RCRA jurisdiction to attach to WTE combustion ash, the Agency enabled WTE ash generators to mix bottom and fly ash in most cases. As previously discussed, combined ash is less likely to test hazardous and trigger RCRA Subtitle C management requirements.

D. Alternative Regulatory Options

Several legislative and administrative options for complying with the City of Chicago decision were discussed in the spring and summer of 1994. Proposals included both tightening and easing the RCRA

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175 Revised Implementation Strategy, supra note 173, at 6.
176 See id.; 42 U.S.C. § 6928(h); see also 60 Fed. Reg. at 6666–70.
178 See Sampling & Analysis, supra note 19, at 1–2.
179 See id.
180 In the immediate aftermath of the decision and in the flurry of discussions, several interested parties suggested extending the transition periods or even staying the rule in order to
Subtitle C regime, establishing special waste management standards for WTE ash, and reverting to RCRA Subtitle D ash regulations.

1. Tightening or Easing the Subtitle C Regime

In its notice of statutory interpretation, EPA had already established a relatively lenient position toward the integration of WTE combustion ash into the RCRA regime. In addition to fixing a late point in time for the testing requirement, the Agency addressed onsite ash management activities in the interpretive notice. The Agency intimated that it would provide exemptions from the requirement of a federal hazardous waste permit for certain postcombustion building management activities as long as accumulation-level requirements were met.

Interested parties advanced proposals to further ease the effects of RCRA Subtitle C regulations governing onsite ash management (as opposed to ash generation). These included an exemption from TSDF requirements and a policy to mandate the onsite treatment of fly ash and bottom ash, either as separate ash streams or in combination, according to the owner's or operator's preference and the plant's operating procedures. The counter-proposal, which would have tightened Subtitle C's regulation of combustion ash, requested that...

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*See Letter from David W. Gatton, supra note 165. Gatton proposed that EPA issue a stay under: (1) Section 3010(b) of RCRA, which provides that new or revised regulations shall take effect six months after promulgation, but authorizes the Administrator to alter this schedule for good cause; (2) Section 705 of the Administrative Procedures Act (APA), which states that "when an agency finds that justice so requires, it may postpone the effective date of an action taken by it;," and (3) Section 553(b) of the APA, which authorizes administrative stays when "justice so requires." See id.; see also Letter from Stephen S. Passage, Montenay Power Corp., to Carol M. Browner, Administrator, U.S. Env'tl. Protection Agency (June 8, 1994) (on file with author). Passage suggested that EPA accord an overall transition period of 24 months to WTE plant operators to phase in a new regime, including a six-month period for the facility to select an ash treatment/screening system and apply for the necessary permits, a 12-month period after permit application to receive such permits, and another six-month period to install and start-up such a system. See id. But see Letter from Richard A. Denison & Karen Florini, supra note 163. Denison and Florini argued that MSW combustion ash had been subject to regulation as a hazardous waste at least since the effective date of the 1984 amendments to RCRA and reasoned that, while courts may treat a regulation as having lawfully been in effect, EPA never promulgated its views on Section 3000(i) of RCRA as a regulation. See id.*

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*See 60 Fed. Reg. at 6669.

*See id.*

*See Letter from David W. Gatton, supra note 165 (alleging that the Supreme Court decision would only subject ash generation—as opposed to ash management—to RCRA Subtitle C).*

*See Letter from Stephen S. Passage, supra note 180.*
EPA pronounce all treatment of ash, whether occurring onsite or offsite, to be governed by RCRA Subtitle C TSDF regulation.  

2. Establishing Special Waste Management Standards

Other regulatory options proposed in the aftermath of City of Chicago included specific exclusions for WTE combustion ash from the Subtitle C regime. Under a federal contingent exclusion, WTE combustion ash failing the TCLP (or possibly other designation tests) would have been considered hazardous unless it was managed in accordance with a specified management program. Suggestions for appropriate ash management methods included handling in accordance with state regulatory programs, disposal in ash “monocells,” which are spaces in landfills dedicated exclusively to ash, and disposal in double-lined “monofills.” Monofills, which are designed to isolate the ash residue, employ an impermeable liner to protect groundwater from potentially hazardous leachate formed when rainwater passes through wastes containing heavy metals or organic compounds. Advocates of such proposals referred to existing regulatory precedents excluding from Subtitle C: (1) the management of certain hazardous wastes through reinjection; and (2) petroleum-contaminated media.

Yet another approach, included in a draft bill introduced by a coalition of environmental and industry groups seeking to foster a compromise, involved exempting MSW ash from hazardous waste regulation and regulating it instead as a “special waste.” This proposal would have replaced EPA’s requirement of testing and treating ash for its hazardous characteristics with a plan including special waste management standards, to be phased in over five years and to apply

185 See Letter from Richard A. Denison & Karen Florini, supra note 163 (expressing doubts as to the effectiveness of commercially available handling and management methods that could make WTE combustion ash safer, and arguing that any post-generation treatment of TCLP-positive ash would require either a permit or compliance with the generator accumulation requirements).

186 See Letter from Frank Moscone, supra note 65; Letter from Harold Himmelman, supra note 165.

187 See Letter from Frank Moscone, supra note 65; Letter from Harold Himmelman, supra note 165.

188 See Letter from Frank Moscone, supra note 65, Letter from Harold Himmelman, supra note 165.


190 See id. § 261.4(b)(10).

191 See LeBlanc, supra note 86, at 524-27 (describing the EDF proposal).
to all WTE ash, whether treated, untreated, fly, bottom, or combined.\textsuperscript{192} Under the plan, ash would have been disposed of in a specially designed monofill with clay and synthetic liners or in a monocell. Batteries containing heavy metals would have been diverted from MWC combustors, and utilization of ash for secondary purposes (such as road construction material or landfill cover) would have been tightly controlled by future regulations.\textsuperscript{193} In exchange for the imposition of these requirements, the WTE industry would have been protected from retroactive liability scenarios predating the Supreme Court's \textit{City of Chicago} ruling. EPA would have been required to promulgate implementing regulations for new ash management standards within twelve months of the bill's enactment. Congress never considered the proposal.

3. Reverting to RCRA Subtitle D

Regulation of WTE ash under Subtitle D of RCRA, discussed by WTE interest groups but never seriously proposed for enactment by Congress, would have reverted ash management back to the situation prior to the \textit{City of Chicago} decision. This would have reinstated the effects of EPA's September 18, 1992, memorandum.\textsuperscript{194} WTE facilities would have been able to continue disposal of their ash in MSW landfills without ash testing.\textsuperscript{195}

\textsuperscript{192} See id.


\textsuperscript{194} See Legislative Proposal Seeks Subtitle D Rule as Alternative for Control of Municipal Ash, 25 Env't Rep. (BNA) 724 (Aug. 19, 1994) (explaining that the legislative proposal is intended "to nullify the effect of [the \textit{City of Chicago}] decision").

\textsuperscript{195} See \textit{Impact of Supreme Court Decision on Ash Minimal Since Most Toxicity Tests Negative}, 219 Daily Env't. Rep. (BNA) AA2 (Nov. 16, 1994) [hereinafter \textit{Impact of Supreme Court Decision}] (reporting on legislative proposals and stakeholder standpoints).
III. CONSEQUENCES OF THE CITY OF CHICAGO DECISION FOR THE WTE INDUSTRY

A. Concerns in the Immediate Aftermath of City of Chicago

As a result of the City of Chicago decision and EPA's implementation strategy, WTE combustion ash was no longer excluded from hazardous waste regulation. In the absence of an EPA listing, WTE facilities had to implement testing programs for determining whether their ash exhibited a hazardous characteristic. At the time of the City of Chicago decision, EPA pointed out that the TCLP was the RCRA-required testing method for WTE combustion ash. If the TC levels established by the test were not exceeded, the ash would not be considered hazardous, thus continued disposal in sanitary landfills was allowed. However, if the ash failed the TC, the generator would have to obtain an EPA identification number and arrange for proper management of the hazardous ash at an authorized TSDF. Most of the original concerns voiced by the WTE industry stemmed from the assumption that a considerable amount of WTE combustion ash would in fact test hazardous. The areas identified by the industry in the wake of City of Chicago included ash management costs and liabilities, ash reuse, and overall industry development.

196 See 40 C.F.R. § 262.11(c)(1),(2) (1998); Letter from Richard A. Denison & Karen Fiorini, supra note 163. Denison and Florini stated that EDF found it “plausible” to “apply knowledge” of a facility’s ash to conclude the ash is hazardous; however, EDF also found that it was “nondefensible” to “apply knowledge” and determine that a plant’s ash is not hazardous, thereby avoiding facility-specific testing. See id.

197 See Impact of Supreme Court Decision, supra note 195, at AA3 (quoting Oliver Fordham, EPA).

198 For EPA’s explanation of TSDF compliance issues, see IMPLEMENTATION STRATEGY, supra note 136, at 2-4. EPA explained that a facility handling MWC ash on the day of the Supreme Court’s WTE ash decision would be able to obtain “interim status” by applying for a federal permit by December 7, 1994, and the Agency indicated that states were also allowed to extend the permit deadline for six months.

1. Ash Management Costs and Liabilities

The WTE industry, states, and local governments hosting WTE facilities after City of Chicago were most concerned about the potentially significant new costs of managing WTE combustion ash. Some cities indicated that they might close their WTE facilities because of the anticipated increased financial burden.200 In this context, the costs for each quarterly—rather than daily—round of toxicity tests were characterized as relatively minor in comparison with the specter of RCRA Subtitle C management, should the WTE ash fail the tests. Sampling costs were estimated to be $1200 per sample for all the constituents of the TC in the first year, and $600 for metals thereafter. Total analytical costs were calculated to be $42,000 for the first year per WTE facility and $33,500 thereafter.203

Prior to the City of Chicago decision, the ultimate disposition of nearly all ash residue and MSW not combusted was some form of landfill burial. More than two-thirds of the WTE facilities utilized ash monofills.204 The remainder of the plants buried residuals in regular MSW sanitary landfills.205

While RCRA Subtitle D land disposal costs range between thirty and fifty dollars per ton,206 disposal of ash in licensed hazardous waste landfills—with double plastic liners, sophisticated moisture collection systems, and tighter operating procedures—costs between $200 and $500 per ton.207 After the Supreme Court's decision, the City of Chicago anticipated that approximately eighty tons of ash a day from its

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201 See REVISED IMPLEMENTATION STRATEGY, supra note 173, at 4.


203 See DeLong, supra note 2, at 10,539 (estimating that facilities will have to pay between $1000 and $1200 per TCLP).

204 See RESOURCE RECOVERY YEARBOOK, supra note 25, at 68.

205 See id.

206 See Keith Schneider, supra note 2, at A18. Similarly, EPA's national estimates for MSW landfill tipping fees hover slightly above $30 per ton. See OFFICE OF SOLID WASTE, U.S. ENVTL. PROTECTION AGENCY, MSW FACTBOOK (Ver. 4.0, 1997) (available at http://www.epa/epaanswer/non-hw/muncpl/factbook/index.htm) (showing an almost even $32 national average over the last years) [hereinafter MSW FACTBOOK].

207 See Keith Schneider, supra note 2, at A18.
Northwest WTE incinerator—over 29,000 tons per year—would not meet the safety limit.208 Such ash would have to be shipped to a hazardous waste landfill at an added cost of $4 to $5 million per year.209 If all WTE combustion ash tested hazardous, Subtitle C compliance on a national scale would have triggered management costs of $1.6 to $2.8 billion annually.210

Other concerns voiced by WTE supporters at the time included the fear that costs of disposal would increase due to potential depletion of the U.S. hazardous waste landfill capacity. A 1993 report had already cautioned that the number of commercial hazardous waste landfills had declined from fifty in 1983 to twenty-four in 1992,211 while another study maintained that the United States had no more than twenty commercial hazardous waste landfills.212 Other sources projected an overall quantitative capacity ceiling for current hazardous waste landfills of around 34 million tons.213 EPA has estimated excess hazardous landfill capacity through the year 2013 to be 26 million tons, with 360,000 tons of capacity being used by small quantity generators, and an additional 9.2 million tons being used for non-RCRA industrial wastes.214 Disposal of even a share of WTE combustion ash at hazardous waste landfills was anticipated at the time to cause an even quicker exhaustion of landfill capacities. In addition, a permit to build

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208 See id.
209 See id.
210 See DeLong, supra note 2, at 10,540.
211 See Curt Holman, Hazardous Waste Landfills Continue to Lose Ground, WORLD WASTES, June 1993, at 6. The article referred to the tenth annual survey of treatment, storage, and disposal facilities by McCoy and Associates Inc., which identified several pressure factors for hazardous waste landfills. These included: (1) a trend among hazardous waste generators to treat their waste to nonhazardous levels and send it to Subtitle D facilities; (2) an increasing trend for generators to start internal waste-management projects to minimize waste streams or eliminate wastes altogether; and (3) a decline in overall remediation activity coupled with the absence of regulations routing major new process wastes to landfills. See id.
212 See id. (referring to Environmental Information Ltd.'s Hazardous Waste Landfills 1993 report, which is based on the EI Environmental Services Directory and interviews with landfill owners).
213 See Hearing on H.R. 2162, supra note 60, at 198 (testimony of David L. Sokol, Chairman of the Institute of Resource Recovery); Sale, supra note 49, at 432. The situation appears to be especially tight in the northeastern United States, where many WTE installations are located. See Stephen L. Kass & Michael B. Gerrard, The Return of Lender Liability, 211 N.Y.L.J., Feb. 25, 1994, at 3 (reporting that there is only one commercial hazardous waste landfill in the northeastern United States, namely the Model City facilities in Niagara County, N.Y.).
a Subtitle C hazardous waste disposal facility was estimated to cost as much as $1 million.\textsuperscript{215}

Fears of losing the cheaper MSW landfill option were fueled when some WTE plants experienced adverse reactions from MSW landfill owners\textsuperscript{216} in the immediate aftermath of \textit{City of Chicago}.\textsuperscript{217} Some owners continued to accept the ash, while awaiting EPA's implementation guidance, whereas others stopped accepting the ash. Private land-fill owners indicated their willingness to continue accepting the ash, provided that WTE facilities, at their own cost, would treat the ash prior to disposal to reduce the potential for environmental harm.\textsuperscript{218} The uncertainties were based on the anticipation of TSDF management requirements and liabilities. While then-existing LDRs were not triggered for ash due to EPA's "newly-identified" waste determination, under future LDRs,\textsuperscript{219} facilities that removed or immobilized the ash residue's hazardous waste constituents would be required to obtain a permit for the specific treatment method used.\textsuperscript{220} In addition, although EPA's "newly identified" waste decision\textsuperscript{221} dispelled some


\textsuperscript{216} See \textit{Resource Recovery Yearbook}, supra note 25, at 70 (explaining that roughly two-thirds of land disposal facilities associated with WTE plants are owned by the public sector, while the remainder, with increasing tendency, is privately owned); see also Abbott, \textit{supra} note 86, at 373 n.146 (noting the likelihood of overcompliance as a result of the Supreme Court's WTE ash decision).

\textsuperscript{217} See Letter from Stephen S. Passage, \textit{supra} note 180.

\textsuperscript{218} See id.

\textsuperscript{219} See LeBlanc, \textit{supra} note 86, at 521 & n.187 (stating that Congress requires LDR promulgation for newly identified wastes because it promotes a policy of studying new wastes and enforcing LDRs against older wastes first). EPA has not promulgated LDRs for hazardous MWC ash. \textit{But see generally} 63 Fed. Reg. 28,556 (1998) (providing EPA's final Phase IV LDRs, which apply universal treatment standards—based on the Best Available Technologies—to "TC metal wastes," including cadmium, lead, and mercury) (codified at 40 C.F.R. pts. 148, 261, 266, 268, 271 (1998)).

\textsuperscript{220} See LeBlanc, \textit{supra} note 86, at 521 (explaining that "[s]tabilization and fixation have been studied, but it is not clear which immobilization methods will be permitted"). In recent years, technologies have been developed and marketed that allow WTE owners and operators to chemically treat combustor ash for safer disposal in a MSW landfill facility because this additional processing neutralizes the toxicity potential in the ash. An example of such a treatment is the WES-Phix(sm) process designed to neutralize lead and cadmium in ash residues. However, the question has arisen whether a process adding other substances to a hazardous solid waste can make the whole amalgamation subject to RCRA Subtitle C under EPA's mixture rule, 40 C.F.R. § 261.3(a)(2)(iii)-(iv) (1998). (While the mixture rule attaches to listed hazardous wastes only, and ash is not a listed waste, it is possible that the mixture itself after being tested may exhibit a characteristic, thus subjecting it to RCRA Subtitle C).

\textsuperscript{221} See 59 Fed. Reg. at 29,373.
fears associated with retroactive RCRA liability for WTE combustion ash management, including corrective action requirements and penalties, retroactivity under Superfund remained an issue of concern. Under Section 107(a) of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), owners and operators of hazardous waste facilities, generators, and transporters of hazardous substances may be subject to CERCLA liability. As a result, local governments were concerned about retroactive Superfund liability if they owned or operated a facility that accepted WTE combustion ash or arranged for the transportation of such ash.

2. Ash Reuse

Up until the time of the City of Chicago decision, WTE combustion ash reuse had been confined to pilot projects, involving road-building materials, artificial reef structures, de-icing applications, and aggregate material. In view of the holding, many WTE representatives felt discouraged from further exploration of ash reuse applications.

222 See Solid Waste Disposal Act, 42 U.S.C. § 6924(a) (1994). Placing hazardous waste in a Subtitle D landfill violates RCRA. See id. § 6924(d). Corrective action could in consequence have required parties to exhume and redispense combustion ash which had been disposed of in ordinary landfills before May 2, 1994. See id. § 6924(v) (directing the Administrator to take "corrective action . . . beyond the facility boundary where necessary to protect human health and the environment"). Fines for mishandling a hazardous solid waste could have amounted to $25,000 per day and extended to any governmental unit that operates or contracts with resource-recovery facilities. See id. § 6928(g). Since the Supreme Court had not addressed issues of retroactivity and EPA had designated ash as a "newly identified waste," retroactive RCRA liability should not attach to situations where the parties complied with the law as it existed at the time of the disposal. Yet, some uncertainty remained because of the thin case law on this issue. For a general analysis of municipal liability under RCRA and CERCLA, see Steven Ferrey, The Toxic Time Bomb: Municipal Liability for the Cleanup of Hazardous Waste, 57 Geo. Wash. L. Rev. 197 (1988).


224 See United States v. Carolawn Co., 14 Env'tl. L. Rep. (Envtl. L. Inst.) 20,696 (D.S.C. 1984) (holding that mixing of MSW and combustion ash as part of co-disposal practices, in which municipalities may engage, could cause leaching in the presence of acids and the leached material could be a hazardous substance under CERCLA); John R. Jacus, CERCLA Liability for Municipal Solid Waste, Nat. Resources & Env'T, Fall 1994, at 24, 48 (explaining that the Supreme Court's WTE ash decision reaffirms that such ash is not categorically exempt from CERCLA liability); see also Sale, supra note 49, at 433 (reasoning that if ash is not exempt from RCRA Subtitle C, it is clearly not exempt from CERCLA); LeBlanc, supra note 86, at 522 (explaining that ash failing the TCLP "is automatically subject to strict liability under CERCLA").

225 See Randy Woods, Ashes to Ashes, Waste Age 46 (Nov. 1991). While reuse of WTE combustion ash has thus been limited, the overall reutilization rate for high-volume combustion ash has been approximately 28%. See id.

Technological developments to spur ash reuse, including "ash weath­
ering," were considered futile in light of the general regulatory climate, and chances for commercial availability of ash reuse technol­
gy in the United States were projected as dim.

EDF alleged that the Supreme Court's decision confirmed the or­
ganization's critical posture towards ash reuse. EDF thus concluded that ash utilization projects were "illegal" for ash that exhibits toxic characteristics, since this ash could not be land-disposed without treatment rendering it nonhazardous. Moreover, EDF emphasized that reuse would be "unwise" for noncharacteristic ash, because it would allow the dispersion of ash or ash-derived products into the general environment, where more people would be exposed and clean-up would be more complicated, rather than into a controlled and monitored disposal area.

3. Overall Industry Development

At the time of the Supreme Court decision in City of Chicago, the cost to build one WTE facility averaged $126 million, but could sometimes cost as much as $400 million. The mean annual operating cost of a WTE facility was estimated at $12.6 million ($56 per ton), and $5.6 million ($32 per ton) excluding debt servicing. While tipping fees, which are paid to a WTE plant for the privilege of dumping or "tipping" waste there, may have been enough to cover post-startup routine operations, other funding sources were vital for the WTE
concept. The major sources of capital funds consisted of private equity, tax-exempt revenue bonds, and industrial development revenue bonds. As a result of changes in the 1986 federal tax code, the use of tax-exempt industrial revenue bonds was restricted, which meant that more WTE facilities had to be financed with taxable debt or with general obligation bonds. In the wake of City of Chicago, pundits predicted that potential liability and litigation would negatively affect the bond ratings of communities hosting WTE plants. If bond ratings plunged, then borrowing to finance other projects would become more risky and expensive.

Due to their high population density and most significant shortage of landfill capacity, major WTE host states, including Florida, Minnesota, New York, and Massachusetts, were concerned about a potential shift away from WTE plants mainly in favor of landfilling.

B. The Reality Five Years After City of Chicago

Despite all the consternation at the time, nearly all WTE combustion ash has passed the TC since the City of Chicago decision. Many of the toxic substances found in combustion ash, mainly heavy metals, are initially present in household waste. Others, such as dioxins, are...
created in the course of the combustion process. In its Federal Register Notice of June 7, 1994, EPA referred to studies showing that ash (usually fly ash) has sometimes exhibited the TC for leaching lead or cadmium above levels of concern. EPA likewise asserted that the ash poses major environmental problems due to the high mobility of its heavy metal content. However, more recent field data cited by industry appear to confirm that the levels of heavy metals present in combined MWC ash leachate from monofills are lower than the TCLP toxicity criteria.

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See 59 Fed. Reg. 29,372, 29,374 (1994) (stating that because a number of factors, such as the nature of the incoming waste stream, the type of combustion unit, the nature of the air pollution control device, and the ash sampling location, would influence whether ash passes or fails the TC, EPA could not predict an overall failure rate for such ash).

See RECYCLING & INCINERATION, supra note 237, at 182–83 (discussing test data demonstrating that “virtually every sample of fly ash ever tested exceeds federal standards defining a hazardous waste, usually for both lead and cadmium”); see also RICHARD A. DENISON, ENVIRONMENTAL DEFENSE FUND, FUNDAMENTAL OBJECTIVES OF MUNICIPAL SOLID WASTE INCINERATOR ASH MANAGEMENT 3 (1988), reprinted in Hearings on Incinerator Ash, supra note 199, at 236 (citing studies revealing that 100% of fly ash, 38% of bottom ash, and 48% of combined ash exceeded RCRA limits for cadmium or lead); see also STANLEY E. MANAHAN, ENVIRONMENTAL CHEMISTRY 461–73 (5th ed. 1991) (explaining that smaller particles are generally more dangerous than larger ones because they can penetrate further into the lungs). For similar concerns, see Letter from Richard A. Denison & Karen Florini, supra note 163. But see Sale, supra note 49, at 422–23 (describing the findings of the Office of Technology Assessment, which were critical of EDF’s data).

See, e.g., NUS CORPORATION, MUNICIPAL WASTE COMBUSTION ASH AND LEACHATE CHARACTERIZATION, WOODBURN MONOPILL, WOODBURN, OREGON, BASELINE STUDY REPORT (1989), SECOND YEAR STUDY REPORT (1990), THIRD YEAR STUDY REPORT (1991), FOURTH YEAR STUDY REPORT (1992), and FIFTH YEAR STUDY REPORT (1993) (stating that the ash hardens like cement and becomes an impervious monolith that does not affect the surrounding environment); Peter M. Coleman & William M.D. Peterlein, Biomass Boiler Ash Testing, Evaluation, and Demonstration of Utilization Options, in PROCEEDINGS OF THE FOURTH INTERNATIONAL CONFERENCE ON MUNICIPAL SOLID WASTE COMBUSTOR ASH UTILIZATION 191 (1991) (explaining that the trace levels of dioxins and furans sometimes detected in MWC ash as well as heavy metals in the ash are physically bound in the hardened ash and are not released when the ash is disposed); Richard W. Goodwin, Engineering Evaluation of Resource Recovery Residue Utilization Modes, in MUNICIPAL WASTE COMBUSTION: CONFERENCE REPORT AND ABSTRACTS FROM THE SECOND ANNUAL INTERNATIONAL SPECIALTY CONFERENCE 363 (1991) (explaining that the addition of scrubber lime increases the extent of ash hardening, which then reduces the metals leachability and physical transport of residue by surface runoff); Brian Bahor & Christine Craig, The Relationship Between Activated Carbon Injection for Mercury Control
The high passage rate may very well be explained by the relatively late point in time for conducting the test. As previously discussed, in most cases, the testing requirement attaches after the two ash streams (fly and bottom ash) have been mixed. This combined WTE ash is in general less likely to test hazardous.

In light of the testing results and more recent studies, the original concerns voiced by the WTE industry have subsided and given way to the perception that the effects of the City of Chicago decision have been mitigated. First of all, due to the nearly-perfect TC passage rate, WTE facilities have continued to dispose of combustion ash in Subtitle D facilities. Current ash management practices that reduce the risk of exposure of the public to contaminants include neutralizing toxic elements in the combined ash, adding lime to solidify the ash, and disposing of it in monofills. Due to the stable tipping rates for Subtitle D landfills, ash disposal costs have held relatively steady. Although the potential for Superfund liability may have increased as a result of the Supreme Court's ash decision, it should be noted that CERCLA liability existed before City of Chicago, and that municipal liability requires meeting somewhat higher thresholds.

Secondly, WTE industry representatives have expressed that the Supreme Court decision and subsequent testing results may actually have revived reuse options for the ash residue by ending uncertainty as to the toxicity of the ash. For example, RCRA regulates only disposal, so other uses of nonhazardous ash are unlimited. States

and Ash Residue Waste Characterizations at Municipal Waste Combustors, in PROCEEDINGS OF THE EIGHTH INTERNATIONAL CONFERENCE ON MUNICIPAL SOLID WASTE COMBUSTOR ASH UTILIZATION 19 (1995) (reporting that advanced air pollution control equipment does not affect TCLP results indicating that the ash is safe). See generally Jeffrey Hahn et al., Fugitive Particulate Emissions Associated with MSW Ash Handling—Results of a Full Scale Field Program, in 83RD ANNUAL MEETING OF THE AIR AND WASTE MANAGEMENT ASSOCIATION (1990) (finding that the soils near an ash monofill were not affected by airblown fugitive ash; that metal levels in soils near ash monofills were similar to background levels; and that soil samples collected close to roads, which were subjected to automobile and truck emissions, contained higher lead levels than soils near ash monofills and away from roads).

242 See MSW FACTBOOK, supra note 206 (reporting a national average of $32 per ton).

243 See B.F. Goodrich Co. v. Murtha, 754 F. Supp. 960, 968 (D. Conn. 1991) (holding that MSW is not exempt from CERCLA and reasoning that if Congress intended to exempt MSW from CERCLA liability it would have explicitly stated this as it did in RCRA), aff'd, 958 F.2d 1192 (2d Cir. 1992).

244 See LeBlanc, supra note 86, at 522 n.201 (citing Jacus, supra note 224, at 48, and explaining that, in an attempt to conserve resources, EPA has an "interim policy" to require "site-specific data" and a "truly exceptional situation"). But see Wartinbee, supra note 126, at 135 (stating that municipalities who treat all ash as hazardous would pay a little more for disposal but save enormously in the future by avoiding Superfund liability).

245 See LeBlanc, supra note 86, at 530 & n.285 (noting that EPA estimates the ash reuse share
regulating use of ash or ash products from waste combustion may require approval by state or local agencies, or a “beneficial use” determination before ash is used as an aggregate in products or alone in other applications such as a substitute for gravel.

Several states have promulgated specific criteria for beneficial use determinations, including consideration of physical properties, chemical nature, environmental effects, technical suitability, and demonstrated adequate market potential of the ash intended for reuse. Ash reuse is underway in projects in Florida, Maryland, Minnesota, Pennsylvania, Massachusetts, Tennessee, and New York. According to studies, the physical and chemical properties of MWC ash allow for safe reuse as landfill road material; as daily, intermediate, and final cover over landfills; as an aggregate or granular base or asphalt-mixture for road construction; in artificial reef development and shoreline protection devices; and in the manufacture of construction quality cement blocks. WTE industry representatives would like EPA to announce that from a federal perspective, beneficial use of treated ash as landfill cover or landfill road subbase aggregate is acceptable to the Agency.

at 10% and that “utilization is common because it makes incineration cheaper by avoiding all disposal costs and generating revenues that offset incineration costs”.

246 See NATIONAL RENEWABLE ENERGY LABORATORY, TECHNOLOGY BRIEF, RECOVERING AND USING PRODUCTS CONTAINING ASH FROM WASTE COMBUSTION, NREL/BR-430-22472c.3 (1997) (listing potential state requirements governing ash reuse).

247 See id.


252 See Telephone Interview with Jonathan V.L. Kiser, supra note 226.
In the context of the overall industry development, the pace of WTE plant construction has slowed in comparison to the golden age of the industry between 1983 and 1993. However, factors other than the Supreme Court’s ash decision have influenced the WTE industry over the past five years. WTE construction costs have been increasing due to the expansion of design capacities and the installment of additional and more expensive air-pollution control devices. Limitations on public funding of projects imposed by the U.S. tax code, issues of local flow control, reduced municipal budgets, relatively stable oil prices, decreasing waste generation and greater emphasis on recycling, and more public opposition have combined to constrict the market for future WTE plants. As a result, fewer vendors with higher daily design capacities now compete. WTE constitutes an increasingly expensive MSW management option. While landfill disposal costs have continued to be stable at $32 per ton, WTE tipping fees quadrupled from 1985 until 1996 to reach a national average of $63 per ton. The drastic increase of WTE tipping fees may reflect the efforts of WTE owners and operators to recoup the expenses of compliance with “maximum achievable control technology” (MACT) standards under the Clean Air Act, and to a lesser extent, higher ash management costs for testing and related activities.

253 But see John Varrasi, They’re Up! They’re Down! They’re Waste-to-Energy Plants, ELECTRICAL WORLD, Mar. 1996, at 462 (stating that WTE plants are more dependable than fossil-fueled plants and efficiently recover solid waste energy).

254 See Michael Valenti, Today’s Trash Tomorrow’s Fuel, MECHANICAL ENGINEERING—CIME, Jan. 1993, at 64 (reporting that between 1983 and 1993, the number of WTE installations had increased from 50 to 142).

255 See Burnt Offerings: Illinois Removes State Subsidies to Waste-to-Energy Facilities, Disturbing the Bond Market, ECONOMIST, Mar. 23, 1996, at 77; see also Richard K. Ellsworth, Valuing Waste-to-Energy Facilities, APPRAISAL J., Jan. 1997, at 63 (explaining that since WTE projects are complex and stringently regulated facilities, a thorough financial and economic analysis is necessary to establish an appropriate value for such projects).

256 See MSW FACTBOOK, supra note 206 (showing that the 1993 $55 peak was followed by a decline to $49 in 1994 and a steep rise to $63 in 1996). If one ton of MSW were sent directly to a landfill, $32 disposal costs would be incurred, while sending the same ton of trash through a WTE ($63), and its residue then onward to a landfill ($15.75, based on a 75% weight reduction through combustion), the total would come to $78.75. See id.

257 EPA’s 1995 MACT rules apply to large units that combust more than 250 tons each day of trash only. MACT standards for small units are being developed by EPA. For the potential cost impacts of the MACT rules, see Municipal Waste Combustors Must Meet MACT Standards Under Clean Air Act Rule, 26 Env’t Rep. (BNA) 1548 (Dec. 22, 1995) (stating that capital costs are predicted to be $151 million and operating, maintenance, inspection, reporting, and record-keeping costs are estimated to be $254 million per year).
C. Potential Future Issues

The real remaining issue of importance from the Supreme Court’s *City of Chicago* decision is the questionable toxicity of WTE combustion ash. Ash toxicity is not only a matter for scientists, but also hinges on legal determinations. Thus, legislative or administrative changes to the existing regulatory framework may revive the old, currently dormant, concerns. There are no bills pending in Congress to that effect. Although EPA has no plans to change its determination of when RCRA Subtitle C jurisdiction for MWC ash attaches,258 or to impose MSW presorting requirements,259 the ash testing regime (especially the design of the TC test) is one significant regulatory area that may change. At the time the Supreme Court decided *City of Chicago*, EPA pointed out that development of another testing method to replace the TCLP test would take a long time.260

The TCLP testing method as currently applied to MSW ash remains controversial. The following section discusses potential limitations of the test and alternative testing regimes.

1. Limitations of the TCLP

After many years of criticism that was levied against continued use of the TCLP test by both industry261 as well as environmental

259 WTE plants intending to avoid classification as TSDFs have to intercept and divert “only regulated hazardous wastes, not exempt household batteries.” See LeBlanc, supra note 86, at 528 n.269 (citing 42 U.S.C. § 6921(i) (1988)). Environmental groups are still lobbying EPA to recommend that any material potentially contributing to the toxicity of combustion by-products be removed from the waste prior to combustion. See Letter from Richard A. Denison & Karen Florini, supra note 163 (recommending source separation of toxic materials by households and commercial waste generators, and preprocessing and screening of waste received at combustors, so as to divert to recycling or hazardous waste disposal such toxic materials). While industry supports curbside and related recycling of items such as auto and household batteries, it opposes extensive separation at the WTE plant of individual small metal-bearing items because of impracticability, worker-health concerns, and potential expense. See Letter from Harold Himmelman, supra note 165 (stating that EPA would lack the statutory authority to impose source separation requirements under RCRA Subtitle C).
260 See Impact of Supreme Court Decision, supra note 195, at AA3 (quoting Oliver Fordham, EPA).
261 See Toxicity Characteristic Test Not Preferred for MSW Incinerator Ash, Commenters Say, 196 Daily Env’t. Rep. (BNA) A8 (Oct. 13, 1994) (describing industry charges that the TCLP was never designed to identify metal compounds in ash since the test was originally announced as part of the LDR process to detect solvents, dioxins, and organic compounds in leachate) [hereinafter Toxicity Characteristic Test]; see also Letter from David W. Gatton, supra note 165 (expressing the concern that the TCLP may overestimate leaching potential because of its
groups, in 1996, EPA's Office of Solid Waste conducted a scoping study to investigate potential gaps in the current hazardous waste characteristics promulgated under RCRA. As the starting point for its investigation of the need for a new testing regime, the Agency identified the two critical components in the determination of whether a waste should be regulated: (1) ascertaining whether a plausible mismanagement scenario for the waste exists should the waste remain unregulated; and (2) constructing a predictive model that can reasonably evaluate whether the waste is capable of posing substantial present or potential harm to human health and the environment under mismanagement conditions.

In addition to evaluating the ability of the TC to protect against risks, including those it was not designed to address, EPA also examined the TCLP and other leaching procedures and assessed their ability to predict environmental releases resulting from different waste types and management conditions. In this context, the following deficiencies of the TCLP were noted by EPA: its inability to predict significant releases under highly alkaline conditions; its unaggressive extraction of pollutants; that acids with a propensity to leach out hazardous constituents would not be created, because, in most cases, ash would be monofilled in tighter regulated Subtitle D facilities and not comingled with other MSW constituents, which could create acids that could in turn lead to a leaching of hazardous constituents).

See DANIEL D. CHIRAS, ENVIRONMENTAL SCIENCE: A FRAMEWORK FOR DECISION MAKING 311 (2d ed. 1988) (addressing the criticism that the TCLP would measure the content of individual constituents—while by the same token allowing a waste with a high total constituent content to be considered nonhazardous—by stating that compounding effects are unknown because, for practical reasons, experiments usually study individual toxins); Toxicity Characteristic Test, supra note 261, at A8 (reporting that some are calling for a new protocol that would discover metal content rather than mere leachate, especially since the TCLP would underestimate the leaching of lead from ash exposed to rainwater).


EPA reviewed risks that are now addressed by the TC (such as direct ingestion of groundwater) by considering new groundwater modeling techniques that have emerged since the promulgation of the original TC levels, as well as any changes to the toxicity values, which served as the basis of the original levels. See SCOPI NG STUDY, supra note 263, at 3–21. Furthermore, EPA evaluated risks from other exposure pathways (such as inhalation, surface water, and indirect/food chain pathway risks) to ecological receptors, which constitute risks not included in the design of the original TC. See id. at 3–27.

Especially the leaching of cadmium and lead may be limited when the pH is in the range of about eight or nine but may increase with a change of the pH. Thus, if a waste is highly
derestimation of the chelation-facilitated mobility of some waste constitu­
ents, its indifference towards oxidation and reduction processes occurring in landfills, and its inability to predict releases to non­
groundwater pathways. In light of the limitations of the TCLP, the
Agency investigated other leaching methods to determine whether
they had better predictive abilities.

2. Alternative Testing Regimes

EPA reviewed other leaching methods, including the Multiple Ex­
novation Procedure (MEP), the Synthetic Acid Precipitation Leach Test (SPLP), and the California Wet Extraction Test (Cal WET),
alkaline and the TCLP leaching medium lowers the pH to only about eight or nine, then the concentra­
tions of these metals in the leachate could be significantly lower than would occur from either a highly alkaline or highly acidic environment. A long term acid environment in a landfill may result from acidic rain water. See id. at 3–43.
The low chelation ability of the TCLP's acetate buffer may result in fewer metal constitu­
ts being leached into the extract, thus not approximating the chelation ability of many other compounds of landfill leachate. See id. at 3–45.
The effect of stabilizing iron fillings may mask the leachability potential of lead. If metallic iron is added to a waste, the lead concentration in the TCLP extract may be decreased by an oxidation/reduction reaction to levels below the lead TC level. If, however, the waste is placed in a landfill, the iron oxidizes over time, thus losing its ability to prevent the leaching of lead to the environ­
ment. See id. at 3–45.
The TCLP does not simulate the release of contaminants into air either directly or through entrained dust, nor does it mimic releases through surface runoff. See id. at 3–47.
The MEP involves an initial extraction with acetic acid and at least eight subsequent extractions with a synthetic acid rain solution. The MEP simulates 1000 years of freeze and thaw cycles and prolonged exposure to a leaching medium. One advantage of the MEP over the
TCLP is that the MEP gradually removes excess alkalinity in the waste, thus facilitating evaluation of the leaching behavior of metal contaminants. The MEP, which may account for highly alkaline conditions, is currently used in EPA's delisting program. See SCOPING STUDY, supra note 263, at 3–44.
The SLPL (test method 1312), which simulates disposal in an acid rain environment, does not involve the TCLP's initial liquid-solid separation step and the TCLP's acetate buffer extraction fluid has been replaced with a dilute nitric acid/sulfuric acid mixture. The SLPL is currently used by several state agencies to evaluate the leaching of TC hazardous constituents from wastes. See id. at 3–45; see also Impact of Supreme Court Decision, supra note 195, at AA3 (reporting EPA's preference for the TCLP in instances where the destination of the ash would be a MSW landfill, while acknowledging the SLPL as appropriate for ash going to a monofill).
Cal WET uses a sodium citrate buffer as the leachate, a 10:1 liquid-to-solids ratio, and a testing period of 48 hours. Cal WET applies a soluble threshold limit concentration as the regulatory standard and develops a total threshold limit concentration. Cal WET is a relatively aggressive test and its citrate buffer has greater chelation effect than the acetate buffer used in the TCLP. See SCOPING STUDY, supra note 263, at 3–46; see also Letter from John H. Gulleidge, Chief Engineer and Geologist, County Sanitation Districts of Los Angeles County, to Bruce Weddle, Director, Municipal and Industrial Solid Waste Division, Office of Solid Waste, U.S. Envtl. Protection Agency (May 18, 1994) (on file with author) (stating that Cal WET would
but the Agency did not find any compelling evidence that these tests are better than the TCLP. EPA further noted that even if the TCLP accurately predicted TC leachate levels, site-specific fate and transport factors, as well as waste management practices, could result in exceedances of regulatory contamination levels. EPA thus concluded in its 1996 scoping study that it would develop a strategy for a comprehensive data collection effort to determine whether to develop and implement a new testing regime. Based on these data, options to address environmental management concerns resulting from TC gaps would be identified and evaluated. Thus, TC reform, including the determination of the appropriate testing regime to identify hazardous wastes, remains on EPA's radar screen. As this multi-step process unfolds over the next several years, interested parties may be presented with various opportunities to influence and shape the final regulations.

**SUMMARY AND CONCLUSIONS**

On May 2, 1994, the Supreme Court held that ash generated by certain municipal WTE facilities that burn household wastes alone or in combination with nonhazardous wastes from industrial and commercial sources is not exempt from regulation as hazardous waste under RCRA Subtitle C. WTE plants must have a program for determining whether the ash exhibits a hazardous characteristic. For toxic ash, WTE facilities must either treat ash onsite to eliminate the characteristic or make arrangements for the proper management of their ash at approved Subtitle C facilities.

In light of an annual MSW generation of more than 210 million tons, local governments have continued to support WTE plants because they can reduce waste volume and weight, while recovering energy from discarded products.

identify many federal nonhazardous wastes as California hazardous wastes and would extract greater amounts of metals from ash).

273 See Edison Elec. Inst. v. EPA, 2 F.3d 438, 444–45 (D.C. Cir. 1993) (stating, within the context of mineral processing wastes, that the TCLP is a widely available test for metal mobility and is typically somewhat aggressive). But see Columbia Falls Aluminum Co. v. EPA, 139 F.3d 914, 922–24 (D.C. Cir. 1998) (involving a case of spent potliners, where the TCLP was found unpredictable in evaluating performance of treatment technology for treating hazardous materials).

274 See KEEP AMERICA BEAUTIFUL, supra note 14, at 1; SENATOR AL GORE, EARTH IN THE BALANCE 145–47 (1992) (describing America's waste management challenge in light of a throwaway ethic, which leads to ever increasing quantities of waste).
Original concerns associated with the *City of Chicago* decision were based on a potentially high TC failure rate of MWC ash. The WTE industry feared that ash management costs and liabilities would skyrocket, while ash reuse projects would be stymied. Industry proponents also expressed concern that these developments would threaten the continued viability of the WTE industry. However, after almost five years of testing, combined WTE combustion ash continues to pass the TC, thus not requiring special Subtitle C hazardous waste management.

While the debates have subsided, any changes in the regulatory framework, especially the design of the TC test, may revive the old concerns. After many years of TCLP criticism, EPA has identified the need to move forward with reforming potential TC gaps.

As previously discussed in this article, RCRA strives to strike a balance between protecting the environment and encouraging efficient waste management activities, including resource recovery. Viewed in combination, the Supreme Court’s *City of Chicago* decision and EPA’s strategy to implement the decision seem to strike a holistic compromise between these sometimes conflicting policy objectives when it comes to MWC ash. While the *City of Chicago* holding embraces the environmental protection prong of RCRA’s twin goals, the effects of EPA’s implementation strategy, especially the Agency’s statutory interpretation generally allowing for the combination of bottom and fly ash, appear to satisfy the resource-recovery prong.

Because the toxicity of WTE ash is the single dispositive fact that determines whether RCRA Subtitle C regulation may apply to combustion ash, the toxicity testing methodology has important ramifications for the WTE industry. Since the current testing regime has been adjudged by EPA and concerned citizens from both industry and environmental advocacy alike to have significant problems, the evolution of a new leaching methodology will continue to be closely watched by all interested parties.

275 See LaSalle, *supra* note 86, at 371 (opining that “[t]he Court bordered on legislating from the bench by choosing to give preference to protecting health over resource recovery, as [sic] task rightfully belonging to Congress or the EPA”). *But see* Abbott, *supra* note 86, at 375 (stating that, on a broader scale, “EPA interpretation and implementation of RCRA may present a problem to the Supreme Court because *Chicago* establishes precedent which diminishes the importance of legislative and administrative history”). *See generally* City of Chicago v. Environmental Defense Fund, Inc., 511 U.S. 328 (1994).

276 See LeBlanc, *supra* note 86, at 532–37 (explaining that each method of managing MSW, including landfilling, source reduction, and recycling, has some drawbacks).

277 See Sale, *supra* note 49, at 444 (noting in that context that nonincinerated MSW may be disposed of in ordinary landfills, despite the presence of potentially hazardous substances).
### Table 1. Plant Capacities and Estimated Ash Residues

<table>
<thead>
<tr>
<th>Number of WTE Plants (Year of Operation)</th>
<th>Daily Design Capacity (TPD)</th>
<th>Corresponding Daily Ash Residue (TPD)</th>
<th>Annual Capacity (Million Tons)</th>
<th>Corresponding Annual Ash Residue (Million Tons)</th>
</tr>
</thead>
<tbody>
<tr>
<td>125 (1993)</td>
<td>99,416</td>
<td>24,854</td>
<td>30.9</td>
<td>7.73</td>
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<tr>
<td>112 (1998)</td>
<td>101,471</td>
<td>25,368</td>
<td>31.8</td>
<td>7.95</td>
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</table>

### Table 2. Estimated Bottom and Fly Ash Residues

<table>
<thead>
<tr>
<th>Number of WTE Plants (Year of Operation)</th>
<th>Daily Bottom Ash Residue (Range in TPD)</th>
<th>Daily Fly Ash Residue (Range in TPD)</th>
<th>Annual Bottom Ash Residue (Range in Million Tons)</th>
<th>Annual Fly Ash Residue (Range in Million Tons)</th>
</tr>
</thead>
<tbody>
<tr>
<td>125 (1993)</td>
<td>18,640.50–22,368.60</td>
<td>2,458.40–6,213.50</td>
<td>5.80–6.96</td>
<td>0.77–1.93</td>
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<tr>
<td>112 (1998)</td>
<td>19,026.00–22,831.20</td>
<td>2,563.00–6,342.00</td>
<td>5.96–7.16</td>
<td>0.78–1.99</td>
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