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Economic Analysis of Final Effluent Limitations Guidelines and Standards for the Landfills Point Source Category

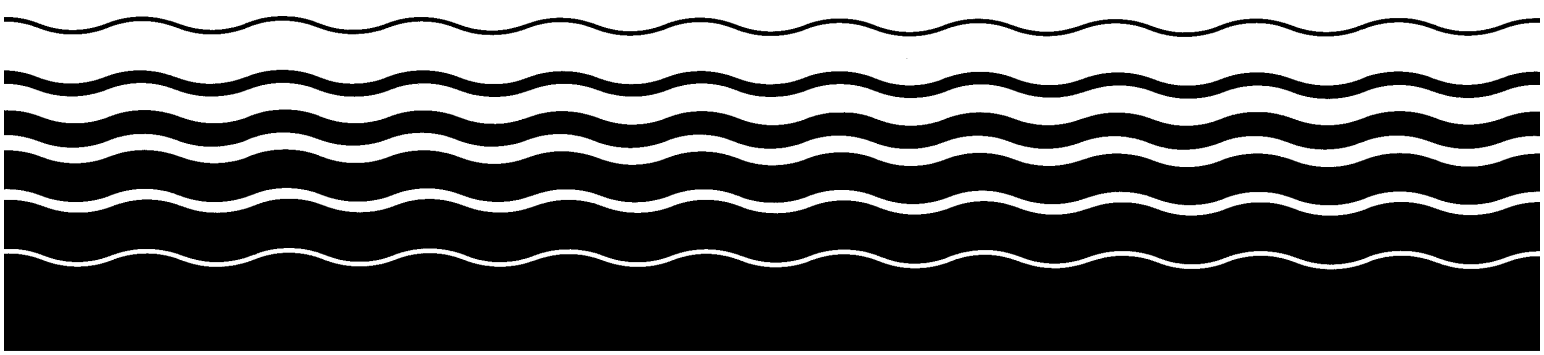


Table of Contents

Economic Analysis of Final Effluent Limitations Guidelines and Standards for the Landfills Point Source Category

Chapter 1

Introduction and Overview

1.1 Overview and definitions

The Federal Water Pollution Control Act Amendments of 1972 established a comprehensive program to "restore and maintain the chemical, physical, and biological integrity of the Nation's waters" (Section 101(a)). To implement these amendments, the U.S. Environmental Protection Agency (EPA) issues effluent limitations guidelines and standards for categories of industrial dischargers. The regulations that the EPA establishes are as follows:

- **Best Practicable Control Technology Currently Available (BPT)** BPT regulations apply to existing industrial direct dischargers, and generally cover discharge of conventional pollutants.

- **Best Available Technology Economically Achievable (BAT)** BAT regulations apply to existing industrial direct dischargers and the control of priority and non-conventional pollutant discharges.

- **Best Conventional Pollutant Control Technology (BCT)** BCT regulations provide an additional level of control for direct dischargers beyond BPT for conventional pollutants.

- **Pretreatment Standards for Existing Sources (PSES)** PSES regulations apply to existing indirect dischargers (i.e., facilities that introduce their discharges into Publicly Owned Treatment Works, or POTWs). PSES regulations generally cover discharge of toxic and non-conventional pollutants that pass through the POTW or interfere with its operation. They are analogous to the BAT controls.

- **New Source Performance Standards (NSPS)** NSPS regulations apply to new industrial direct dischargers and cover all pollutant categories.

- **Pretreatment Standards for New Sources (PSNS)** PSNS regulations apply to new indirect dischargers and generally cover discharge of toxic and non-conventional pollutants that pass through the POTW or interfere with its operation.

Table 1-1 below provides more detailed information about these six types of regulations.

This Economic Analysis (EA) assesses the economic impact of the final effluent limitation guidelines and standards for the Landfills Industry Category. The final regulation establishes technology-based effluent limitations for wastewater discharges associated with the operation and maintenance of new and existing hazardous and non-hazardous waste landfill facilities regulated, respectively, under Subtitle C and Subtitle D of the Resource Conservation and Recovery Act (RCRA). Sources of landfill wastewater include, but are not limited to, landfill leachate and gas collection condensate. Today's final rule does not establish pretreatment standards for the introduction of pollutants into Publicly Owned Treatment Works (POTWs) from the operation of new and existing landfills regulated under Subtitle C or Subtitle D of RCRA.

The rule does not apply to wastewater discharges from "captive" landfills – those landfills associated with other industrial or commercial activities, in most circumstances. For example, it does not apply to captive landfills that only receive wastes generated by the industrial operation directly associated with the landfill. In addition, the rule does not apply to captive landfills that receive both wastes generated by the industrial operation directly associated with the landfill as well as other wastes, so long as the other wastes are similar in nature to the wastes generated by the industrial operation directly associated with the landfill. Further, the regulation does not apply to wastewater discharges associated with treatment of contaminated groundwater from hazardous and non-hazardous waste landfills.

Table 1-1. Levels of Pollutant Controls

	CONTROLS ON DIRECT DISCHARGERS	CONTROLS ON INDIRECT DISCHARGERS
EXISTING SOURCES	**BPT** Best Practicable Control Technology Currently Available The lowest level of control, BPT targets conventional pollutants but can also control priority and nonconventional pollutants.	No controls for indirect dischargers comparable to BPT for directs, since indirect dischargers discharge wastewater into a POTW, which treats conventional pollutants.
	BCT Best Conventional Pollutant Control Technology Controls conventionals (i.e., conventional pollutants) only. Limits for conventionals must be equal to or more stringent than BPT.	No controls for indirect dischargers comparable to BCT for directs, since indirect dischargers discharge wastewater into a POTW, which treats conventional pollutants.
	BAT Best Available Technology Economically Achievable Applies to existing facilities. Usually, BAT limits only apply to priority pollutants and nonconventionals. BAT can only control conventional incidentally or as a surrogate / indicator for priority pollutants and/or nonconventionals. BAT limits can be equal to or more stringent than BPT regulations.	**PSES** Pretreatment Standards for Existing Sources Generally analogous to BAT regulations for direct dischargers. EPA determines which pollutants to regulate in PSES on the basis of whether or not they pass through, cause an upset in, or otherwise interfere with the operation of a POTW or its sludge practices. PSES usually begins with BAT control technology, adjusted on the basis of pass-through and interference considerations. Limits usually apply only to priority pollutants and nonconventionals. PSES can only control conventionals incidentally, as a surrogate / indicator for priority pollutants and nonconventionals, or if the industry discharges large enough loadings to cause a national problem for pass-through or interference.*
NEW SOURCES	**NSPS** New Source Performance Standards Applies to new sources. EPA can promulgate NSPS for conventionals on the basis of BPT limitations. NSPS limits can be equal to or more stringent than BPT regulations (e.g., require BPT technology plus additional treatment). EPA can promulgate NSPS for priority pollutants and nonconventionals on the basis of BAT limitations. NSPS limits can be equal to or more stringent than BAT regulations.	**PSNS** Pretreatment Standards for New Sources Applies to new sources. Generally analogous to NSPS. Generally promulgated for priority pollutants and nonconventionals

* Limits for oil and grease were set in Petroleum Refining to prevent nationwide interference problems. See 40 CFR-419.

1.2 Summary of the rule

The final rule applies to the hazardous and non-hazardous waste landfills industry. For the purposes of this rule, non-hazardous waste landfills accept only non-hazardous wastes, as defined in the Resource Conservation and Recovery Act (RCRA). Landfills that accept hazardous wastes or a mixture of hazardous and non-hazardous wastes are hazardous waste landfills under this rule. Any landfill in operation before 1980 is also a hazardous waste landfill under the rule. The landfills effluent guidelines include BPT, BCT, BAT and NSPS limitations.

Best Practicable Control Technology (BPT)

This rule establishes concentration-based BPT limitations that reflect the best practicable technology performance. The technology basis for BPT is end-of-pipe treatment using equalization followed by biological treatment, clarification and multimedia filtration. For hazardous waste landfills, EPA bases BPT on equalization with chemical precipitation with primary clarification followed by biological treatment with secondary clarification.

Best Conventional Pollutant Control Technology (BCT)

This rule establishes BCT equal to BPT limitations for both hazardous waste and non-hazardous waste landfills.

Best Available Technology Economically Achievable (BAT)

This rule establishes BAT equal to BPT limitations for both hazardous and non-hazardous waste landfills.

New Source Performance Standards (NSPS)

This rule establishes NSPS equal to BPT limitations for both hazardous and non-hazardous waste landfills.

Pretreatment Standards for Existing Sources (PSES)

This rule establishes no PSES limitations.

Pretreatment Standards for New Sources (PSNS)

This rule establishes no PSNS limitations.

1.3 Regulatory options considered

In EPA's engineering assessment of the best practicable control technology currently available for non-hazardous waste landfills, the Agency evaluated three potential technologies commonly in use by the industry: chemical precipitation, biological treatment and multimedia filtration. EPA rejected chemical precipitation – an effective treatment technology for the removal of metals – due to the low concentration of metals typically found in non-hazardous waste landfill leachate.

1.3.1 BPT selection

BPT Option I consists of equalization followed by biological treatment with clarification. The Agency included various types of biological treatment such as activated sludge, aerated lagoons, and anaerobic and aerobic biological towers or fixed film reactors in its calculation of limits for this option. EPA chose biological treatment due to its effectiveness in removing the large organic loads commonly associated with leachate. EPA based the costing for Option I on the cost of aerated equalization followed by an extended aeration activated sludge system with secondary clarification and sludge dewatering. Approximately 30 percent of the non-hazardous facilities employed some form of biological treatment and 13 percent had a combination of equalization and biological treatment.

Option II for the non-hazardous category consists of Option I technology with the addition of a multimedia filter after the biological treatment. EPA chose this option due to the ability of the biological system to control the organics and the effectiveness of the filter in the removal of total suspended solids (TSS) that may remain after biological treatment. Approximately 10 percent of the direct discharging non-hazardous facilities used the technology described in Option II.

EPA selected Option II, equalization followed by biological treatment and multimedia filtration, as the technology basis for BPT limitations for the non-hazardous waste landfills category. Option II surpassed Option 1 in comparisons of costs, pounds of pollutant removals, economic impacts and environmental benefits. BPT Option II removed significantly more pounds of conventional pollutants than Option I for a moderate cost increase. Furthermore, by adding a multimedia filter to the biological system, the treatment system has the ability to dampen the variability of the suspended solids discharged from the biological system. Option I did not control the removal of TSS as well as Option II. Furthermore, the Agency determined that both options resulted in two facilities incurring significant economic impacts.

With respect to hazardous waste landfills, EPA's landfills survey found no respondents classified as direct dischargers. All of the hazardous landfills not excluded from the regulation were either indirect or zero dischargers. Therefore, the Agency relied on technology transfer in order to set BPT standards for direct dischargers. The Agency deems it necessary to set standards for direct discharges from hazardous landfills because there may be facilities not included in the survey discharging directly to surface waters. Additionally, facilities that are currently zero dischargers or are discharging to a POTW may decide to discharge wastewater directly to surface waters in the future.

For the final rule, EPA considered the following three potential technology options for establishing BPT effluent limitations for the hazardous waste landfill subcategory:

- Option I - Aerated equalization followed by chemical precipitation with primary clarification and multimedia filtration.

- Option II - Aerated equalization followed by chemical precipitation with primary clarification, biological treatment with secondary clarification and multimedia filtration.

- Option III - Zero or alternative discharge.

EPA evaluated chemical precipitation as a treatment technology because of metals concentrations typically found in hazardous landfill leachate and the efficient metals removals achieved through chemical precipitation. EPA also evaluated biological treatment as an appropriate technology because of its ability to remove organic loads present in the leachate. The Agency also considered multimedia filtration to be an appropriate technology for consideration. For the final rule, based on the levels of TSS in raw wastewater

at hazardous landfills, EPA determined that multimedia filtration was a necessary technology option to consider. In the first two options listed above, multimedia filters are effective in removing any TSS that might remain after primary or secondary clarification. Finally, EPA considered a zero or alternative discharge option as a potential BPT requirement because a significant segment of the industry is currently not discharging wastewater to surface waters or to POTWs. The zero or alternative disposal option would require facilities to dispose of their wastewater in a manner that would not result in wastewater discharge to a surface water or a POTW.

EPA eliminated Option I from consideration because it did not control organic pollutants effectively. As was the case in the proposal, EPA also decided to eliminate Option III because, for the industry as a whole, zero or alternative discharge options are either not viable or the cost is wholly disproportionate to the pollutant reduction benefits and thus it is not "practicable." Methods of achieving zero or alternative discharge currently in use by hazardous landfills are deep well injection, solidification, and contract hauling of wastewater to a Centralized Waste Treatment (CWT) facility or to a landfill wastewater treatment facility. Thirty seven facilities are estimated to inject landfill wastewater underground on-site; 103 facilities send their wastewater to a CWT or landfill treatment system; and one facility solidifies wastewater.

For example, one demonstrated alternative disposal option for large wastewater flows is underground injection. However, this is not considered a practically available option on a nationwide basis because it is not allowed in many geographic regions of the country where landfills may be located. These restrictions may preclude underground injection at a given landfill. In such circumstances, landfills would need to resort to contract hauling to a Centralized Waste Treatment (CWT) facility. Unless the CWT itself were a zero discharge facility, the ultimate result would be treatment and discharge to surface waters or a POTW following waste treatment that may be no more effective than that which could have been provided on-site. This might result in substantial transportation costs for the landfill and associated non-water quality, environmental impacts (e.g., truck emissions) resulting in no net reduction in the discharge of pollutants. EPA's survey demonstrated that only landfills with relatively low flows (under 500 g.p.d.) currently contract haul their wastewater to a CWT. The costs of contract hauling are directly proportional to the volume of wastewater and distance over which it must be transported, generally making it excessively costly to send large wastewater flows to a CWT – particularly if it is not located nearby.

EPA evaluated the cost of requiring all hazardous landfills to achieve zero or alternative discharge status. For the purposes of costing, EPA assumed that a facility would have to contract haul wastewater off-site because it may be impossible to pursue other zero or alternative discharge options. EPA concluded that the cost of contract hauling off-site for high flow facilities was unreasonably high and disproportionate to the removals potentially achieved. In addition, EPA concluded that the wastewater shipped to a CWT will typically receive treatment equivalent to that promulgated today, and that zero/alternative discharge requirements would result in additional costs to discharge without greater removals for hazardous landfill wastewater.

Based on the characteristics of hazardous landfill leachate and on an evaluation of appropriate technology options, the Agency selected Option II (aerated equalization followed by chemical precipitation and biological treatment with secondary clarification followed by multimedia filtration) as the BPT technology for the hazardous subcategory.

1.3.2 BCT selection

In developing BCT limits, EPA considered whether there are technologies that achieve greater removals of conventional pollutants than proposed for BPT, and whether those technologies are cost-reasonable according to the prescribed BCT tests. EPA identified no technologies that can achieve greater removals of conventional pollutants than the BPT standards that also pass the BCT cost-reasonableness tests. Accordingly, EPA establishes BCT effluent limitations equal to the BPT limitations.

1.3.3 BAT selection

For BAT limitations in the non-hazardous waste landfills category, EPA evaluated three potential technologies currently used in the industry: chemical precipitation, biological treatment plus multimedia filtration and reverse osmosis. Chemical precipitation is an effective treatment technology for the removal of metals. The Agency eliminated chemical precipitation as an option due to the very low concentration of metals found in non-hazardous waste landfill leachate. EPA chose biological treatment followed by multimedia filtration as Option I due to the ability of the biological system to remove the large organic loads commonly found in the leachate and the effectiveness of the filter in the removal of TSS that may remain after biological treatment. This treatment option is the same as the option selected for BPT in the non-hazardous category.

As a second option for BAT, EPA assessed the benefits and removals of a biological treatment system with a multimedia filter followed by a single-stage reverse osmosis. Initially, EPA considered reverse osmosis as a viable option due to its very effective removal of toxic and conventional pollutants. However, after a thorough analysis of this option, the Agency determined that the biological treatment system and the multimedia filter established as BPT were removing the majority of toxic pollutants. The small incremental removal of toxic pounds achieved by Option II beyond Option I removals was not justified by the large cost for the reverse osmosis treatment system.

As stated in the BPT analysis, EPA's survey of the hazardous landfills industry identified no in-scope respondents that were classified as direct dischargers. All of the hazardous landfills in the EPA survey were indirect or zero or alternative dischargers. Therefore, the Agency based BPT limitations on technology transfer and treatment systems in place for indirect dischargers in the hazardous subcategory and on treatment systems in place for BPT facilities in the non-hazardous subcategory. In EPA's engineering assessment of possible BAT technologies for direct discharging hazardous facilities, EPA evaluated the same three potential technology options it had evaluated when it was developing BPT limitations for the hazardous waste landfill subcategory. EPA has identified no other technologies that would represent BAT level of control for this industry.

EPA determined that it should establish BAT limits based on the same technology evaluated for BPT limits because EPA identified no more stringent treatment technology option. As explained in the BPT analysis, EPA eliminated Option I (equalization, chemical precipitation, and multimedia filtration) from consideration because it did not control organic pollutants effectively. In addition, EPA concluded that zero or alternative discharge is not an available alternative treatment technology for this industry. As explained above, zero or alternative discharge is not broadly applicable to landfills or may result in the transfer of waste residuals to other media.

1.3.4 NSPS selection

EPA is establishing New Source Performance Standards (NSPS) that would control the same conventional, priority, and non-conventional pollutants controlled by the BPT effluent limitations. The technologies used to control pollutants at existing facilities are fully applicable to new facilities. Furthermore, EPA has not identified any technologies or combinations of technologies demonstrated for new sources that are different

from those used to establish BPT/BCT/BAT for existing sources. Therefore, EPA is issuing NSPS limitations that are identical to those in each category for BPT/BCT/BAT.

1.3.5 PSES selection

The Agency is not establishing pretreatment standards for existing sources (PSES). The Agency bases its decision on several factors. EPA's analysis of indirect discharging landfills found raw leachate concentrations at levels approximately one-half of the inhibition value of a POTW biological treatment system. EPA also found no evidence of contamination problems of POTW biosolids as a result of landfill leachate. Furthermore, in EPA's study of the indirect dischargers, EPA found no documented persistent problems with POTW upsets as a result of landfill wastewater.

1.4 Structure of the economic analysis

This Economic Analysis (EA) describes both the methodology employed to assess impacts of the rule and the results of the analyses. Figure 1-1 summarizes the overall structure of the EA. The two main inputs to the analysis are: 1) data on industry baseline financial and operating conditions, and 2) projected costs of complying with the rule. The "Waste Treatment Industry Questionnaire Phase II: Landfills" (hereafter, the "landfills survey") conducted under the authority of Section 308 of the Clean Water Act (CWA) provided the principal baseline financial and operating data.

Pursuant to its CWA Section 308 authority, EPA surveyed 252 landfills. The survey asked for balance sheet and income statement information, as well as quantitative and qualitative information regarding each facility's dependence on market sectors, types of customers and business activity. The survey asked facilities to characterize the competition they faced in various markets. The survey also gathered data regarding facility liquidation value, cost of capital and the facility's owning firm. EPA supplemented survey data with secondary sources, including trade literature and public filings.

In addition to baseline facility data, the second major type of data input to the analysis is the technical estimate of costs associated with compliance with the regulatory options. EPA developed these estimates based on engineering analysis of the in-scope facilities. EPA incorporated the cost estimates into the EA by

adding an annualized capital cost of compliance to the estimated annual operating and maintenance costs of compliance to yield a single, total annualized compliance cost.

For privately-owned landfills, EPA used baseline financial data and estimated annualized compliance costs to calculate baseline and post-compliance cash flows at the level of the entire facility as well as for waste treatment operations alone. EPA considered facilities that convert from non-negative to negative facility-level cash flows as a result of incurring compliance costs to be closures associated with the regulation. EPA also calculated the ratio of compliance costs to revenue as a secondary measure of financial stress short of closure.

The analysis subjected municipally-owned landfills to two impact tests based on median household income. The first test calculates the ratio of compliance costs to median household income. Ratios equal to or greater than 1 percent indicate that the facility will incur severe impacts. The second test calculates the ratio of total landfill disposal costs – that is, baseline costs plus incremental compliance costs – to median household income. In this case, ratios exceeding 1 percent indicate moderate impacts.

The EA builds from the facility-level impact analysis, the results from which then drive the other components of the EA (see Figure 1-1). The firm-level impact analysis evaluates the effect of facility-level compliance costs on the parent firm. The community impact analysis examines how employment losses due to projected facility closures affect not only the people that were employed by the facility but also the communities to which these people belong. Another part of the EA assesses landfill closures might influence the U.S. trade balance by changing export and import activity.

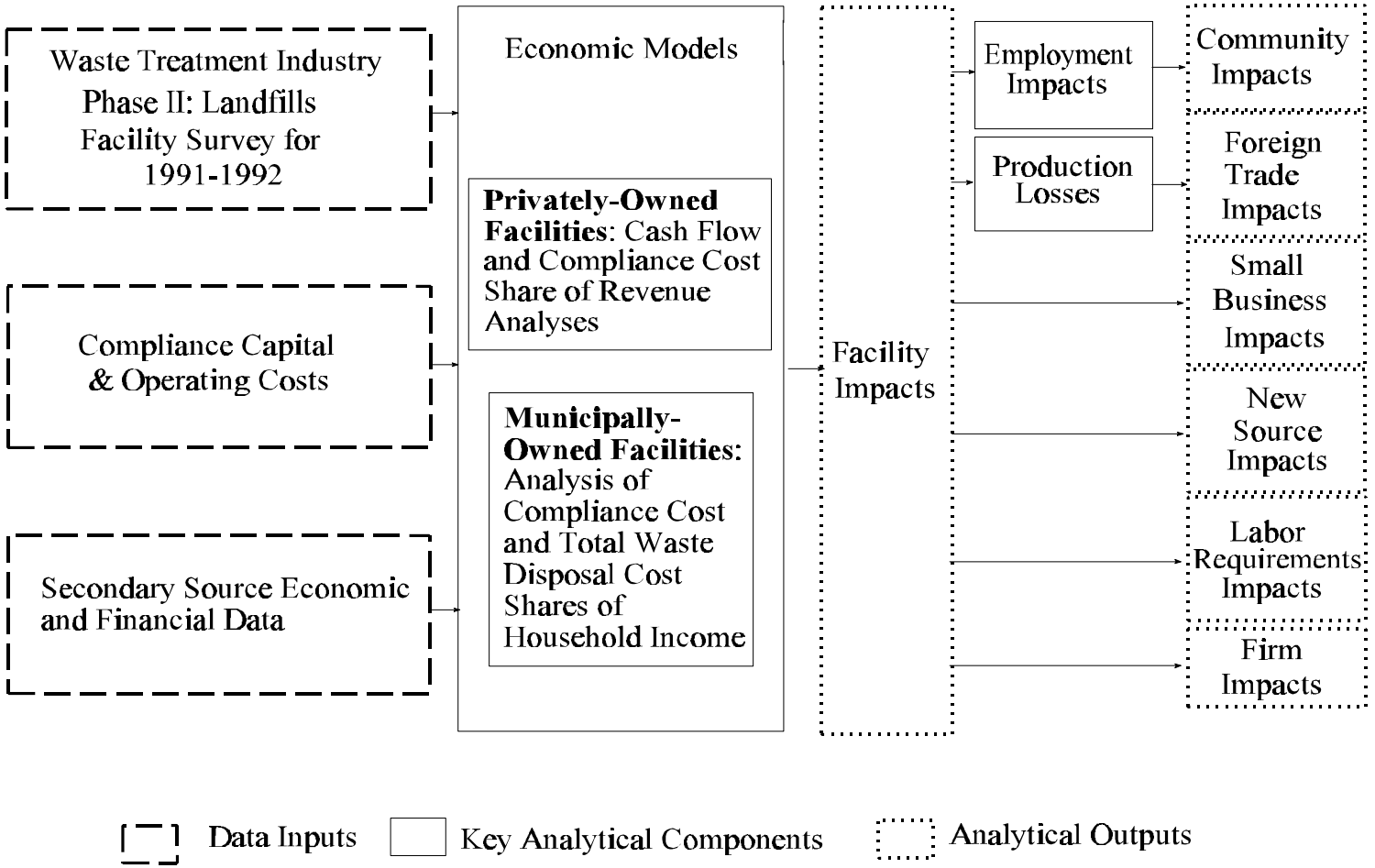
EPA also examined the rule to determine if it would create barriers to entry. If existing firms were to gain a significant financial advantage over new firms in complying with the rule, then the rule might deter new entrants and reduce market competition.

Finally, EPA assessed the regulatory impact on small businesses, in accordance with the requirements of the Regulatory Flexibility Act. The key methodological component of this analysis was the identification of small businesses. EPA used small business thresholds provided by the Small Business Administration, which defines small businesses by firm-level employment or revenues, depending on the industry. In the Regulatory Flexibility Analysis, EPA applied these thresholds and found no small businesses among the in-scope facilities.

1.5 Organization of the economic analysis report

The remaining parts of the Economic Analysis are organized as follows. Chapter 2 describes the data sources consulted for this EA. Chapter 3 profiles the landfills industry and examines the economic and financial structure and performance of its markets. Following the background material in Chapters 2 and 3, Chapter 4 details the methodology used to estimate facility impacts and presents the results. Chapters 5 through 9 connect the results of the facility impact analysis to potential collateral effects on firms, foreign trade, communities, new entrants and small businesses. Chapter 10 summarizes the environmental impact assessment. Chapter 11 describes the cost-reasonableness test and presents the results from that test.

Figure 1-1
Economic Impact Analysis of the Landfills Industry
Effluent Limitations Guidelines: Analytic Components



Chapter 2

Data Sources

2.1 Introduction

This chapter describes the primary and secondary sources that provided economic and financial data used to assess the expected economic impact of the landfills rule.

2.2 Primary source data

In 1994, EPA mailed the Waste Treatment Industry Questionnaire Phase II: Landfills (hereafter referred to as the survey) to 252 landfills identified at that time and received 220 substantially complete responses. The survey obtained 1991 and 1992 information on the technical and financial characteristics of facilities to estimate how an effluent guideline would affect facilities.

The technical data obtained by this questionnaire included information on facility operating processes that use water, the quantities of water and pollutants discharged by the various processes, the treatment systems that are currently in place for managing discharge of pollutants and other data. These data provided the basis for estimating treatment system and process change costs for complying with various landfills rule options. The estimated technical costs for compliance in turn yielded estimates of the capital and operating costs of treatment systems and any production costs or savings that would accompany installation and operation of a treatment system.

The survey also obtained a variety of financial data from the facilities. These data included: two years (1991-1992) of income statements and balance sheets at the facility and firm levels; selected financial data for landfill and waste treatment operations; estimated value of facility assets and liabilities in liquidation; borrowing costs; employment at the level of the facility as well as by type of operation, and characterizations of market structure. The financial data obtained in the survey provided the basis for assessing how the rule is likely to affect facility finances.

2.3 Secondary source data

In addition to enabling numerous analytical tools in the economic impact analyses in this document, secondary source data helped to characterize and update background economic and financial conditions in the national economy and in the landfills industry. For example, the analysis used secondary source data to track the numerous consolidations and facility closures since administering the survey. Secondary source data also contributed significantly to the firm-level analysis and to the characterization of future prospects. Secondary sources used in the analysis include the following:

- 1987 to 1992 *U.S. Industrial Outlooks*, published by the Department of Commerce, which supplied information for Chapter 3.

- Small business thresholds, by 4-digit industry group from the Small Business Administration, used in the Regulatory Flexibility Analysis and in the preliminary statistical analyses.

- Industry sources, trade publications (especially *EI Digest* and *The Hazardous Waste Consultant*) and press releases, which contributed to the landfills profile presented in Chapter 3 and to the facility and firm-level impact analyses.

- Financial databases, including Robert Morris Associates' *Annual Statement Studies*, Dun & Bradstreet's *Million Dollar Directory* and the Dun & Bradstreet company database. These sources provided diagnostic financial ratios and firm-level income statement and balance sheet values, as well as supplementary identification data.

- The FY 1997 *Economic Report of the President* provided Producer Price Index and Gross Domestic Product deflator series.

- Supplementary data for landfills from the *1994 Statistical Abstract of the United States*, published by the Department of Commerce and EPA's *Characterization of Municipal Solid Waste in the United States*.

- Municipality data, including household income and other demographic data used in the facility impact, regulatory flexibility and community impact analyses, derived from the Bureau of the Census' *County and City Data Book, 12th Edition*, 1994, and the Bureau of Economic Analysis' *Regional Multipliers: A User Handbook for the Regional Input-Output Modeling System (RIMS II) 2nd Edition*, 1992).

- U.S. Bureau of the Census, *County Business Patterns 1994*, U.S. Government Printing Office, Washington, DC, 1996.

Chapter 3

Profile of the Landfills Industry

3.1 Introduction

Once characterized by numerous small facilities, the landfills industry has merged into larger facilities under a smaller number of owners. Overcapacity continues to threaten profitability, but firms that own landfills have diversified into a number of waste management activities in order to respond to changing markets, technologies and regulations.

This chapter presents an overview of the landfills industry, focusing on parameters that relate to the industry's ability to respond to regulatory compliance costs. The profile relies in part upon responses to the landfills survey described in Chapter 2. This profile also incorporates contributions from industry observers and secondary sources.

The following section defines relevant terms and explains the structure of the landfills industry. After the definitions, the profile examines the Subtitle D (non-hazardous wastes) portion of the landfills industry, focusing on market structure and financial performance, and then focuses on the landfills that EPA expects must comply with a landfills rule. The chapter concludes by examining the time period covered by the survey and prospects in the near future.

3.2 Industry definitions

A landfill is a facility that disposes of solid wastes in an area of land or an excavation that receives wastes for permanent disposal, and that is not a land application unit, surface impoundment, injection well, or waste pile. A land application unit is an area where operators or users apply wastes onto or incorporated into the soil surface (excluding manure spreading operations) for agricultural purposes or for treatment and disposal. A surface impoundment is a facility or part of a facility that is a natural topographic depression, human-made excavation, or diked area, formed primarily of earthen materials (although it may be lined

with human-made materials), designed to hold an accumulation of liquid wastes or wastes containing free liquids and that is not an injection well. Examples include holding storage, settling, and aeration pits, ponds, and lagoons.[1] A facility is a piece of continuous property owned by a single entity. There are often several distinct landfill units located at a facility.

The wastewater flows covered by the rule include leachate, gas collection condensate, drained free liquids, laboratory-derived wastewater, contaminated storm water and contact washwater from truck exteriors and surface areas that have come in direct contact with solid waste at the landfill facility. However, this effluent guideline does not apply to groundwater contaminated by a landfill and collected, treated, and discharged. Chapter 2 of the Development Document includes a discussion of the exclusion for contaminated groundwater flows.

Landfills differ according to the type of solid wastes they accept and by the type of entities that own the landfills. Depending on the type of wastes disposed at a landfill, the landfill may be subject to regulation and permitting under either Subtitle C or Subtitle D of RCRA.

RCRA Subtitle C hazardous waste landfills receive wastes identified or listed as hazardous wastes under EPA regulations. Subtitle C hazardous waste regulations apply to landfills that presently accept hazardous wastes or accepted hazardous waste at any time after November 19, 1980. 40 CFR Parts 264 and 265 includes performance regulations governing the operation of hazardous waste landfills.

RCRA Subtitle D landfills can accept wastes not required to be sent to Subtitle C facilities. Subtitle D landfills that do not presently accept household refuse or did not accept household refuse after October 9, 1991, are subject to the performance regulations included in 40 CFR Part 257. These landfills may accept such non-hazardous wastes as construction and demolition debris, ash, or sludge. Facilities that presently accept household refuse are subject to the performance regulations included in 40 CFR Part 258 Revised Criteria for Municipal Solid Waste Landfills. Municipal Solid Waste Landfills (MSWLFs) may also receive other types of RCRA Subtitle D wastes, such as ash, non-hazardous sludge, and industrial solid waste.

[1] Definitions of landfills, land application units and surface impoundments are found in CFR 257.2.

Landfills also differ according to whether they are owned by private firms or by government entities – typically municipalities. This profile will use the terms *privately-owned* and *municipally-owned landfills* to refer to these two types of ownership.

3.3 Subtitle D landfills (non-hazardous wastes)

RCRA Subtitle D facilities handle two kinds of non-hazardous waste: municipal waste and non-municipal waste. By far, the majority of data available from secondary sources pertains to municipal waste landfills. Because of the relative paucity of data pertaining to Subtitle D non-municipal waste landfills, this profile draws heavily from the landfills survey to characterize nonmuicipal landfills..

Market structure

Once characterized by numerous small facilities, landfills have responded to economies of scale and to market uncertainty by consolidating into larger landfills receiving wastes from a wide region through systems of smaller transfer facilities. In 1995, the Environmental Industry Associations (EIA) reported 2,893 facilities compared to 5,726 facilities in 1991and 7,575 facilities in 1988. Overall, the number of landfills declined 62 percent from 1988 to 1995.[2]

Economies of scale occur when high fixed costs or certain production technologies yield decreasing unit costs as the level of production increases. While economic theory predicts that the unit cost of production should eventually increase with output, there is typically a range of output over which producing more of a commodity can decrease the average cost of each unit produced.

Typically, scale economies result from fixed costs, which are those costs that do not vary with the level of output. For instance, an oil drilling operation incurs substantial exploration, testing and drilling costs before producing a single barrel of oil.[3] If the facility produces only one barrel of oil, the cost of that first

[2] Repa, E.W. and A. Blakey. *Municipal Solid Waste Disposal Trends, 1996 Update,* Environmental Industry Associations, 1997. The 1988 value was obtained by the authors from the Government Accounting Office

[3] Economists sometimes distinguish between sunk costs and fixed costs. While fixed costs include all costs that do not vary with output, sunk costs are those fixed costs that cannot be recovered in liquidation. The distinction is not needed here because any kind of fixed cost contributes to economies of scale.

barrel is the entire fixed cost of the operation, plus any costs specifically incurred during the extraction of that barrel of oil. If, on the other hand, the facility produces two barrels of oil, then the fixed cost is allocated over both barrels, and the average unit cost falls by approximately a half.

Economies of Scale Due to Fixed Costs (Hypothetical Example)

Production Quantity	**Fixed Costs** *Exploration, permits, etc.*	**Variable Costs** *Oil well operating costs, etc.*	**Unit Cost Per Barrel**
1 barrel	$100	$2	$102
2 barrels	$100	$4	$52

Scale economies can also result from a production technology that operates more cost-effectively at higher levels of output. Internal combustion engines, for instance, sometimes become more fuel efficient at higher operating temperatures associated with higher rates of output. Landfills experience significant scale economies because of both high fixed costs and production technologies, resulting from regulatory as well as non-regulatory factors.

Compliance determination, initial permitting and monitoring involve regulatory costs that are constant with respect to output or that increase less than proportionately with production volume. In particular, Federal regulation of landfill leachate and groundwater contamination in 1993 added high fixed costs of compliance to assorted costs from prior regulations. EIA reported that these federal regulations encouraged the building of larger landfills to spread out the high costs of complying with the new environmental standards over a larger revenue base.[4] Table 3-1 lists regulatory actions relevant to both hazardous and non-hazardous waste landfills, as the next section of this chapter will discuss scale economy phenomena among hazardous waste landfills similar to scale economies among Subtitle D landfills.

[4] Repa, E.W. and A. Blakey. *Municipal Solid Waste Disposal Trends, 1996 Update*, Environmental Industry Associations, 1997.

Table 3-1. Major Regulatory Events Affecting Landfills

1980 Section 3001 of RCRA	Categorized and regulated hazardous wastes
1984 Hazardous and Solid Waste Amendment to RCRA	Prohibited placing untreated hazardous waste on or in the land; banned corrosive, metal and cyanide wastes and bulk liquids; promulgated heavy metal and organic toxins treatment standards; for new or expanded hazardous waste landfills, required double liners and leachate collection systems.
1988-90 Land Disposal Restrictions	Standards set for concentrations of hazardous wastes permitted in landfills.
1993 Federal Regulations for Municipal Landfills	Established minimum technology standards for landfills; set groundwater monitoring and corrective action requirements; required control of landfill leachate for 30 years after closure.

Source: Environmental Protection Agency

In addition to capital compliance costs related to pollution abatement and monitoring, fixed costs include efforts needed to address increasingly combative communities around new landfills, which compound the high cost of scarce land for new landfill sites.

Landfills also experience economies of scale for several non-regulatory reasons. First, the landfills entail certain fixed capital costs for facility construction and fixed overhead costs, including administrative worker salaries and a portion of utilities that do not vary with the level of output. One study by the National Bureau of Economic Research showed that the average unit cost of a typical municipal landfill declines by about 70 percent as its capacity increases from 227 to 2,700 metric tons per day.[5] In addition, the use of transfer stations to consolidate waste for transport to medium to large-sized regional facilities is generally less expensive than transporting the same aggregate amount of waste in smaller parcels. Handling costs can decrease as the rate of wastes handled increases by taking advantage of specialized machinery or labor.

[5] Beede, D.N. and D.E. Bloom. *Economics of the Generation and Management of Municipal Solid Waste,* National Bureau of Economic Research, 1995, pg. 21.

As a result, the industry shifted away from small, local facilities toward the practice of transporting waste from local transfer stations to larger, more distant regional landfills.

Origins of Overcapacity

Overcapacity in the industry dates from the 1980s, when a rapid rate of landfill closures generated predictions of capacity shortages. States responded with legislation to divert waste from landfills and to increase recycling. In addition, a cyclical downturn in the general economy during the late 1980's reduced the rate of waste generation from commercial and industrial sources. These events markedly reduced solid waste volumes. Meanwhile, landfill capacity did not decline as quickly as predicted, because most closures were small sites. Thus, the number of closing facilities proved misleading.

In recent years, waste treaters integrated both horizontally and vertically. Larger landfills replaced smaller landfills, and single sites began to perform several types and stages of waste treatment. This vertical integration positions waste treaters to accommodate the current trend among communities to adopt an integrated waste management approach. In integrated waste management, landfills are the least preferred method of waste management. A community would preferentially seek to manage wastes through waste reduction, recycling, and composting. Vertically integrated firms engaged in landfill operation offer waste management services at a number of stages in the handling of solid wastes, such as recycling, transfer and collection.

Overcapacity arose from inaccurate forecasts of decreasing capacity. In the late 1980s, articles warned about an impending garbage and landfill "crisis."[6] The industry responded by building larger regional landfills. States responded by enacting disposal capacity requirements as part of broader waste management laws. These requirements usually specified that counties and solid waste management boards had to guarantee a set number of years of disposal capacity. To meet these goals, a number of states passed laws requiring that certain percentages of waste be diverted from landfills (often by recycling or incineration).

Consequently, disposal capacity increased between 1991 and 1995, rather than decreasing as predicted. In 1995, the majority of states (38) had more than ten years of disposal capacity, compared to 1991, when the majority of states (29) had less than ten years of disposal capacity.

[6] Rasmussen, S. *Case Study: 1991 Municipal Solid Waste Landfill Criteria Regulatory Impact Analysis,* prepared for Resources for the Future, 1996, pg. 5.

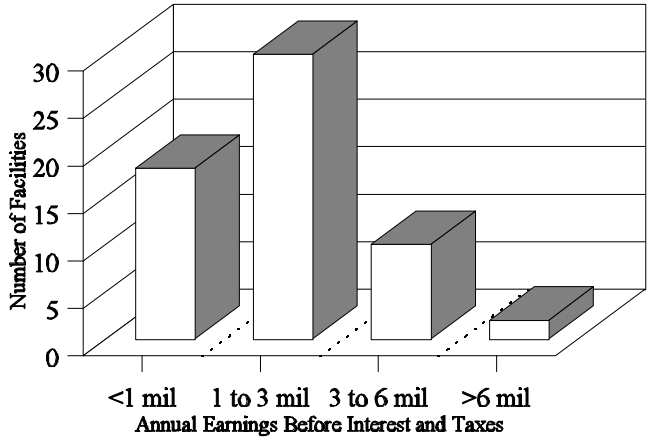
Despite the trend toward consolidation and integration, a sizeable number of small landfills remain. In particular, municipally-owned facilities tend to be smaller than privately-owned facilities, and these non-profit entities did not participate in industrial consolidation to the same extent as private landfills. As of 1996, roughly 78 percent of landfills are reportedly government-owned, yet they account for less than half the nation's municipal solid waste (MSW) disposal capacity by volume.[7]

Privately-owned and municipally-owned facilities also differ in the types of waste landfilled. Residential wastes constitute a higher proportion of wastes handled by municipally-owned landfills than private landfills. On the other hand, privately-owned landfills often handle industrial waste, construction and debris, brush, and sewage, in addition to residential and commercial MSW. Privately-owned companies handle about 90 percent of commercial waste.

Financial performance

Financial performance indicators in this profile draw from survey data, sample weighted to represent national estimates. The profile provides return on assets and earnings data for privately-owned facilities only, since municipally-owned landfills typically do not operate to generate profits. Values are expressed in 1992 dollars, and where respondents provided two years of data, as requested by the survey, values represent constant dollar averages.

Figure 3-1. Distribution of Privately-Owned Landfills By Earnings Size



Most privately-owned landfills earn between $1 million and $3 million annually in earnings before interest and taxes (Figure 3-1). Facilities in this earnings range account for half the facilities in the survey sample, on a weighted basis.

Profitability, as measured by pre-tax return on assets, is relatively high with a large percentage of the facilities earning returns greater than 15 percent. On a weighted basis, 39 facilities (65

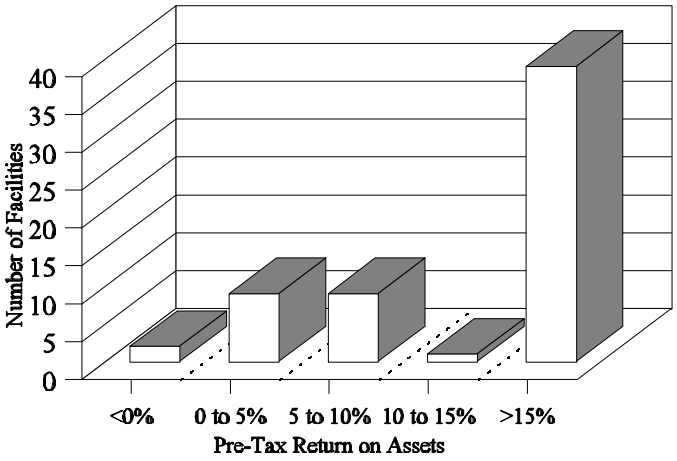
[7] McCarthy, J.E. *Congressional Research Service Report for Congress: Solid Waste Issues*, Environmental and Natural Resources Policy Division, 1995, pg. 5.

percent) fall into that highest range. Only two facilities (3 percent) earned negative returns on a pre-tax basis. Figure 3-2 presents these results.

Municipally-owned landfills receive the bulk of their revenues from either taxes or fees. Few facilities receive substantial funding from both sources.

Future trends

Figure 3-2. Distribution of Privately-Owned Landfills By Return on Assets



Increased disposal capacity (see Figure 3-3) indicates that the number of MSW landfills in the U.S. will likely remain constant in the near future. Landfill owners will probably add additional disposal capacity on a regional basis only as existing capacity is depleted. A number of small landfills located in arid or remote locations may close after the special extensions to Subtitle D expire for these facilities on October 9, 1997. The shutdowns, however, are unlikely to be as extensive as the ones in the past. In addition, projected disposal capacity will not change significantly in the near future.

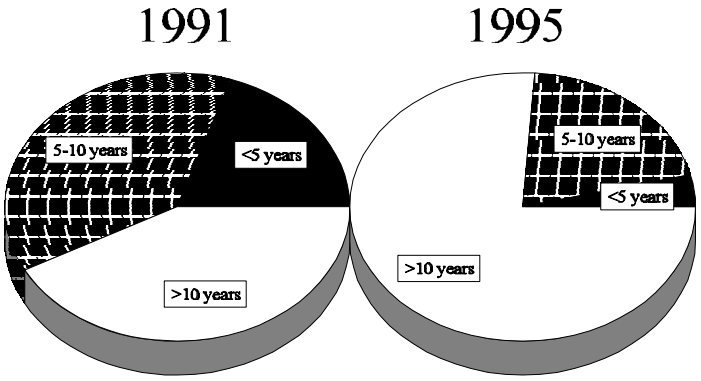
While the total amount of MSW generated annually continues to rise, the rate of this growth is slowing. Per capita MSW generation is expected to remain constant at 4.4 pounds per person per day through the year 2000. The main reason for this trend is the effect of state and local efforts to keep yard waste out of the waste management system. In spite of the steady per capita MSW generation rate, EPA expects the amount of MSW generated to increase to 223 million tons by the year 2000 and 262 million tons by the year 2010 due to natural population growth and sustained long-term economic growth.[8]

Issues that may have a significant impact on the MSW landfills industry in the future include federal rulings regarding interstate shipment of waste and flow control. Interstate shipment of waste has become

[8] U.S. Environmental Protection Agency, *Characterization of Municipal Solid Waste in the United States: 1995 Update,* 1995, pg. 1-3.

more common in recent years due to the national trend towards larger regional disposal facilities, differences in landfill standards, and local shortages of disposal capacity, particularly in the Northeast and on the West Coast. To avoid becoming the dumping ground for waste from nearby states, several states have passed restrictions on waste transported into their states. Resolutions of associated court cases will likely have a significant impact on the structure of the MSW landfills industry.

Figure 3-3. Remaining Disposal Capacity
Distribution for U.S. States (1991-1995)



Source: Municipal Solid Waste Disposal Trends, 1996 Update, Environmental Industry Assoc.

Chapter 4

Facility Impact Analysis

4.1 Introduction

The facility-level impact analysis assesses how the landfills rule would affect individual landfills, which are the smallest unit of analysis in the Economic Analysis (EA). This chapter provides the basis for estimating the extent of facility closures and associated production and employment losses that may result from the rule. Other economic impact analyses build from the facility impacts estimated in this chapter. Facilities differ from firms in that facilities are geographically contiguous entities, while a firm might own more than one facility, at various locations. The next chapter assesses firm-level impacts.

Based on the facility impact analysis, EPA finds that the landfills rule is economically achievable and will not subject affected facilities to unmanageable or unreasonable financial or economic burdens.

This analysis draws largely from facility economic and financial data obtained from responses to the landfills survey administered in 1994 to a sample of landfills that EPA expects would have to comply with the landfills rule. Additionally, engineers used technical survey and other data to estimate compliance costs for each facility under each regulatory option. In this chapter, EPA uses economic and financial responses from the survey to evaluate the impact of compliance costs on the financial condition of Subtitle D direct dischargers included in the rule.[9] This chapter does not evaluate economic impacts on hazardous waste landfills because hazardous waste landfills will incur no incremental costs and experience no impacts due to the landfills rule.

The major sections of this chapter explain the methodology behind each component of the facility impact analysis and present the results. EPA applied four kinds of financial tests:

[9] See Chapter 1 for a discussion of the landfill categories and regulatory option selection.

- **After-Tax Cash Flow Test** This test examines whether a facility loses money on a cash basis. If a facility's cash flow is negative when averaged over the period of analysis, then EPA finds that the facility's management and ownership will experience severe economic impacts.

- **Compliance Cost Share of Revenue** This test examines whether a facility's estimated compliance costs amount to 5 percent or more of revenue, in which case the facility would likely experience moderate economic impacts.

- **Compliance Cost Share of Household Income** This test examines whether a municipally-owned facility's estimated compliance costs equal or exceed 1 percent of the median household income in the jurisdiction governed by the municipality that owns the facility. If so, the facility will likely experience severe economic impacts.

- **Total Landfill Disposal Cost Share of Household Income** This test examines whether a municipally-owned facility's total landfill disposal costs – including compliance costs – equal or exceed 1 percent of the median household income in the jurisdiction governed by the municipality that owns the facility (where publicly-owned). If so, the facility will likely experience moderate economic impacts.

The appropriate tests for each facility depend on the type of facility in question. The facility impact analysis distinguishes between two types of non-hazardous waste landfills, depending on ownership: privately-owned and municipally-owned landfills.[10] Either type may accept municipal or non-municipal waste or both, and private businesses may operate municipally-owned facilities. However, the landfills evaluated in this facility impact analysis do not generate any hazardous leachate. Facilities that commingle hazardous with non-hazardous leachate are classified as hazardous for the purpose of the rule.

Table 4-1 indicates which facility impact tests EPA applied to each group of facilities. The compliance cost share of revenue test and after-tax cash flow test were performed for all privately-owned landfills. They do not apply to municipality-owned landfills, which operate on a non-profit basis. Instead, EPA

[10] One can divide these categories further according to the type of non-hazardous waste accepted: municipal or non-municipal. An analysis conducted at this level of detail yielded no gain in information. Therefore, EPA promulgates the effluent guideline and presents analyses for the aggregate category.

applied the compliance cost share of household income and total landfill disposal cost share of household income test to all municipally-owned landfills.

Table 4-1. Facility Impact Tests Applied to Each Category of Landfill

Landfills Category	Estimated National Population*	After-Tax Cash Flow	Compliance Cost Share of Revenue	Compliance Cost Share of Household Income	Total Landfill Cost Share of Household Income
Privately-Owned Direct Dischargers	42	✔	✔		
Municipality-Owned Direct Dischargers	96			✔	✔
Indirect Dischargers	Not regulated by the rule.				

* After exclusion of baseline closures

Since all of these tests evaluate annualized compliance costs, the next section describes how annualized compliance costs were calculated. The following sections detail the methodology underlying each test. The chapter concludes with a presentation of the results.

4.2 Compliance costs

Upon promulgation of effluent guidelines, each in-scope facility can either meet the guidelines by applying pollution prevention and control technology, or it can substitute alternative waste management technologies not regulated by the guidelines. While the Agency expects an actual facility to choose the least costly option, the facility impact analysis described here uses the conservative assumption that each facility complying with the regulation does so by making the capital expenditures and incurring operating costs to meet the requirements of the regulation. To the extent that facilities substitute alternative treatment and disposal methods not included in the landfills rule, actual costs to industry will be less than compliance costs evaluated in the facility impact analysis.

Engineering analysis yielded estimates of how much each facility would need to spend to comply with each regulatory option. The estimated expenditures comprised an *operating and maintenance costs* component, which recurs annually, and a one-time *capital cost of compliance* component. In order to perform the economic impact tests, EPA combined the two cost components into a single *annualized* cost. Based on properly calculated annualized cost, the facility should be indifferent between: a) incurring the annualized

cost every year, and b) incurring a capital cost plus operating and maintenance cost the first year and then only operating and maintenance costs each subsequent year.

The facility impact analysis proceeds on an after-tax basis because after-tax cash flow is the portion of cash flow that the facility can use to meet regulatory compliance costs. After-tax cash flow commonly indicates the ongoing viability of business enterprises. In this analysis, EPA calculated after-tax annualized costs (ATC_{Ann}) as follows:

$$ATC_{Ann} = ATC_{OM} + ATC_{C,Ann}$$

where

ATC_{Ann}	=	After-tax annualized cost of compliance
ATC_{OM}	=	After-tax operating and maintenance cost of compliance
$ATC_{C,Ann}$	=	After-tax annualized capital cost of compliance

The only adjustment needed to calculate ATC_{OM} from technical estimates of operating and maintenance costs is to subtract the offsetting benefit the facility would experience from reduced taxes. EPA used a marginal corporate tax rate of 34 percent, which implies that for every dollar of operating and maintenance compliance costs, before taxes, the facility would lose 66 cents in after-tax profit.[11] Therefore,

$$ATC_{OM} = (1-\tau) \times C_{OM}$$

where

ATC_{OM}	=	After-tax operating and maintenance cost of compliance
C_{OM}	=	Operating and maintenance cost of compliance (pre-tax)
τ	=	Marginal corporate tax rate (34% in this analysis)

[11] While the survey gathered data regarding total tax expenses and income, such data can only yield estimates of average tax rates. Generally, industry respondents generally cannot estimate the marginal tax rates required by the impact analysis without considerable burden and inaccuracy. Therefore, EPA uses the highest corporate tax rate as the best estimate of the marginal tax rate facing most facilities.

After adjusting for taxes, EPA annualized the engineering estimates of capital costs of compliance. EPA annualized capital costs by amortizing them over 15 years, using a discount rate of 7 percent. The 15 year time period conforms with EPA practice and reflects a technical estimate of the useful life of the relevant kinds of capital. The 7 percent discount rate is consistent with OMB's measure of the social opportunity cost of capital (see Executive Order #12866) and represents a conservative estimate of the real, after-tax cost of capital for a typical facility using both equity and debt financing.[12] EPA showed, in developing the landfills rule impact methodology, that annualized compliance costs are only modestly sensitive to large variations in the discount rate.

To calculate offsetting tax benefits, EPA used straight-line depreciation over 15 years – the estimated useful lifetime of the relevant capital goods. Therefore, the facility applies 1/15th of the capital cost of compliance to each year's income calculations for tax purposes. Tax codes in effect at the time of this analysis allow businesses to use straight-line depreciation or a Modified Accelerated Cost Recovery (MACRS) depreciation schedule.[13] EPA chose the straight-line method for this analysis because it is the simpler and more conservative method.

The following equation calculates the annualized, after-tax capital cost of compliance.

$$ATC_{C,Ann} = \frac{r}{1-(1+r)^{-t}} \times C_C - \frac{C_C}{t} \times \tau$$

where

$ATC_{C,Ann}$	=	After-tax annualized capital cost of compliance
C_C	=	Capital cost of compliance

[12] EPA performed a sensitivity test in the Metal Products and Machinery Phase 1 proposed effluent guidelines EA to show that annualized costs are quite insensitive to discount rates over a reasonable range. In a review of prior economic impact analyses, the Office of Water similarly found that the use of OMB's 7 percent rate is probably preferable to collecting facility-specific measures of costs of capital because of the burdensome data requirements and the practically insignificant analytical benefits associated with alternatives. (See "Review of Data Gathering and Methodology Issues for Effluent Guideline Economic Impact Analyses (Draft)," August 1996.)

[13] The "15-year" class of depreciable property includes "municipal wastewater treatment plants" and other property with a class life of 20 to 25 years. 1992 U.S. Master Tax Guide, Commerce Clearing House, Inc., 1991.

r	=	Discount rate (7% in this analysis)
t	=	Amortization period (15 years)
τ	=	Corporate tax rate (34%)

In the above formula, the first expression on the right-hand side is the annualized equivalent of the lump sum capital cost, C_C. The second expression is the offsetting benefit in the form of reduced taxes associated with depreciation. Each year, the taxable income is reduced by 1/15 the total capital cost of compliance. The tax associated with that depreciation is τ times the depreciation.

Finally, substituting numeric values into the above formulas, the calculation of annualized, after-tax compliance costs becomes:

$$ATC_{Ann} = 0.66 \times C_{OM} + \left(0.1098 \times C_C - \frac{C_C}{15} \times 0.34\right)$$

where

ATC_{Ann}	=	After-tax annualized cost of compliance
C_C	=	Capital cost of compliance
C_{OM}	=	Operating and maintenance cost of compliance

ATC_{Ann} is the compliance cost subtracted from baseline cash flow in the after-tax cash flow test, and it is also the value compared to total revenue in the compliance cost share of revenue test.

Offsetting revenue increases

Hypothetically, some facilities might offset a portion of compliance costs by passing them through to customers in the form of higher prices, but landfills have little capacity to do so in their markets. EPA used the conservative assumption in this analysis of zero cost pass-through. Since EPA finds that industry would not bear unmanageable impacts in the zero cost pass-through case, it follows that it would not bear unmanageable impacts under any other cost pass-through assumption.

Some facilities might also ameliorate impacts by substituting alternative waste treatment and handling techniques or changing the mix of services they offer. The current facility impact analysis excludes these dynamic, long-run responses that can mitigate the financial impact of effluent guidelines.

4.3 Methodology underlying the after-tax cash flow test

Cash flow measures a business's ability to make a profit on a day-to-day basis. Negative cash flow indicates that the business does not bring in enough cash to meet its cash expenses and costs. While a facility with positive cash flow might or might not be viable in the long run, negative cash flow definitely presents a problem to businesses and is often the first "trigger" for radical changes in business operations, such as closure. Negative cash flow may also call for more sophisticated financial evaluations, such as net present value analysis. Businesses typically do not conduct net present value analyses on a regular basis but may do so when facing negative cash flows.

Because taxes compete for cash with other cash expenses, the relevant measure of cash flow to evaluate regulatory impacts is the after-tax cash flow. This is a value that business managers report and monitor on an ongoing basis, which contributes to its appropriateness for assessing facility impacts.

EPA conducted the after-tax cash flow test both in the baseline case and post-compliance case and applied the test only to privately-owned landfills, because publicly-owned facilities generally operate on a non-profit basis. If a facility's baseline cash flow is not negative, but, after incurring estimated compliance costs, the facility's cash flow becomes negative, then EPA determines that facility will experience severe economic impacts *as a result of the rule*. If, on the other hand, a facility exhibits negative cash flow before the adoption of a landfills rule, then the negative cash flow must be attributed to some prior cause.

EPA conducted the after-tax cash flow test using facility-wide income statement values, which provide the optimal basis for measuring the financial health of an affected business entity. EPA chose not to repeat the analysis using costs and revenues associated with waste treatment operations alone because waste treatment revenue differed from total facility revenue in only four instances, and then by no more than 5 percent in each case.

The after-tax cash flow test involves calculating, for each sample facility, the average after-tax cash flow (ATCF) over the years for which income statement data were obtained in the survey. The calculations are as follows:

1. Express all income statement values for a sample facility as a two-year average, in 1992 constant dollars, based on the Producer Price Index for finished goods (PPI). The PPI is the appropriate deflator because the alternative use for equity invested in waste treatment facilities is most likely investment in other forms of industrial production. The survey requested financial data for 1991 and 1992, and most facilities reported values for both of these years. However, a few facilities were not in operation in one or more of these years, or accounting procedures changed during the period in a way that precluded responding for one of the years. For these facilities, the average is the properly deflated value for the year for which the respondent reported data.

2. Compute facility-level after-tax cash flow in 1992 dollars for each year of data. The following equation computes the *After-Tax Cash Flow* (ATCF).

$$ATCF = (1-\tau)(R-C+D)$$

where

ATCF	=	After-tax cash flow
R	=	Total revenue in 1992 dollars (1991-1992 average)
C	=	Total costs and expenses (1991-1992 average)
D	=	Depreciation expense (1991-1992 average)
τ	=	Corporate tax rate, assumed to be 34 percent

3. Calculate post-compliance cash flows. The above calculations yielded baseline after-tax cash flows, based on survey responses. EPA estimated post-compliance cash flows by subtracting after-tax, annualized compliance costs from baseline cash flows. Thus,

$$ATCF_{PC} = ATCF - ATC_{Ann}$$

where

ATCF	=	Baseline after-tax cash flow
$ATCF_{PC}$	=	Post-compliance after-tax cash flow
ATC_{Ann}	=	After-tax, annualized cost of compliance

EPA classified facilities with non-negative baseline cash flow ($ATCF \geq 0$) but negative post-compliance cash flow ($ATCF_{PC} < 0$) as incurring significant adverse impacts due to regulation. Facilities with negative cash flows in the baseline case would continue to have negative cash flow with or without the addition of regulatory compliance costs and are not candidates for facilities incurring significant adverse impacts due to the landfills rule.

4.4 Methodology underlying the compliance cost share of revenue test

In previous rulemaking efforts, policy makers have found the relationship between compliance costs and the revenue size of regulated entities useful in assessing the likely impacts of compliance costs. The cash flow analysis does not fully address this issue because cash flow depends on both costs and revenue. A very large facility – in terms of revenue – could have very small cash flow if its costs are relatively high. Therefore, the results of the cash flow test vary according to profitability, not the according to the size of compliance costs and facility revenue.

The compliance cost share of revenue test expresses each facility's annualized compliance cost as a ratio to facility revenue. EPA considers ratios equal to or in excess of 5 percent as moderate impacts. Since the survey gathered revenue data both for the facility as a whole and for waste treatment operations alone, EPA simply averaged facility revenues in 1992 dollars over the period of the survey and then divided the average revenue for each facility by its annualized compliance cost, according to the following equation.
where

$$CCSR = \frac{ATC_{Ann}}{R}$$

CCSR	=	Compliance cost share of revenue
R	=	Total facility revenue in 1992 dollars (1991-1992 average)
ATC_{Ann}	=	After-tax, annualized cost of compliance

An alternative methodology substituting waste treatment revenues for total facility revenues from all activities yielded only small changes in compliance cost shares and no difference in the number of significant impacts.

4.5 Methodology underlying the compliance cost share of household income test

The impact analysis subjected municipally-owned landfills to two impact tests based on median household income. The first test calculated the ratio of compliance costs to median household income. When this ratio equals or exceeds 1 percent, EPA finds that the facility will likely incur severe impacts. The next section will describe the second test, which calculated the ratio of total landfill disposal costs – that is, baseline costs plus incremental compliance costs – to median household income. In this case, ratios exceeding 1 percent indicate moderate impacts.

Median household income is an appropriate measure of scale against which to compare compliance costs. The costs incurred by municipally-owned landfills, which operate on a not-for-profit basis, fall primarily upon the landfills' household customers. Customers may incur costs through a variety of mechanisms, such as increased landfill fees and taxes, decreased municipal landfill services or decreased wages earned by landfill employees.[14] Households account for the large majority of municipal landfill customers. Table 4-2 shows that household waste accounted for 79.8 percent of wastes (by tonnage) sent to municipally-owned landfills.

Therefore, this facility impact analysis uses the ratio of compliance costs to median household income to estimate the impact on both the household and industrial components of each municipality that owns a landfill. The analysis does not assume that only households incur costs; it only assumes that the shares of

[14] For-profit businesses operate some government-owned landfills. It is possible that contractual obligations might compel profit-seeking businesses to bear the compliance costs in the short run. However, in the long run, the business are likely to increase prices to, at least partially, compensate for the cost increase. This analysis evaluates a worst-case situation in which all compliance costs are borne by the landfill users via price increases.

compliance costs borne by households and commercial customers vary little between municipalities. This is the appropriate assumption because there is no precisely quantifiable way to predict the variation between municipalities in the share of compliance costs likely to fall on households.[15] Given that there is no predictable variation in the ratio of household to commercial shares of compliance costs, the ratio of compliance costs to household income provides exactly the same information as the ratio of compliance costs to commercial revenue or combined household and commercial income. EPA selected household income because this is the parameter for which the most accurate data are available.

Table 4-2. Source of Wastes Received by Municipally-Owned Landfills

Source of Waste	**Percent of All Wastes** *1991/1992 average*
Households	79.8
Commercial Sources	13.6
Other (non-differentiated)	6.7

National estimates based on the survey question 5.9 responses from sites included at the time of proposal.

EPA has previously employed the compliance cost share of household income test in assessing, for example, the impacts of the Solid Waste Disposal Facility Criteria Final Rule-40 CFR 257 and 258. That analysis indicated significant impacts where per-household total annualized costs equaled or exceeded one percent of median household income. EPA's guidance on implementing the requirements of the Regulatory Flexibility Act[16] recommends comparing annualized household compliance costs to median household income.

The impact test required two data inputs, in addition to compliance costs as calculated previously:

1. Population of households. The survey (Section A, question A.20) asked for the number of households served by each respondent. This is the population over which fee increases would be

[15] For example, using the ratio of household to commercial population or waste shares fails because the distribution of compliance costs depends primarily on supply and demand elasticities in commercial input and output, household labor and household consumption markets – not on the size of households compared to industry. Allocating compliance costs according to fees and taxes currently paid by households and commercial taxpayers also fails, because the actual incidence of tax burdens is not related to the distribution of cash tax assessments and payments.

[16] In this guidance, EPA suggests two tiers of significant impacts: 1 percent of income and 3 percent of income.

distributed. This method may lose some accuracy to the extent that households that pay compliance costs but do not receive landfill service have more or less income than households that receive landfill service but do not pay compliance costs.[17] The best available information suggests that, among municipally-owned landfills, the population of households served is substantially similar to the population likely to contribute toward meeting compliance costs.

2. Median household income. EPA obtained median household incomes from the *County and City Data Book* (U.S. Bureau of the Census) for the jurisdictions served by the landfill as reported in the landfills survey (question 5.13). Facilities listed as many as fourteen jurisdictions. The median income associated with each landfill is the population-weighted average of the median incomes of the jurisdictions served.[18]

The following equation calculates the ratio of compliance costs to household income:

$$CCSI = \frac{ATC_{Ann}}{H \times I}$$

where

CCSI	=	Compliance cost share of household income
ATC_{Ann}	=	After-tax annualized cost of compliance
I	=	Median household income among jurisdictions served
H	=	Number of households served

[17] However, even substantial differences in the tails of income distributions between served households and households incurring costs might not affect the median significantly.

[18] Responses to the landfills survey did not indicate whether the landfills accepted waste from the entire area of the jurisdictions listed or only segments of the jurisdictions. The analysis assumes that the landfill serves the entire jurisdiction for all jurisdictions listed.

4.6 Methodology underlying the landfill disposal cost share of household income test

For municipally-owned facilities, EPA evaluated whether the incremental compliance costs *in combination with current disposal costs* equal or exceed 1 percent of household income. Communities with very high landfill expenses in the baseline may experience stress from even small compliance costs. When the total post-compliance disposal costs equal or exceed the threshold, EPA finds moderate impacts.

Waste disposal costs per household prior to promulgation of the rule are calculated as each facility's price per ton for disposing of household waste – obtained from the landfills survey (question 4.28) – multiplied by the national average quantity of waste generated per household. The national average waste generation per capita, exclusive of recycling, is 0.62 tons per year.[19] The average number of persons per household is

$$TCSI = \frac{\frac{ATC_{Ann}}{H} + (1.64 \times C_{Base})}{I}$$

2.64.[20] Therefore, average waste generation per household, exclusive of recycling, is 0.62 × 2.64 = 1.64 tons per year. Using this value, the analysis calculates average post-compliance waste disposal costs per household.

where

TCSI	=	Total landfill disposal cost share of household income
ATC_{Ann}	=	After-tax annualized cost of compliance
I	=	Median household income among jurisdictions served
H	=	Number of households served
C_{Base}	=	Baseline disposal cost per ton

[19] *Characterization of Municipal Solid Waste in the United States*, 1994 update.

[20] *Statistical Abstract of the United States*, 1994.

4.7 Results

This section presents facility impact results for each category expected to incur costs under the landfills rule. These categories include Subtitle D direct dischargers that accept wastes from firms other than their own. The rule does not apply to Subtitle D indirect dischargers.

In aggregate, the 138 landfills (national estimate excluding projected baseline closures) expected to incur compliance costs under the landfills rule will incur approximately $8.57 million in annualized, pre-tax compliance costs under the rule (see Table 4-3). EPA estimated that privately-owned facilities will bear $2.99 million, or 35 percent, of compliance costs with the remaining 65 percent of compliance costs incurred by municipally-owned landfills. After-tax compliance costs sum to $7.64 million.

Table 4-3. Aggregate Compliance Costs
National Estimates, 1998 Dollars

	Pre-Tax	After-Tax
Privately-Owned	$2,988,731	$2,056,569
Municipally-Owned	$5,579,036	$5,579,036
All Landfills	$8,567,767	$7,635,605

Tables 4-4 and 4-5 show that two privately-owned landfills fail the after-tax cash flow test as a result of the regulatory option and thus incur severe impacts. This amounts to less than 5 percent of the 42 facilities in the category. The two landfills accounted for $4.8 million in revenues out of $1,092.7 million (in 1998 dollars) earned nationally by in-scope, privately-owned landfills. These severely-impacted landfills employed 20 employees, out of 4,272 employees nationally.[21]

Table 4-4. Number of Privately Owned Direct Dischargers Estimated To Incur Significant Impacts

Estimated National Population*	After-Tax Cash Flow Test	Compliance Cost Share of Revenue Test
42	2	0

** after exclusion of baseline closures*

[21] Average 1991-1992 revenues, expressed in 1998 constant dollars. Employment is measured in full-time equivalent workers, rounded upward to whole numbers.

Table 4-5. Number of Municipally Owned Direct Dischargers Estimated To Incur Significant Impacts

Estimated National Population*	Compliance Cost Share of Household Income Test	Total Landfill Cost Share of Household Income Test
96	0	0

** after exclusion of baseline closures*

The compliance cost share of revenue test yielded no facilities estimated to experience moderate impacts. The maximum compliance cost share of revenue identified was 4 percent.

The analysis indicates that no municipally-owned landfills will incur significant impacts under either option. In every case, incremental costs per household of complying with an effluent guideline, as well total post-compliance landfill disposal costs per household, amount to less than 1 percent of median household incomes.

Chapter 5

Firm-Level Impacts Analysis

5.1 Introduction

While Chapter 4 assessed the facility-level impacts of a landfill effluent guideline, this chapter estimates the impacts on firms. Firm-level impacts may exceed those assessed at the facility level, particularly when a firm owns more than one facility that will be subject to regulation.

Firms differ from facilities in that firms are business entities or companies, which may operate at several physical locations. Facilities are individual establishments defined by their physical location, whether or not they constitute an independent business entity on their own. Some facilities in the survey sample are single-facility firms. In these cases, the firm-level impact depends only on the facility-level impact. In other cases, sampled facilities are owned by multi-facility firms, so that the impact on the parent firm depends not only on that facility, but also on the impacts on and characteristics of other facilities owned by the same firm.

Firm-level compliance costs exceeding 5 percent of firm revenues indicated significant adverse impacts. Using this criterion, EPA finds no significant adverse impacts on affected firms and therefore determines that firms that own in-scope landfills will not bear unreasonable economic burdens resulting from this effluent guideline.

5.2 Methodology

EPA assessed firm-level impacts by estimating the ratio of firm-level compliance costs to revenues earned by the firm. The analysis used a threshold of 5 percent to indicate significant adverse impacts. EPA obtained firm revenues from the landfills survey and Dun & Bradstreet. However, obtaining firm-level compliance costs posed a greater challenge. The survey could not always determine how many facilities a responding firm might own that would be in-scope but that did not receive a survey. For instance, assume

Firm A owns two responding facilities within the survey sample, each of which will incur an estimated $1,000 in compliance costs. Firm A also owns a number of other facilities not in the survey sample. The analysis would find that Firm A will incur at least $2,000 in compliance costs. Therefore, Firm A's costs may be much more, depending on how many other facilities Firm A owns that would also incur compliance costs. Collecting data for every facility owned by each surveyed firm is often prohibitively burdensome.

However, the survey did collect data regarding the number of other landfills owned by the firm that owned each respondent, and the survey also solicited the number of such landfills that were captive and thus out of scope. Therefore, the maximum number of landfills in each parent firm that could *possibly* be subject to the landfills rule is the total number of landfills in the firm less the number of captive landfills. The firm-level analysis assumes the "worst-case" scenario that all these potentially regulated facilities are in fact regulated by the current rule.

The compliance costs assigned to regulated facilities for which no survey data were received are the average compliance costs among facilities that did respond to the survey within the same firm. For example, if a firm has ten facilities, two of which are captive, then the firm-level methodology assumes that the remaining eight facilities that could be in-scope are in fact in-scope. If the survey included four of these facilities, and the estimated compliance costs for each facility based on engineering analysis are as follows:

Sampled Facility #1	$10,000
Sampled Facility #2	$20,000
Sampled Facility #3	$30,000
Sampled Facility #4	$40,000

then the compliance cost assigned to each of the facilities not in the survey is $25,000 – the average compliance cost among the four sampled facilities.

Algebraically, the analysis calculates firm-level compliance cost for each firm that owns at least one-in-scope facility in the sample as follows:

$$CC_{firm} = \frac{(N_{total} - N_{captive})}{N_{sample}} \times \sum_{i=1}^{N_{sample}} CC_i$$

where

CC_{firm}	=	Total annualized compliance cost for the firm
N_{total}	=	Total number of landfill facilities owned by the firm
$N_{captive}$	=	Number of captive landfill facilities owned by the firm
N_{sample}	=	Number of landfill facilities owned by the firm in the survey sample
CC_i	=	Total annualized compliance cost for sample facility *i* in the firm

In addition to the assumption that all non-captive landfill facilities owned by a firm are in-scope, EPA includes some other assumptions that tend to make the analysis more conservative.

- The analysis assumed that firms do not transfer capital, labor and technology between facilities. This assumption tends to overestimate impacts, since such transfers would reduce the economic impact of effluent guidelines.

- The firm-level analysis applied all of the financial impacts on facilities to their parent firms additively, without allowing for scale economies that might benefit a firm. For instance, if rule familiarization and compliance determination are conducted centrally, a firm might be able to avoid the costs of these activities at each site.

- EPA conducted the firm-level impact analysis under the assumption that compliance costs could not be offset by higher product prices or lower input prices. A fully dynamic analysis could estimate the portion of compliance costs passed on to customers and to upstream industries and labor markets that supply inputs to landfills.

While the methodology does not generate statistically representative sample of firms and their associated impacts, it does illustrate EPA's judgment that compliance costs are unlikely to constitute a significant share of firm-level revenues, even when firms own many regulated facilities.

5.3 Results

Six firms own the eleven sampled landfills that were open during the period of analysis and for which firm-level data were available. Among these firms, the maximum estimated compliance cost shares of firm-level revenue ranged from 0.00 percent to 1.09 percent. In no case did firm-level compliance costs exceed 5 percent of revenues.

Table 5-1 summarizes the firm-level impacts. The analysis estimated that three of the six firms will experience no more than 0.1 percent impacts on revenues. The three firms account for 99.73 percent of revenues in the firm impact analysis. Two firms will incur between 0.1 percent and 1 percent impacts, accounting for 0.21 percent of firm revenues, and only one firm will incur compliance costs from 1 to 5 percent of revenues. That firm accounts for 0.06 percent of revenues in the firm impact analysis.

Table 5-1. Firm-Level Impacts

	Compliance Cost Share of Revenue			
	<0 .1%	**0.1% to 1%**	**1% to 5%**	**> 5%**
Number of Firms	3	2	1	0
% of Industry Revenue	99.73%	0.21%	0.06%	0.00%

Chapter 6

Foreign Trade Impacts

The landfills category does not engage in substantive foreign trade. Therefore, EPA finds that – especially in light of the small estimated regulatory impacts on the industry – the rule will have no significant impact on U.S. foreign trade.

Chapter 7

Community Impacts

7.1 Employment impacts

The only facility closure identified in the facility impact analysis occurs in a facility with a sample weight of 1.96. This facility employs ten employees, six of whom are involved in landfill operations.[22]

The Bureau of Economic Analysis (BEA) estimated employment multiplier for sanitary service industries is 4.9349 in the affected state.[23] Therefore, estimated direct and indirect employment losses are 49 FTEs. Indirect employment losses occur when firms that buy from or sell to the closing facility incur economic impacts and when employees of the closing facility experience reduced income and contribute less to aggregate demand within the local economy. Maximum direct plus indirect FTE losses associated with this facility closure amount to less than 0.01 percent of the state's total 1992 employment of 1.78 million persons.[24]

Due to the negligible scale of FTE losses, EPA estimates that the rule will not result in significant adverse community impacts. Furthermore, employment gains in the manufacture, sales, installation and operation of compliance equipment and facilities typically offset – to some extent – employment losses due to regulatory closures.

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[22] These ten employees represent 20 employees nationally at two facilities. Therefore, even assuming that both facilities represented by this sample facility are in the same state, the *maximum possible estimated* direct employment loss in that state is 20 full-time equivalent employees (FTEs).

[23] *Regional Multipliers: A User Handbook for the Regional Input-Output Modeling System (RIMS II) 2nd Edition*, (May 1992) Bureau of Economic Analysis , Washington, D.C.

[24] *Statistical Abstract of the United States, 1993*, U.S. Department of Commerce, Washington, D.C.

7.2 Executive Order No. 12898

EPA obtained 1990 county-specific census data regarding populations of various demographic and economic groups throughout the United States in order to determine whether minority or low-income populations experience disproportionate adverse economic impacts as a result of the rule. However, the small number of employment losses precludes any determination of statistically significant disproportionalities in impacts.

For example, the standard deviation in county populations of white persons is 178,207, and the standard deviation in numbers of households with incomes above $15,000 per year is 3,906. In this context, a logit analysis of the significance of 49 FTE losses would not have sufficient precision to detect any disproportionate, much less significant, adverse impacts on relevant demographic groups.[25]

[25] Even assuming the unlikely case that all 97 FTE losses nationally occur in a single county would not change this conclusion.

Chapter 8

Impacts on New Sources

The landfills effluent guideline includes limitations that will apply to new discharging sources within the landfills category. EPA examined the impact of these regulations for new dischargers to determine if they would impose an undue economic and financial burden on new sources seeking to enter the industry.

In general, EPA estimates that, when new and existing sources face the same discharge limitations, new sources will be able to comply with those limitations at the same or lower costs than those incurred by existing sources. Engineering analysis indicates that the cost of installing pollution control systems during new construction is generally less than the cost of retrofitting existing facilities. Thus, a finding that discharge limitations are economically achievable by existing facilities also means that those same discharge limitations will be economically achievable to new facilities.

Chapter 9

Analysis of Small Entity Impacts

9.1 Introduction

This chapter examines the expected effects of the landfills rule on small entities as required by the Regulatory Flexibility Act (RFA). The RFA calls for the Agency to prepare a Regulatory Flexibility Analysis for regulations that are expected to have a significant impact on a substantial number of small entities. The purpose of the Act is to ensure that, while achieving statutory goals, government regulations do not impose disproportionate impacts on small entities.

The RFA also calls for the identification of record-keeping and reporting requirements, as well as any Federal rules that duplicate, overlap or conflict with the rule. There are no incremental reporting and record-keeping requirements directly associated with the landfills rule. In addition, no known Federal rules duplicate, overlap or conflict with the rule.

As shown in this chapter, EPA finds that the rule will not impose significant impacts on a substantial number of small entities. For privately-owned small businesses, EPA estimated economic impacts as the ratio of compliance costs to sales at the level of the parent firm. For municipally-owned entities, EPA estimated economic impacts as the smaller of the ratio of compliance costs to facility revenues or to government revenues. EPA estimated that no more than one small entity nationally would incur impacts greater than 1 percent of revenues as a result of complying with the rule, and no small entities would exceed a 3 percent impact threshold.

Section 9.2 discusses the definitions and methodology underlying EPA's findings. Section 9.3 presents detailed results.

9.2 Methodology

The Agency followed Small Business Administration (SBA) and RFA guidelines in determining which landfills were small entities. These steps were as follows:

- EPA identified those facilities included in the landfills survey that were subject to compliance costs and therefore subject to impacts of the regulation.

- EPA determined the definition of a small entity appropriate for each facility, according to whether the facility was municipally-owned a privately-owned small business.

- For each type of ownership, EPA identified and applied the test of impact significance described above.

Because the RFA requires EPA to determine whether or not a substantial number of entities incur significant impacts, the determination of need for regulatory flexibility under the RFA should reflect both the severity of impacts on individual entities and also the number of entities affected. A regulation can have significant impacts on a substantial population either by requiring a moderate number of small entities to incur very high facility impacts, or by requiring a larger number of small entities to incur a more moderate level of facility impacts.

In order to evaluate impacts, EPA must compare each parent firm of an in-scope facility to the relevant definition of small entity to determine if it is a small entity or not. EPA must next determine the relevant compliance costs and the appropriate measure of revenue. Both the small entity definition and relevant revenue measure depend upon the type of ownership associated with the facility. Compliance costs are the total, annualized compliance costs derived in the facility impact analysis. They include engineering estimates of recurring compliance costs and a one-time capital cost.

Municipally-owned landfills

With respect to municipally-owned entities, the RFA defines small entities as government jurisdictions with populations of less than 50,000. EPA obtained populations of government jurisdictions from the

Bureau of the Census *City and County Data Book*. The survey also collected respondent estimates of the population of the area *served* by each landfill. In the past, EPA considered the service area population as a measure of entity size. However, EPA used jurisdictional population to define small governmental jurisdictions because the Bureau of the Census data were more reliable and consistent, and because the Agency deems jurisdictional population more appropriate. A separate analysis (not presented here) using service area population confirmed that neither the quantitative nor qualitative analytical findings vary according to which measure was used.

To calculate compliance cost shares of revenue, EPA considered two analytical methodologies. First, EPA compared compliance costs to government revenues. However, the Agency also considered an alternative option of comparing compliance costs to facility (i.e., landfill) revenues. Conceptually, the more fungible municipal revenue accounts are, the more relevant total government revenue should be to evaluating the impact of compliance costs on municipalities. If municipally-owned landfills cannot access revenues from other activities, such as general property taxes and other general funds, it is preferable to evaluate compliance costs in the context of landfill facility revenues alone. Given data limitations and the fact that most municipalities own one or few Subtitle D landfills, facility revenue would serve as an acceptable proxy for landfill revenues, in the latter option.

EPA conducted both analyses and used the smaller of the ratio of annualized compliance costs to facility revenues or to government revenues to determine impacts. By using the minimum ratio, the analysis examined the ratio of compliance costs to facility (landfill-targeted) revenues for those landfills intended to cover their operations with landfill-targeted revenues. At the same time, the analysis examined the ratio of compliance costs to general (non-targeted) revenues for those landfills funded by non-targeted funds, or by funds not reported in facility income statements.

Privately-owned landfills

The SBA defines privately-owned firms operating in SIC 4953 (refuse systems) with revenues less than $6 million annually as small entities.[26] By this definition, a facility would belong to a small entity if and only if its revenue combined with revenues from its parent firm and all affiliates total $6 million or less.

[26] Table of Size Standards, March 1, 1996. SBA advised using this standard for current dollar firm revenues over a time period including 1992 (personal communication, Bob Ray, Office of Size Standards, October 1996).

EPA obtained relevant revenue data from the landfills survey and from Dun and Bradstreet's Marketing Services division.

Because the survey was not designed as a random sample of firms, the small entity impact analysis uses some of the methodology described in the firm-level analysis (Chapter 5). For example, if a small entity includes a sampled facility with a sample weight of two, that could mean that the sampled facility represents two facilities in two separate firms or in one firm. In Chapter 5, the methodology assumed the "worst-case" scenario that both regulated facilities belonged to the same firm and that all other facilities in that firm would also be regulated, incurring costs similar to the sampled facilities.

EPA first performed the regulatory flexibility analysis using the assumption described in Chapter 5 – that all non-captive landfills owned by multi-site firms in the analysis are regulated. This assumption maximizes the potential impact on each firm while minimizing the number of firms affected. EPA then repeated the analysis using the assumption that the sampled facility is the only facility in the firm to incur costs. This second assumption maximizes the *number* of firms that can incur impacts but, because the analysis distributes the national estimates of compliance costs over a larger number of firms, it minimizes the impact on any individual firm. Thus, the two iterations of the regulatory flexibility analysis describe the upper bounds of first the intensity of impacts and then the number of entities experiencing impacts.

9.3 Results

The Agency evaluated the impacts of landfills rule on 138 direct discharging Subtitle D facilities (national estimate), represented by 35 sample facilities that were open during the period of the analysis and for which small entity classification data were available. These 35 sample facilities were owned by 30 firms or government entities, of which 9 were small entities. On a national basis, therefore, EPA estimated that there are no fewer than 30 entities and no more than 133 entities (since two firms owned seven of the sample facilities).[27]

[27] If two firms own 7 of the sample facilities and none of the others, then there are 131 other facilities that could possibly belong to single-site entities. Thus, these 131 remaining facilities can account for no more than 131 entities. Including the two known multi-site firms, the number of in-scope firms or government entities cannot exceed 133.

Table 9-1 shows the estimated lower and upper bounds on the number of firms or government entities owning in-scope facilities and the corresponding numbers of small entities. Notably, EPA estimated that there are no more than 39 small entities on a national basis – not a large number.

Table 9-1. Number of Firms or Government Entities Owning Subtitle D Landfills *(National Estimates)*

Category	# of Facilities	# of Entities	# of Small Entities
Lower Bound	138	30	9
Upper Bound	138	133	39

Table 9-2 shows that EPA expects no more than one small entity to incur compliance costs above 1 percent of revenue under the rule, while EPA expects no small entities open during the period of analysis to incur costs above 3 percent of revenue.

Table 9-2. Magnitude and Frequency of Small Business Impacts *(Open Landfills)*

	Number of Small Entities	Number of Entities With Compliance Costs > 1% of Revenue		Number of Entities With Compliance Costs > 3% of Revenue	
Lower Bound	9	0	0	0	0
Upper Bound	39	0	1	0	0

Consequently, EPA finds that the rule will not have a significant economic impact on a substantial number of small entities.

Chapter 10

Summary Environmental Assessment

10.1 Introduction

This environmental assessment quantifies the water quality-related benefits associated with achieving the Best Available Technology (BAT) limitations that EPA promulgated to regulate nonhazardous landfills. Using site-specific analyses of current conditions and changes in discharges associated with the regulation, EPA estimated instream pollutant concentrations for 26 priority and nonconventional pollutants from direct discharges using stream dilution modeling.

EPA assessed the potential impacts and benefits to aquatic life by comparing the modeled instream pollutant concentrations to published EPA aquatic life criteria guidance or to toxic effect levels. EPA projected potential adverse human health effects and benefits by:
follows:

- comparing estimated instream concentrations to health-based water quality toxic effect levels or criteria, and

- estimating the potential reduction of carcinogenic risk and noncarcinogenic hazard (systemic) from consuming contaminated fish or drinking water.

The assessment estimated upper-bound individual cancer risks, population risks, and systemic hazards using modeled instream pollutant concentrations and standard EPA assumptions. The assessment evaluated modeled pollutant concentrations in fish and drinking water to estimate cancer risk and systemic hazards among the general population, sport anglers and their families, and subsistence anglers and their families. Because of the hydrophobic nature of the two chlorinated dibenzo-p-dioxin (CDD) congeners under evaluation, EPA projected human health benefits for only these pollutants by using the Office of Research and Development's Dioxin Reassessment Evaluation (DRE) model to estimate the potential reduction of carcinogenic risk and noncarcinogenic hazard from consuming contaminated fish. EPA used

the findings from the analyses of reduced occurrence of instream pollutant concentrations in excess of both aquatic life and human health criteria or toxic effect levels to assess improvements in recreational fishing habitats that are impacted by nonhazardous landfill wastewater discharges (ecological benefits). EPA expects these improvements in aquatic habitats will improve the quality and value of recreational fishing opportunities.

In addition, the report presents the potential fate and toxicity of pollutants of concern associated with nonhazardous landfill wastewater on the basis of known characteristics of each chemical. The report includes reviews of recent literature and studies, as well as information obtained from State environmental agencies, as evidence of documented environmental impacts on aquatic life, human health, and on the quality of receiving water.

Performed analyses included discharges from a representative sample set of 37 direct nonhazardous landfills. EPA extrapolated results to the national level (approximately 143 nonhazardous landfills), based on the statistical methodology used for estimated costs, loads, and economic impacts. This report provides the results of these analyses.

10.2 Comparison of instream concentrations with ambient water quality criteria (AWQC)

10.2.1 Nonhazardous landfills (sample set)

The water quality modeling results for 37 direct nonhazardous landfills discharging 26 pollutants to 35 receiving streams indicate that at current discharge levels, instream concentrations of 1 pollutant will likely exceed acute aquatic life criteria or toxic effect levels in 1 of the 35 receiving streams. Instream concentrations of 2 pollutants will likely exceed chronic aquatic life criteria or toxic effect levels in 9 percent (3 of the total 35) of the receiving streams. The landfills guidelines will reduce pollutant loadings by 39 percent. The landfills guidelines also will eliminate acute aquatic life excursions and reduce the chronic aquatic life excursions to 1 pollutant in the 3 receiving streams. Additionally, at current and BAT discharge levels, EPA projects no excursions of human health criteria or toxic effect levels.

10.2.2 Nonhazardous landfills (national extrapolation)

Extrapolating the modeling results of the sample set yields 143 nonhazardous landfills, discharging 26 pollutants to 139 receiving streams. From the extrapolated instream pollutant concentrations, the analysis projects 2 pollutants will exceed chronic aquatic life criteria or toxic effect levels in 24 percent (34 of the total 139) of the receiving streams at current discharge levels. The landfills guidelines will reduce excursions of chronic aquatic life criteria to 1 pollutant in the 34 receiving streams. BAT discharge levels will eliminate the excursions of acute aquatic life criteria or toxic effect levels due to 1 pollutant in 2 receiving streams.

10.3 Human health risks and benefits

Projections for the sample set show that the landfills guidelines will reduce total excess annual cancer cases from the ingestion of contaminated fish for direct wastewater discharges by 3.5E-4 cancer cases. The monetary value of benefits to society from these avoided cancer cases is $800-$4,500 (1998 dollars). Results, extrapolated to the national level, project the reduction of total excess annual cancer cases to be 1.0E-3 cases with monetary benefits estimated at $2,500-$13,100 (1998 dollars). Projections indicate systemic toxicant effects from fish consumption for direct nonhazardous landfill discharges. For the sample set, projections indicate that systemic effects will result from the discharge of 1 pollutant to 1 receiving stream at both current and BAT discharge levels. Estimates indicate an affected population of 328 subsistence anglers and their families. Results, extrapolated to the national level, project an estimated population of 643 subsistence anglers and their families affected from the discharge of 1 pollutant to 2 receiving streams.

10.4 Ecological benefits

The analysis projects no potential ecological benefits of the final regulation resulting from improvements in recreational fishing habitats. The final regulation will not completely eliminate instream concentrations in excess of aquatic life and human health ambient water quality criteria (AWQC) in any stream receiving wastewater discharges from direct nonhazardous landfills.

The estimated benefit of improved recreational fishery opportunities is only a limited measure of the value to society of the improvements in aquatic habitats expected to result from the final regulation. Additional benefits, which could not be quantified in this assessment, include increased assimilation capacity of the receiving stream, protection of terrestrial wildlife and birds that consume aquatic organisms, maintenance of an aesthetically pleasing environment, and improvements to other recreational activities such as swimming, water skiing, boating, and wildlife observation. Such activities contribute to the support of local and State economies.

10.5 Pollutant fate and toxicity

EPA identified 32 pollutants of concern (priority, nonconventional, and conventional) in wastestreams from nonhazardous landfills. In this assessment, EPA evaluated the potential fate and toxicity of 26 of these pollutants on the basis of the known characteristics of each chemical.

Most of the 26 pollutants have at least one known toxic effect. Using available physical-chemical properties and aquatic life and human health toxicity data for these pollutants, the analysis determined that 5 exhibit moderate to high toxicity to aquatic life, 7 are classified by EPA as known or probable/possible human carcinogens, and 20 are human systemic toxicants. In addition, 7 have EPA drinking water values (MCLs or SMCLS), and 6 are designated by EPA as priority pollutants. In terms of projected partitioning among media, 9 of the evaluated pollutants are moderately to highly volatile (potentially causing risk to exposed populations via inhalation), 1 has a moderate potential to bioaccumulate in aquatic biota (potentially accumulating in the food chain and causing increased risk to higher trophic level organisms and to exposed human populations via consumption of fish and shellfish); 2 are moderately to highly adsorptive to solids; and 2 are slowly biodegraded.

Evaluations do not include the impacts of the 2 conventional and 4 nonconventional pollutants when modeling the effect of the final regulation on receiving stream water quality or when evaluating the potential fate and toxicity of discharged pollutants. These pollutants are total suspended solids (TSS), 5-day biological oxygen demand (BOD_5), chemical oxygen demand (COD), total dissolved solids (TDS), total organic carbon (TOC) and total phenolic compounds. The discharge of these pollutants may adversely affect human health and the environment. For example, habitat degradation may result from increased suspended particulate matter that reduces light penetration, and thus primary productivity, or

from accumulation of sludge particles that alter benthic spawning grounds and feeding habitats. High COD and BOD_5 levels may deplete oxygen concentrations, which can result in mortality or other adverse effects on fish. High TOC levels may interfere with water quality by causing taste and odor problems and mortality in fish.

10.6 Documented environmental impacts

This assessment also summarizes documented environmental impacts on aquatic life, human health, and receiving stream water quality, based on a review of published literature abstracts, State 304(l) Short Lists, State Fishing Advisories, and contact with State environmental agencies. States identified 2 direct discharging landfills as point sources that cause water quality problems; these are included on their 304(l) Short List. State contacts indicate that of the 2 direct facilities, 1 is no longer a direct discharger and the other is currently in compliance with its permit limits and is no longer a source of impairment. In addition, States issued fish consumption advisories for 2 waterbodies that receive the discharge from 2 direct discharging nonhazardous landfills. One of the advisories is based on dioxin levels. The other advisory is based on chemicals that are not pollutants of concern for the landfill industry.

Chapter 11

Cost-Reasonableness Test

11.1 Introduction

This chapter presents the results from the cost-reasonableness analysis that EPA performed to support the final effluent limitations guidelines and standards for the landfills industry. The chapter presents only a brief discussion of methodology. An earlier document, "Proposed Economic and Cost-Effectiveness Analysis for Effluent Limitations Guidelines and Standards for the Landfills Point Source Category" (EPA, January 1998) presents a more detailed discussion of the C-R methodology.

CWA Section 304(b)(1)(B) requires a cost-reasonableness assessment for BPT limitations. In determining BPT limitations, EPA must consider the total cost of treatment technologies in relation to the effluent reduction benefits achieved by such technology. This inquiry does not limit EPA's broad discretion to adopt BPT limitations that are achievable with available technology unless the required additional reductions are wholly out of proportion to the costs of achieving such marginal level of reduction.

The C-R ratio is the average cost per raw pound of conventional pollutants removed by a BPT regulatory option. The C-R ration has the following characteristics:

- C-R ratios measure the average cost of achieving a unit of pollutant removal.
- C-R ratios include the removal of conventional pollutants (though in some cases, they may also include priority and nonconventionals).
- Removals of all pollutants are measured in raw pounds in calculating a C-R ratio.
- C-R ratios are expressed in current dollars.

The cost-reasonableness analysis uses the estimated annual costs of complying with the landfills rule. The annual costs include annual expenses for operating and maintaining compliance equipment and for meeting monitoring requirements, and an annual allowance for the capital outlays for pollution prevention and treatment systems needed for compliance. EPA calculated compliance costs on a pre-tax basis, without any adjustment for tax treatment of capital outlays and operating expenses. In these calculations, EPA used a discount rate of 7 percent.

11.2 Annualized costs for each control option

The Technical Development Document and the economic analysis of the proposed landfills rule present full details of the methods used to estimate the costs of complying with the regulatory options. A brief summary of the compliance cost analysis follows.

The C-R analysis include two categories of compliance costs: (1) capital costs, including costs for equipment, retrofitting and upgrading control technology, permit modification, and land; and (2) operating, maintenance, and monitoring costs. While operating, maintenance, and monitoring costs occur annually, capital costs are a one-time "lump sum" cost. To express the capital costs on an annual basis, EPA annualized capital costs over the expected useful life of the capital equipment – 15 years – at a discount rate of 7 percent. Total annualized costs are the sum of annualized capital costs and the annual operating, maintenance and monitoring costs. The cost-effectiveness analysis presented in the main body of this report uses pre-tax costs as the basis for its calculations.

The engineering analysis yielded compliance cost estimates in 1992 dollars, the base year of the landfill industry regulatory analysis. EPA converted these compliance costs to 1998 dollars using the Engineering News Record's Construction Cost Index (CCI). This adjustment factor is:

$$\textit{Adjustment factor} = \frac{1998\ CCI}{1992\ CCI} = \frac{5920}{4985} = 1.18756$$

11.3 Results

Table 11-1 shows that the landfills rule achieves 598,579 pounds of removals at an annual cost of $8.55 million (1998 dollars). This corresponds to an average cost-reasonableness of $14 per pound removed.

Table 11-1. National Estimates of Landfill Costs and Pollutant Removals

Regulatory Option	Annualized Cost *1998 Dollars, Millions*	Pollutant Removals *Raw Pounds*	Average Cost-Reasonableness *($1998/lb)**
Selected BPT Rule	8.55	598,579	14

Source: Environmental Protection Agency memo to the landfills rule public record, "Results of the Cost-Reasonableness Analysis," November 29, 1999.
**Rounded to the nearest dollar.*

EPA considers the cost-reasonableness value of the rule to be acceptable and that the rule is cost-reasonable.