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The Honorable John Glenn
Ranking Minority Member
Committee on Governmental Affairs
United States Senate

The Honorable John Lewis
House of Representatives

As you requested, the enclosures contain our summaries of 10 studies on the race and income of people living near a variety of waste facilities, primarily ones for hazardous waste. These studies of the issue known as "environmental justice" were conducted by the Environmental Protection Agency (EPA) and members of academia, private industry, and advocacy groups. An abbreviated summary of these studies is also found in chapter 3 of our report to you entitled Hazardous and Nonhazardous Waste: Demographics of People Living Near Waste Facilities (GAO/RCED-95-84, June 13, 1995).

The issue of environmental justice--the question of whether hazardous waste facilities and polluting industries are disproportionately located in neighborhoods where poor people and/or minorities live--has been the subject of growing concern over the past decade. In 1987, the United Church of Christ published a nationwide study of the association between hazardous waste facilities and the racial/socioeconomic composition of the communities hosting such facilities. That study was followed by others that analyzed different types of facilities or used different methods in an attempt to shed further light on the issue.

We selected the 10 studies listed below because they met the following specific criteria: They (1) addressed hazardous waste facilities, (2) were national or regional in scope, and (3) were published after 1986. While all of the studies included hazardous waste facilities in their analysis, only two also included nonhazardous waste facilities.

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General Accounting Office unless specifically
approved by the Office of Congressional
Relations.

RELEASED

Enclosure	Title of enclosure
I	Toxic Waste and Race in the United States
II	Untitled Study on the Demographics of Communities Hosting Waste Disposal Facilities Operated by Waste Management, Inc.
III	Presentation Notes on Draft Preliminary Findings: Demographics and Siting in EPA Region IV
IV	Population Estimates for Thirty-Five Commercial Treatment, Storage, and Disposal Facilities
V	Environmental Policy and Equity: The Case of Superfund
VI	Social Equity and Environmental Risk
VII	Toxic Waste and Race Revisited
VIII	The Demographics of Dumping and Environmental Equity Issues in Metropolitan Areas
IX	An Environmental Equity Study for Inactive Hazardous Waste Sites
X	Race, Ethnicity, and Poverty Status of the Populations Living Near Cement Plants in the United States

Each of our summaries describes the study's results and methodology as well as the assumptions and limitations identified by the study's authors. The studies varied in length and complexity, and that variety is reflected in the length of our summaries. In some cases, we have also provided our own observations on the study's results or methodology. We relied on the published versions of the studies or the draft studies as provided to us. Unless otherwise specified, all tables are based on our analysis of data in the studies. Throughout the enclosures, we follow the terminology for racial/ethnic groups used by the authors of the studies.

One important observation applies to all 10 studies and to our own study of the demographics of people living near nonhazardous municipal landfills in the report GAO/RCED-95-84. None examined the changes in demographics near

specific waste facilities over time. To do this would require determining the characteristics of the population at the time the facilities were built and these same characteristics as of the latest census. Such information, if it demonstrated inequity at the time the facilities were built, could raise questions about the need for further procedures in selecting a site or in the public's participation in decisions about the site. As noted in our report GAO/RCED-95-84, we attempted to do this type of analysis for a sample of municipal landfills but were unable to do so because of inadequacies in the 1980 census data.

Another limitation of all of the studies, including our own, is that they did not examine the extent to which people living near the facilities were exposed to harmful materials. Instead, the studies focused on either (1) the proximity of different demographic groups to the facilities or (2) the coexistence of facilities and different demographic groups within certain geographic boundaries. Both approaches, however, are only a proxy for risk because conditions can vary even within such geographic boundaries. For example, the direction of the prevailing wind or the flow of groundwater could produce different levels of exposure for nearby residents on opposite sides of a facility.


For each summary, we asked the authors of the relevant study to comment on the section entitled "Assumptions, Limitations, and Our Observations." Those authors who provided comments made technical suggestions to clarify certain points. We have incorporated these comments where appropriate.

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As agreed with your offices, unless you publicly announce its contents earlier, we plan no further distribution of this report until 30 days after the date of this letter. At that time, we will send copies to appropriate congressional committees; interested Members of Congress; the Administrator, EPA; and other interested parties. We will also provide copies to others on request.

B-261015

We hope that this information will assist you in your understanding of recent research on environmental justice at waste facilities. If you have any further questions, please call me at (202) 512-6111. Major contributors to this report include Jerry Killian, Judy Pagano, Larry Turman, and Ross Campbell.



Peter F. Guerrero
Director, Environmental
Protection Issues

Enclosures - 10

TOXIC WASTES AND RACE IN THE UNITED STATES

Two cross-sectional studies were conducted,¹ using demographics within ZIP codes, to determine the racial and socioeconomic characteristics of Americans living, at fixed times, in residential areas surrounding commercial hazardous waste facilities and sites throughout the United States. The waste facilities are regulated by the Resource, Conservation, and Recovery Act of 1976 (RCRA) and the waste sites are regulated by the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA).²

AUTHOR/SPONSORSHIP

Commission for Racial Justice, United Church of Christ, and Public Data Access, Inc., 1987.

RESULTS

RCRA Sites. Race was the most significant factor among the variables tested in association with the location of commercial hazardous waste facilities covered by RCRA. According to the study, the communities with the largest number of commercial hazardous waste facilities had the highest composition of racial minorities and ethnic residents. In communities with two or more facilities or with one of the nation's five largest landfills, the average percentage of minorities within the population was more than three times that of communities without such facilities (38 percent versus 12 percent). In communities with one commercial hazardous waste facility, the average percentage of minorities in the population was twice that of communities without such facilities (24 percent versus 12 percent). According to the study, three of the five largest commercial hazardous waste landfills in the United States were located in communities with predominately black or Hispanic populations.

¹The full title of the combined studies is Toxic Wastes and Race in the United States: A National Report on the Racial and Socio-Economic Characteristics of Communities With Hazardous Waste Sites.

²The RCRA facilities covered by the study were owned or operated in 1986 by a variety of companies that treated, stored, and/or disposed of hazardous waste for customers in exchange for payment. CERCLA sites are included in an inventory of hazardous waste sites compiled by EPA. Once a site has been placed in the inventory, EPA or the state evaluates the site to determine whether hazardous substances are not contained and are contaminating soil, groundwater, or the air.

The variables indicating socioeconomic status (mean household income and mean value of owner-occupied homes) appeared to play a lesser, but important, role in the location of commercial hazardous waste facilities. Of the two variables, only the mean value of owner-occupied homes remained a significant indicator after controlling for urbanization and regional differences. It was still a less significant indicator, however, than the percentage of minorities within the population for differentiating between communities with and without hazardous waste facilities.

CERCLA Sites. The study reported that three out of every five black and Hispanic Americans lived in communities with one or more CERCLA sites and more than half of the nation's total population (54 percent) lived in residential ZIP code areas where such sites were located.

The study also noted that blacks were heavily overrepresented (ranging from 24 to 46 percent) in the populations of the six metropolitan areas with the largest number of CERCLA sites:

- Memphis, Tennessee (173 sites)
- St. Louis, Missouri (160 sites)
- Houston, Texas (152 sites)
- Cleveland, Ohio (106 sites)
- Chicago, Illinois (103 sites)
- Atlanta, Georgia (94 sites)

According to the study, Los Angeles, California, had more Hispanics living in communities with CERCLA sites than any other metropolitan area in the United States.

GENERAL METHODOLOGY

The following definitions were used in studies of both the RCRA facilities and the CERCLA sites:

- "Race" was measured using populations classified by the U.S. Census Bureau in the 1980 census as whites, Hispanics, blacks, Asians and Pacific Islanders, American Indians, Eskimos, Aleuts, and other "non-White" persons not of Hispanic origin.
- "Communities" were defined using residential ZIP codes.
- "RCRA sites" refers to the 415 commercial facilities for treating, storing, and disposing of hazardous waste in operation at the time the study was conducted. Such commercial facilities handle waste from other locations in return for payment.
- "CERCLA sites" refers to the 18,164 sites that, at the time of the study, (1) the Environmental Protection Agency (EPA) had

included on a list of sites needing to be investigated to determine whether or not they were contaminated and needed to be cleaned up under CERCLA and (2) were located in residential ZIP codes identified in the census files. The study uses the term "uncontrolled toxic waste sites" to refer to all CERCLA sites on the list, not just those deemed eligible for cleanup under Superfund.

METHODOLOGY FOR STUDY OF RCRA SITES

This analytic study sought to determine whether the variables of race and socioeconomic status played a significant role in the location of RCRA commercial hazardous waste treatment, storage, and disposal facilities. The study focused on commercial, or "off-site," facilities, explaining that the location of such facilities is more likely to be influenced by factors other than proximity to industrial activity, such as land values or the degree of opposition to the facility by local residents.

The 415 operating facilities examined included all those identified in the contiguous United States as of May 1986. Information on the commercial facilities was extracted from EPA's Hazardous Waste Data Management System and verified by using directories of commercial hazardous waste facilities.

The study compared five major variables in all areas of the nation: percentage of minority population, mean household income, mean value of owner-occupied homes, number of CERCLA sites, and volume of hazardous waste generated. The study's findings concentrated on the first three of these variables. The mean household income and mean value of owner-occupied homes were included to determine whether socioeconomic status was more important than race in the location of the facilities.

The study did not focus on the factors underlying the existence of CERCLA sites and the volume of hazardous waste produced. The authors noted that the factors underlying the existence of CERCLA sites should be included to see whether some relationship exists between historic or geographic factors, such as land use or zoning, and the location of the facilities in ways not accounted for in their analysis. However, the authors noted that the scope of their study precluded such analyses.

The variable of the volume of hazardous waste generated was analyzed to determine if the location of facilities was related to their proximity to potential customers. The information on the amounts of waste generated was estimated rather than developed from actual data. Because of this limitation, the use of the variable in the study was limited.

The study's variables were compared over geographic areas defined by residential ZIP codes. The study defined "residential ZIP codes" as having a total population of at least one person and at least one person who could be enumerated by race or by Hispanic origin. All 35,406 residential ZIP codes in the contiguous United States were then divided into four mutually exclusive groups of five-digit ZIP codes. The four groups covered areas

- (1) without operating RCRA commercial hazardous waste management facilities (35,037),³
- (2) with one operating RCRA commercial hazardous waste management facility that was not a landfill (310),
- (3) with one operating RCRA commercial hazardous waste landfill that was not one of the five largest (18), and
- (4) with one of the five largest RCRA commercial hazardous waste landfills or more than one RCRA commercial hazardous waste facility (41).

These four categories cover the study's 415 operating commercial hazardous waste treatment, storage, and disposal facilities, including 27 landfills. The 41 communities in the fourth category house 87 facilities, including 9 landfills.

The study's hypotheses were tested by comparing factors such as the percentage of the population that was minority in communities with and without facilities. The analysis used different statistical tests to test major hypotheses in order to derive findings independent of any one test.

ASSUMPTIONS, LIMITATIONS,
AND OUR OBSERVATIONS

The study of the RCRA sites noted that its scope limited the possibility of evaluating the specific factors involved in the process of selecting the site of a facility (siting). The study was not designed to show cause and effect but was intended to reveal and test the significance of associations. Other factors not included in the analysis that might be involved in selecting a site include access to transportation and customers, land use, and environmental conditions such as geology.

³The number in parentheses shows how many ZIP codes were in each group.

The authors noted that while the variations in geographic areas covered by a given ZIP code⁴ represent a limitation for the use of the codes in the analyses, the vast majority of five-digit residential ZIP codes in metropolitan areas cover relatively small geographic areas.

According to the study, a substantially larger percentage of members of racial or ethnic minorities live in communities where some form of hazardous waste activity takes place. The study's data show, however, that

- 17 out of 27 communities with RCRA landfills have a minority population of 11.2 percent or less and
- 17 of the 41 communities making up the fourth ZIP-code group (with one of the five largest RCRA landfills or more than one RCRA facility) have a minority population of 19.8 percent or less.

To provide a perspective, using 1980 census data for all 50 states and the District of Columbia, 20.1 percent of the population were members of minorities (defined as all nonwhites and all whites of Hispanic origin).

METHODOLOGY FOR STUDY OF CERCLA SITES

This descriptive study was intended to document the presence of CERCLA sites in communities with racial and ethnic minorities.

Data on uncontrolled toxic waste sites came from EPA's Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS) listing. The study was based on communities surrounding 18,164 such sites. These sites represented all the sites in the United States catalogued by EPA as of early 1985 that were located within residential ZIP code areas.

Information for about 36,000 residential ZIP code areas was analyzed at several levels: nationally, by EPA region,⁵ by state, and by selected metropolitan areas. The study selected for investigation the 50 metropolitan areas that had the largest black

⁴For example, a ZIP code containing a facility might extend 3 miles from the facility in some places and only 1/2 mile in others. ZIP codes can encompass a small town, a few city blocks, or several square miles.

⁵EPA divides the nation into 10 regions for administrative purposes.

populations according to listings developed by the U.S. Census Bureau.

Instead of using five-digit ZIP codes, the analysis for these 50 cities used the aggregated three-digit ZIP codes that define large metropolitan areas as the basis for analyzing population statistics relative to the number of CERCLA sites. According to the study, in most cases, the metropolitan areas defined by using three-digit ZIP codes were slightly larger than the corporate boundaries of the cities.

ASSUMPTIONS, LIMITATIONS,
AND OUR OBSERVATIONS

The same limitation about the use of ZIP codes noted about the study of RCRA sites also applies in this study of CERCLA sites.

The results of the analyses that focused only on the 50 metropolitan areas with the largest black populations are not representative of all metropolitan areas nationally. Since these cities were selected for analysis because of their high concentrations of black population, any results from this part of the study will feature cities with high concentrations of minorities.

The study focused on the CERCLA listing of hazardous waste sites. The study used the term "uncontrolled hazardous waste sites," which it defined as closed sites (no longer operating) on EPA's list of sites that pose a present and potential threat to human health and the environment. The CERCLA list includes a wide variety of sites ranging from sites eligible for cleanup under Superfund to sites that have been inspected and need no further action.

Although the study highlighted that three of every five black and Hispanic Americans lived in communities with uncontrolled toxic waste sites, according to the study's data:

- 54 percent of all people,
- 54 percent of all whites,
- 57 percent of all blacks,
- 57 percent of all Hispanics, and
- 56 percent of all minorities

lived in communities with uncontrolled hazardous waste sites.

Furthermore, although the study highlighted that blacks were heavily overrepresented in the six metropolitan areas with the largest number of CERCLA sites, the study's data showed that the percentages of the black and white population in the waste site areas were similar for the two groups in some cities and different in others, as shown in table I.1.

Table I.1: Percentage of Population in Selected Cities Living in Waste Site Areas, by Race

City	Black	White
Memphis, Tenn.	99.8	99.6
St. Louis, Mo.	81.0	83.4
Houston, Tex.	69.8	57.1
Cleveland, Ohio	63.1	59.7
Chicago, Ill.	76.1	59.1
Atlanta, Ga.	82.8	60.2

Note: Waste site areas are residential ZIP codes within the metropolitan areas containing hazardous waste sites. In most cases, the metropolitan areas were slightly larger than the corporate boundaries of a given city.

UNTITLED STUDY ON THE DEMOGRAPHICS OF COMMUNITIES HOSTING WASTE
DISPOSAL FACILITIES OPERATED BY WASTE MANAGEMENT, INC.

This study provided a demographic snapshot of the communities that host waste disposal facilities operated by subsidiaries of a private firm, Waste Management, Inc.

AUTHOR/SPONSORSHIP

Claritas, Inc., for Waste Management, Inc., August 1992.

RESULTS

Of the 132 disposal facilities operated by Waste Management's subsidiaries, 101, or 76 percent, were located in communities that had a white population not of Hispanic origin that was equal to or greater than the average for that population in the state.

METHODOLOGY

The study examined 132 hazardous and nonhazardous waste disposal facilities operated by Waste Management's operating subsidiaries: Waste Management of North America, Chemical Waste Management, Inc., and Wheelabrator Technologies, Inc. The facilities included landfills and incinerators. Using data from the 1980 census, the study analyzed the racial demographics in the five-digit postal ZIP codes in which the facilities were located. Specifically, the study compiled data on the percentage of whites not of Hispanic origin in each ZIP code and compared this with the percentage of whites not of Hispanic origin in the host state. The analysis covered facilities in 36 states. Hazardous and nonhazardous waste disposal facilities were not separated in the study.

ASSUMPTIONS, LIMITATIONS,
AND OUR OBSERVATIONS

The study addresses only Waste Management's disposal facilities. It does not include Waste Management's facilities for storing solid and hazardous waste, such as municipal transfer stations. There were approximately 15 to 20 such facilities at the time the study was conducted. The study did not elaborate on the choice of ZIP codes as the unit of analysis and the state as the area of comparison.

PRESENTATION NOTES ON DRAFT PRELIMINARY FINDINGS:
DEMOGRAPHICS AND SITING IN EPA REGION IV

In this study, demographics in counties and census tracts¹ were used to analyze Superfund hazardous waste sites in EPA's Region IV.² The same demographics were also used to examine industrial facilities with hazardous air emissions, but we did not include this information because it was beyond the scope of our review.

AUTHOR/SPONSORSHIP

E.B. Attah, Department of Sociology, Clark Atlanta University, for EPA's Region IV, 1992. The study was cosponsored by the university and EPA's Region IV.

RESULTS

According to the study, CERCLA³ hazardous waste sites were widely scattered throughout Region IV, but concentrations were noticeably higher in urban areas. When the average number of sites per county was calculated, the author found no relationship to the percentage of minorities within the population in the counties. However, when the average number of sites per census tract was calculated, the study found that the average number of sites increased as the percentage of minorities in the population increased. Specifically, an average of 0.27 sites per tract appeared in tracts with minority populations of 10 percent or less, while tracts with minority populations of 11 percent or more averaged at least 0.54 CERCLA sites per tract.

The study noted that for CERCLA facilities, "clear differences exist in the average burden of sites per tract for different levels of minority representation in the tract population ample grounds are in evidence for vigorously pursuing a detailed investigation of inequity in environmental risk devolution between majority and minority segments of the population." The author

¹The U.S. Bureau of the Census defines census tracts as small, locally defined statistical areas in metropolitan areas and some other counties. They generally have stable boundaries and an average population of 4,000.

²The states in Region IV are Alabama, Florida, Georgia, Kentucky, Mississippi, North Carolina, South Carolina, and Tennessee.

³This study examined all CERCLA sites in Region IV, regardless of whether they had been placed on EPA's list of the nation's most hazardous sites, called the National Priorities List.

called for further study to refine and extend the analysis, including adding other sources of pollution, separating urban and rural areas, and considering economic factors such as income and land values.

METHODOLOGY

The study's preliminary findings are based on data from EPA on CERCLA hazardous waste sites in Region IV. There were almost 5,400 CERCLA sites in the region, and the study examined 4,855.

Demographic data were taken from the 1990 census. Populations were categorized by race as either white or minority. "Minority" was defined as the total population minus the white population.

The average number of CERCLA sites per county and per census tract were calculated, and the counties and census tracts were categorized by the percentage of minority population. The data were examined to determine whether jurisdictions with high percentages of minorities had more or fewer facilities than jurisdictions with low percentages of minorities.

ASSUMPTIONS, LIMITATIONS, AND OUR OBSERVATIONS

Minority is defined as the total population minus the white population. Because some Hispanics may be counted as white, they may have been undercounted as minorities. Although Hispanics represent only about 1 percent of the region's population, they may have been a significant factor in certain cities or states. For example, Hispanics make up almost 9 percent of Florida's population.

Although the author made the point that there was a pattern within census tracts but no significant trend within counties, the study did not consistently present the information on the average number of CERCLA sites per county or census tract relative to the minority population. For counties, the population was broken into three categories: 0 to 20-percent minority, 21- to 40-percent minority, and over 40-percent minority. For census tracts, four categories were used: 0 to 10-percent minority, 11- to 25-percent minority, 26- to 50-percent minority, and over 50-percent minority. This inconsistency could make a difference in the conclusions, but the data in the study did not allow us to make this determination.

The author did not explain the use of minority populations above and below 10 percent as the cutoff in census tracts. In the nation as a whole, the minority population, including African Americans, Hispanics, Asians, Native Americans, and others, was about 24 percent in 1990; in Region IV, it was higher. The study may

therefore overstate the differences in minority representation in tracts with a relatively high number of CERCLA sites.

Overstatement could occur when a tract with many sites has a minority population greater than 10 percent but less than the average for the region.

The author reported that there were almost 5,400 CERCLA sites in the region, but only 4,855 were included in the analysis. No explanation was given for the difference.

The author also acknowledged that additional study is needed to examine the relationships between site selection for facilities and economic factors, such as land values or transportation costs, to determine if these factors are stronger or weaker indicators of proximity to the facilities than race.

POPULATION ESTIMATES FOR THIRTY-FIVE COMMERCIAL
TREATMENT, STORAGE, AND DISPOSAL FACILITIES

This internal EPA study examined the race and ethnicity of populations living near 35 operating commercial land disposal facilities that receive hazardous waste.

AUTHOR/SPONSORSHIP

ViGYAN, Inc., for the Office of Solid Waste, EPA, November 1992.
Internal agency briefing presented February 23, 1993.

RESULTS

EPA has performed only selected analyses of the study's results and has not reported what conclusions, if any, can be drawn. However, on the basis of the preliminary analyses that EPA has performed and our review of the data supporting the study, we drew the following conclusions about the results:

- At 21 facilities, or 60 percent, the percentage of blacks living within a 5-mile radius was equal to or less than the percentage of blacks residing in the county in which the facility was located (host county). At 23 facilities, or about 66 percent, the percentage of Hispanics living within a 5-mile radius was equal to or less than the percentage of Hispanics in the host county. At 6 facilities, or 17 percent, the percentage of blacks or Hispanics living within a 5-mile radius exceeded the percentage of minorities in the host county by more than one-third.
- At 17 facilities, or about 49 percent, the percentage of blacks living within a 5-mile radius was less than the percentage of blacks residing in the state. At 25 facilities, or about 71 percent, the percentage of Hispanics living within a 5-mile radius was less than that the percentage of Hispanics in the state.
- The results at individual facilities varied widely. The population living within a 5-mile radius of a facility in Kettleman City, California, was 93.6 percent Hispanic. The population living within a 1/2-mile radius a facility in Baton Rouge, Louisiana, was 98.6 black.

Table IV.1 shows the percentage of facilities that had minorities living within a 1/2 mile range of the 35 facilities; the percentage of minorities is given in increments of 10.

Table IV.1: Percentage of Facilities With Given Ranges of Minorities Living Within a 1/2-Mile Radius

Minority	Percentage of facilities with population within 1/2-mile radius that was						
	0-10% minority	11-20% minority	21-40% minority	41-60% minority	61-80% minority	81-90% minority	91-100% minority
Black	54	9	11	11	9	3	3
Hispanic	89	6	3	0	0	3	0

Moving to a 5-mile radius, tables IV.2 and IV.3 show how the percentages of blacks and Hispanics that EPA reported living near the 35 facilities compared with the populations of blacks and Hispanics in the host county and state.

Table IV.2: Percentage of Facilities With Minority Populations Above and Below the County Average

Minority	Percentage of facilities with minority populations within 5-mile radius that were				
	Equal to or below the county average	Above the county average by 0-10%	Above the county average by 11-20%	Above the county average by 21-30%	Above the county average by over 30%
Black	60	20	6	3	11
Hispanic	66	26	3	0	6

Table IV.3: Percentage of Facilities With Minority Populations Above and Below the State Average

Minority	Percentage of facilities with minority populations within 5-mile radius that were				
	Equal to or below the state average	Above the state average by 0-10%	Above the state average by 11-20%	Above the state average by 21-30%	Above the state average by over 30%
Black	49	11	14	11	14
Hispanic	71	20	0	0	9

METHODOLOGY

EPA's study compiled demographics on persons living near 35 active commercial land disposal facilities that received hazardous waste. The study's scope included all such facilities in existence as of mid-1992, when the study began. The study's objective was to determine whether a disproportionate number of racial and ethnic minorities lived in close proximity to the facilities.

The study used data from the 1990 census at the block level,¹ selecting several variables for analysis. For race, the study examined data for whites, blacks, American Indians, Asians and others. The study also included data on people of Hispanic origin, the age of the population (i.e., those under 18 years of age and those 18 years old and older), and population density.

The study used a geographic information system (GIS)² to measure population distributions within seven specified distances from the sites: 1/2, 1, 1-1/2, 2, 3, 4, and 5 miles. In general, a circle was established approximating the area of the site, and concentric circles were drawn to correspond to the seven distances. Population data were then computed for each circle around the site. If a census block fell only partially within a circle, the study included a population estimate proportionate to the area of the block falling within the circle. The study assumed that the distribution of the population across census blocks was even.

ASSUMPTIONS, LIMITATIONS,
AND OUR OBSERVATIONS

Although data were collected for whites, blacks, American Indians, Asians, and other races, to date EPA has only analyzed the question of disproportionate burden with respect to blacks and people of Hispanic origin.

¹As defined by the U.S Bureau of the Census, the census block is normally bounded by streets and other prominent physical features. Blocks may be as small as a typical city block bounded by four streets or as large as several square miles in rural areas.

²Geographic information systems are computer software programs that can integrate spatial data, such as information about topography, waterways, and roads, with information about populations, natural resources, and other variables.

ENVIRONMENTAL POLICY AND EQUITY: THE CASE OF SUPERFUND

This study analyzed the implications for environmental equity of EPA's Superfund program. The analysis includes an examination of the geographic distribution of sites on the agency's National Priorities List (NPL) using data that describe the socioeconomic characteristics of each county in the United States and the number of proposed and final NPL sites in each county as of January 1, 1989. The study also examined who pays for cleanups and how long EPA's cleanups take. However, we did not review this aspect of the study because it was outside the scope of our report.

AUTHOR/SPONSORSHIP

John A. Hird, in Journal of Policy Analysis and Management, Volume 12, Number 2, 1993, pp. 323-343. The research was supported by a faculty research grant from the graduate school of the University of Massachusetts at Amherst.

RESULTS

The author analyzed basic study questions at the national level; groups of counties selected because they met specific criteria related to poverty, unemployment, the level of nonwhite population, and the median housing value; and groups of counties containing at least a specified number of NPL sites. The results of these analyses differed; that is, the level of analysis and the group selected for analysis could influence the outcome.

At the national level, the study concluded that counties with higher concentrations of nonwhites had more NPL sites when factors such as the median housing value, poverty levels, and unemployment rates were held constant to remove them from the analysis. According to the author, this result corroborates the findings of the United Church of Christ study (see enclosure I).

The study concluded that a greater manufacturing presence, measured by the percentage of a county's economy that was made up of manufacturing, was strongly associated with a greater number of NPL sites in the county.

The study found no statistical link exists between poorer counties and the number of Superfund sites they contain. To the contrary, the results indicated that the more economically advantaged counties (in terms of both wealth and the absence of poverty) were likely to have more Superfund sites. A higher median housing value in a county was strongly correlated with a larger number of NPL sites, while higher poverty levels were significantly associated

with fewer NPL sites. Higher unemployment rates were only weakly associated with more NPL sites.

Population density appeared unrelated to the number of sites, although more new housing starts were strongly associated with fewer NPL sites in the county. The author concluded that NPL sites tended to be located mostly in older communities with a strong manufacturing base if factors such as the median housing value, poverty levels, and higher unemployment rates were held constant.

By separately examining only those counties with high levels of poverty, unemployment, race and ethnicity (measured by the level of the population that was nonwhite), and median housing values, respectively, the study found that the number of NPL sites in counties highly represented by the poor, the unemployed, and nonwhites was below the national average (the results for all but nonwhites were statistically significant). Furthermore, significantly more NPL sites were located where median housing values were higher than the national average for counties.

Based on an analysis of the 43 counties in which the population of nonwhites exceeded 50 percent, the study concluded that the average number of NPL sites was slightly below the national average, but the difference was not statistically significant. When the analysis was restricted to the 13 counties that contained 10 or more NPL sites, the author found that the average poverty and unemployment rates were far below the national average and the median housing value was well above average--and each of these differences was statistically significant. Only the percentage of nonwhites (12.14 percent) was slightly higher than average, although not significantly so. Similar results held when the author observed only the 53 counties with at least five NPL sites.

The study's results, based on simple bivariate analyses (cross-tabulations between two variables), indicated strong, statistically significant relationships between a higher number of NPL sites and a lack of poverty and unemployment, higher housing values, and a lower percentages of nonwhites. According to the author, these results indicate that wealth and poverty were associated with the location of Superfund sites but not in the direction some allege and not because of a correlation based on observed relationships.

METHODOLOGY

The author analyzed the geographic distribution of Superfund sites using data on the socioeconomic characteristics of each county in the United States from the Census Bureau's County and City Data Book, 1988 and data on the number of proposed and final NPL sites in each county as of January 1, 1989, obtained from EPA. The overall analysis covered 3,139 counties and 788 NPL sites.

The author used a multivariate Tobit analysis (involving multiple independent variables) to determine whether the number of NPL sites in each county was correlated with the socioeconomic characteristics of the surrounding area, and therefore whether the risks associated with Superfund sites disproportionately affect the poor or racial minorities. All variables were measured at the county level unless otherwise specified.

The author assumed that, in general, the number of NPL sites in any given area--the dependent variable--can be considered a function of the following characteristics: the amount of hazardous waste likely to have been generated in the area, residents' demands to have a site placed on the NPL, and the region's social and economic composition.

The independent variables used in the Tobit analysis included the quantity of hazardous waste generated in each state in 1985 and the percentage of each county's economy composed of manufacturing. The degree to which residents were likely to mobilize politically was measured by the percentage of residents who were college-educated and the percentage of housing units that were owner occupied. The socioeconomic characteristics used included the median value of housing and the percentage of county residents below the poverty level, unemployed, and nonwhite.

The independent control variables included the county's population density (used to identify urban/rural differences) and the percentage of growth in new housing units from 1970 to 1980 (used to measure the area's residential growth before the passage of CERCLA, the Superfund legislation).

Use of the Tobit model for the estimates required several variables to be rescaled to allow for model convergence because the technique is sensitive to the relative magnitude of the independent variables. The author presented the Tobit estimation results, scaling factors used, and results of tests for significance as well as the conclusions drawn from those results.

The author then examined subsets of 3,139 counties that exceeded, in relation to specific conditions, the national mean for counties. He examined groups of counties containing high proportions of residents who met the criteria listed in table V.1.

Table V.1: Counties Meeting Specified Characteristic Thresholds

Condition within the county	Number of counties
Poverty level above 15.78%	1,292
Unemployment above 8.7%	1,274
Nonwhite population above 11.89%	1,195
Median housing value above \$35,296	1,254

For these groups of counties, the author computed the average number of NPL sites per county and compared that to the national average number of NPL sites per county. The author repeated the analysis for the 43 counties in which the population of nonwhites exceeded 50 percent.

The author then compared the national average poverty rate, unemployment rate, median housing value, and average percentage of the nonwhite population to similar values calculated for (1) the 53 counties that contained at least 5 NPL sites and (2) the 13 counties with 10 or more NPL sites.

The author addressed the possibility that the multivariate Tobit analysis described above might have obscured simple, and more readily observed, relationships between the presence of NPL sites and measures of ethnicity and class. He calculated simple bivariate Tobit estimates in which the dependent variable was the number of NPL sites in the county and the independent variable was either poverty or unemployment rates, median housing values, or the percentage of nonwhites in the county, respectively.

ASSUMPTIONS, LIMITATIONS, AND OUR OBSERVATIONS

The data used in the analysis were at the county level. The author recognized the possible problems of aggregation associated with analyzing a larger geographic unit (the county). He considered the county both large enough to include the effects of hazardous waste sites and small enough to record significant socioeconomic variation. We note that using the county as the basic unit of geographic analysis could mask results that might be obtained by analyzing smaller geographic units.

The author noted that because the overall national results were based on 3,139 counties, other significant causal relationships

within subsets of the data may have been overlooked. He said that it is therefore possible that many NPL sites were located in counties overrepresented by disadvantaged groups (i.e., the poor and unemployed), even though the overall picture did not reflect this conclusion. The author later told to us that "several statistical tests on subsets of the data [below the national level] failed to uncover a link between race and proximity to Superfund sites."

The only racial comparisons used in the analyses involve divisions of the populations into whites and nonwhites. Although the author did not specify how he defined "nonwhite," he later clarified to us that "nonwhite" was defined as all persons who were not categorized as "white" by the Census Bureau. An analysis that focused on counties containing high proportions of racial minorities used counties in which the percentage of the nonwhite population was above 11.89 percent--the national mean for all counties, according to the study. According to 1990 census data for all 50 states and the District of Columbia, 19.7 percent of the population was nonwhite and 24.4 percent of the population was minority--defined as nonwhites combined with whites of Hispanic origin.

The author used the term "wealth" in the study without specifying how it was measured but later confirmed to us that the median value of housing was used to represent wealth. In addition, the author used the term "older communities" without specifying how the age was measured. He later explained to us that "older communities" were those communities where the percentage of housing built between 1970 and 1980 was low.

SOCIAL EQUITY AND ENVIRONMENTAL RISK

This study examined whether hazardous waste sites were disproportionately located in communities that have minority or low-income populations that are higher than the regional or national averages. The study reviewed the social and economic characteristics of populations in 622 communities hosting over 800 inactive hazardous waste sites on EPA's National Priority List (NPL)--known as Superfund sites. The study also examined the assignment of a hazard ranking score to these sites and the length of time taken to implement cleanup actions at the sites for communities with different demographic characteristics. However, we did not review these two aspects of the study because they were beyond the scope of our review.

AUTHOR/SPONSORSHIP

Rae Zimmerman, in Risk Analysis, Volume 13, Number 6, 1993, pp. 649-666. The work was sponsored by EPA and New York University.

RESULTS

According to the study, in 1990 the black population in Superfund communities averaged 9.1 percent (unweighted).¹ This percentage was lower than the national percentage of 12.1 in that year. It was also lower than the weighted percentages of blacks in regions, with the exception of the South. In the South, the unweighted average of blacks in communities with Superfund sites was 23.7 percent, compared with 18.5 percent in the region. The percentage for the nation and its regions fell within one standard deviation of the average percentages for communities with Superfund sites.

The author also computed weighted averages of means using the population size (total as well as minority) of each community. This approach gives more importance to communities that have a large population, whereas the earlier approach did not account for relative population size.

While the percentage of blacks in the nation was 12.1 in 1990, the weighted average of blacks in the 622 communities hosting over 800 Superfund sites was 18.7 percent. Thus, black populations in these communities were approximately 50 percent higher than analogous

¹The unweighted population average of means counts each community equally regardless of its population size. In contrast, the weighted population average accounts for communities according to the population size (total as well as minority) of each community.

populations in the nation as a whole. However, about three-quarters of blacks in communities with Superfund sites were concentrated in communities with 20 percent or more blacks.

The unweighted average for Hispanics in communities with Superfund sites was 6.6 percent, compared with 9.0 percent for the nation. The proportion of Hispanics in communities with Superfund sites was comparable to or less than that of the regions in which the communities were located. However, when the weighted approach was used, Hispanics were relatively more prevalent in communities with Superfund sites than they were in the nation as a whole. Specifically, the Hispanic population in Superfund communities was 13.7 percent, compared with 9.0 percent for the nation. The author surmised that the difference seen when using the weighted average was due to a few large communities with Superfund sites and large Hispanic populations, primarily in Arizona, California, and Florida.

The study reported that 14.8 percent of all people in the United States lived in communities with Superfund sites, whereas 23.0 percent of blacks lived in these communities. The author concluded that blacks were approximately 50 percent more likely to live in a community with a hazardous waste site than the population at large. Hispanics were in a similar situation: 22.7 percent lived in Superfund communities, compared with 14.8 percent for the total population.

The study also examined data on poverty for Superfund communities. The unweighted mean percentage of persons below the poverty level in Superfund communities was comparable to that of the nation and the regions, except in the South. In that region, the percentage of the population in Superfund communities that live in poverty was slightly higher than the percentage in the South as a whole.

When the population below the poverty level, as defined by the 1980 census, was aggregated across all Superfund communities and when the weighted averages were calculated and compared with the nationwide figures, the percentage of the population in poverty was slightly higher (14.0 percent) than the nationwide average of 12.4 percent. The author concluded that this result implies that the association of severe poverty with the presence of Superfund sites was less pronounced than the association of race and ethnicity with such sites.

However, in examining poverty in conjunction with race and ethnicity, the author found a "not insignificant number" of Superfund sites in communities with relatively high levels of poverty and/or minority residents. The author classified these as "minority communities." In these communities, the rates of poverty or minority population were higher than the national average and

generally exceeded regional averages as well. Table VI.1 shows the number of different types of minority communities in 1990.

Table VI.1: Composition of Population

Composition of population	Number of sites
>15% below poverty line and >15% black	93
>20% below poverty line and >15% black	53
>15% below poverty line and >15% Hispanic	34
>20% below poverty line and >15% Hispanic	9
>15% below poverty line, >15% black, and >15% Hispanic	13

Note: These numbers cannot be added since the same sites appear in more than one category. These data do not include communities with Superfund sites that had populations of less than 2,500 in 1980, although some communities were included whose populations were 2,500 in 1980 but had dropped below that number by 1990.

Source: Rae Zimmerman, "Social Equity and Environmental Risk," p. 659.

METHODOLOGY

The author focused on the demographics of "communities." The U.S. Census defines these as "places," or where places do not exist, as "minor civil divisions." These areas represent political subdivisions and were chosen because they are the smallest formal level of political decision-making. The study used 1980 and 1990 U.S. Census data.

The study's universe started with 1,090 Superfund sites (out of about 1,200 in the country at the time of the study). This number excludes military and Department of Energy sites and those not located in the continental United States. The study's analysis of equity covered 814 Superfund sites in 622 communities, which excludes sites in communities with populations below 2,500. The sites were excluded because certain census data were not available for these communities. The study used both weighted and unweighted percentages for race, ethnicity, and poverty.

ASSUMPTIONS, LIMITATIONS,
AND OUR OBSERVATIONS

The author discussed some of the methodological choices that need to be made in this type of analysis, each with advantages and disadvantages. One choice noted by the author is that "communities" are defined as political subdivisions and not as specific geographic areas, such as 1-mile rings around the facility. The author later told us that the choice of community or "Census Place" rather than some smaller unit was necessary because machine-readable data for 1990 for small geographic units were not available at the time the study was performed. She also told us that the study was not meant to focus on proximity to the waste site but rather on the community context in which the site was located.

The author recognized that boundary size affects the analysis and said that geographic information systems (GIS) can be used to generate consistent geographic areas around Superfund sites (for example, a ring with a 3-mile radius). She pointed out, however, that when areas generated in this way do not correspond with the units for which census data are aggregated, extrapolations have to be made to arrive at a population within the area. Inaccuracies may occur when such techniques assume an even distribution of population across the area generated by the GIS--a possibility that the author considered a limitation. While it is true that extrapolation is needed with this approach, its representation of the true distribution of the population is more accurate as the geographic areas decrease. Such a decrease occurs, for example, when moving from census tract to block group.

The author said that "to reflect a potential environmental health-based concept of risk, the boundary should relate to exposure or risk from the site; however, a single boundary reflecting all variations in toxicity and contaminant fate and transport for each chemical present plus variabilities in the duration of human exposure and vulnerability would be virtually impossible The potential variation in results at different geographic levels suggests a need to at least explore a number of scales simultaneously, and to conduct sensitivity analyses to ensure that the implications for equity at different scales are not wildly different."

In the study, the demographic data on Hispanics are not broken out by race. Because Hispanics can be of any race, some double counting of blacks and Hispanics could occur if results are combined to arrive at one total result for minorities. The study presented results for blacks and Hispanics separately. By focusing on blacks and Hispanics, the study excluded all other minority groups, including Asian Americans, Native Americans, and Pacific

ENCLOSURE VI

ENCLOSURE VI

Islanders. This exclusion precluded gauging a collective effect for the larger group of minorities.

TOXIC WASTE AND RACE REVISITED

This study is an update of certain aspects of the 1987 report Toxic Wastes and Race in the United States (see enclosure I) by the United Church of Christ Commission for Racial Justice and Public Data Access, Inc. Both studies focused on the racial and socioeconomic characteristics (per capita income and poverty status) of communities where hazardous waste sites are located. The 1987 study used 1980 census data; the second used 1990 census data updated to 1993.

AUTHOR/SPONSORSHIP

Center for Policy Alternatives, National Association for the Advancement of Colored People; and United Church of Christ Commission for Racial Justice, 1994.

RESULTS

According to the study, in 1993 people of color were even more likely than whites to live in communities with commercial hazardous waste facilities¹ than they were in 1980. From 1980 to 1993, the proportion of the average population--averaged across communities with commercial hazardous waste facilities--made up of people of color increased from 25 percent to almost 31 percent.

In communities with one operating commercial hazardous waste landfill, people of color (averaged across communities) increased from 22 percent in 1980 to 36 percent in 1993. The study found that the percentage of people of color was nearly 2.5 times greater in communities with operating commercial hazardous waste landfills than it was in communities without commercial waste facilities of any type and was twice as great in communities with an operating commercial hazardous waste facility that was not a landfill.

The percentage of people of color was 46 percent in the 22 communities with the highest levels of activity in managing commercial hazardous waste (either three facilities, an incinerator, or one of the largest landfills) compared with 14 percent in communities without commercial waste facilities.

Compared with the national average, poverty was 35 percent higher and income was 19 percent lower in communities with either three commercial facilities, an incinerator, or one of the largest

¹Commercial hazardous waste facilities accept and manage waste from other parties for payment.

landfills (averaged across communities). The study reported, however, that these differences were not statistically significant.

METHODOLOGY

This study examined whether there had been any significant changes in the disparities in racial, income, or poverty status that the 1987 study found between communities with various levels of activity in commercial hazardous waste management.

Both studies examined demographic characteristics within five-digit ZIP code areas. "Communities" were defined as the geographic area within a residential ZIP code. The original study defined "residential ZIP codes" as those having a population of at least one person who could be enumerated by race or by Hispanic origin. The percentages of the populations of people of color within ZIP code areas with hazardous waste facilities were compared with those in ZIP code areas without facilities.

Five-digit ZIP code areas were divided into groups on the basis of their level of hazardous waste activity. The groups are five-digit ZIP codes:

- I = with no commercial hazardous waste management facilities (34,107);²
- II = with one commercial hazardous waste management facility that was not a landfill (408);
- III = with one commercial hazardous waste landfill that was not among the nation's five largest (10);
- IV = with more than one commercial hazardous waste management facility or one of the nation's five largest landfills (56); and
- V = with three commercial hazardous waste management facilities, an incinerator, or one of the five largest landfills (this group was not analyzed in the 1987 report) (22).

In 1993, four of the five largest landfills that were operating in 1987 were still in operation. The CECOS International facility, the third largest landfill in the 1987 study, did not appear in this study's ZIP code searches. The authors assumed it was no longer operating. Furthermore, because the ZIP codes in group V

²The number in parentheses shows how many of the ZIP codes were in each group.

were not analyzed in the original study, the authors of this study applied the 1980 and 1990 census data to determine any demographic changes.

ZIP code statistics on the facilities were derived from the 1992 Environmental Information Services Directory and checked against EPA's Facility Index Data System (FINDS). A list of 552 commercial hazardous waste management facilities was taken from the directory. Fourteen commercial incinerators identified through another source were added to the list. When these data were compared with the data in EPA's FINDS, some ZIP code designations were changed, and a number of facilities were excluded because they could not be located in the FINDS data base. The result was a list of facilities in 489 different ZIP codes. The list was further refined to eliminate nonresidential ZIP codes. The end result was a list of 473 residential five-digit ZIP code areas containing 530 facilities.

The study uses the term "people of color" for all persons defined by the U.S. Census Bureau as black, of Hispanic origin, Asian and Pacific Islander, American Indian, Eskimo and Aleut, or others that are nonwhite and not of Hispanic origin. "Average percent people of color" was defined as the total population less non-Hispanic whites, divided by the total population, and averaged across all of the ZIP code areas within a group.

Two socioeconomic measures were also tabulated for the 473 ZIP code areas and the United States as a whole: the 1993 average per capita income (estimated) and the percentage of families in poverty (poverty status in 1989 as reported in the census). These measures were weighted by population when averaged across the ZIP code groups.

A difference-of-proportions test was used to gauge the statistical significance of the differences between (1) each group's percentage of minorities and (2) changes in percentages of minorities compared with those in ZIP code group I.

ASSUMPTIONS, LIMITATIONS, AND OUR OBSERVATIONS

Because the purpose of the study was to update the 1987 study, the methodology selected parallels the methodology in that study: ZIP code areas with facilities were compared with all ZIP code areas without facilities. The authors of the 1987 study noted that while

variations in the geographic areas covered by a given ZIP code³ represent a limitation for the use of the codes in the analyses, the vast majority of residential five-digit ZIP codes in metropolitan areas cover relatively small geographic areas. According to the authors of the updated study, ZIP code areas are the smallest geographic units that cover the entire United States and that can easily be used to integrate statistics on business establishments and demographics.

ZIP code boundaries, which are set by the U.S. Postal Service, can change over time; some specific neighborhoods may be included 1 year but not 13 years later. Therefore, it may be misleading to compare the demographic data of a ZIP code over time. Furthermore, the 415 facilities that were examined in 1987 (using 1980 census data) are different from the 530 facilities examined in 1993. This change in the universe of facilities may have affected the study's conclusions. Another approach would have been to identify those facilities operating in 1987 that were still operating in 1993 and analyze the demographic data of populations near these facilities over time. Facilities that have begun operating since the 1987 study was done could also have been analyzed separately.

The authors noted that the changes over time could be due to a number of factors, including the changes in the universe of facilities and communities. They also noted that the analysis did not answer the question of which of these factors may be most responsible for the observed changes. It simply demonstrated that the racial gap between communities in ZIP code areas with commercial toxic waste facilities and those without such facilities had grown significantly.

The use of unweighted rather than weighted averages could also have affected the study's findings. For example, the study found that the 22 ZIP code communities with the greatest amount of activity in commercial hazardous waste had an average of 46 percent people of color, "three times higher . . . than in communities without commercial waste facilities." This result is based on an unweighted average of the "percent people of color" over the 22 communities with commercial facilities and those without facilities. This approach treats all communities equally, regardless of the population size. Using a weighted analysis, the average percentage of people of color would be about two times higher in communities with the greatest amount of activity in commercial facilities than in communities without such facilities.

³For example, a ZIP code containing a facility might extend 3 miles from the facility in some places and only 1/2 mile in others. ZIP codes can encompass a small town, a few city blocks, or several square miles.

THE DEMOGRAPHICS OF DUMPING AND ENVIRONMENTAL
EQUITY ISSUES IN METROPOLITAN AREAS

This summary combines descriptions of two articles that describe the same analysis: "Environmental Equity: The Demographics of Dumping," and "Hazardous Waste Facilities: 'Environmental Equity' Issues in Metropolitan Areas." For this study, data at the census-tract level were used to analyze claims that commercial facilities for the treatment, storage, and disposal of hazardous wastes are located disproportionately in areas with minority populations. The study focused on the distribution of facilities and the precise nature of any environmental inequity across social groups. Comparisons were made between tracts containing such facilities and tracts without such facilities within selected standard metropolitan statistical areas (SMSA).

AUTHORS/SPONSORSHIP

"Environmental Equity: The Demographics of Dumping," Douglas L. Anderton, Andy B. Anderson, John Michael Oakes, and Michael R. Fraser, Social and Demographic Research Institute, University of Massachusetts-Amherst, Demography, Volume 31, Number 2, May 1994, pp. 229-248. This work was supported by a grant from Waste Management, Inc. (sponsored by the Institute for Chemical Waste Management), to the Northeast Regional Environmental Public Health Center, University of Massachusetts at Amherst.

"Hazardous Waste Facilities: 'Environmental Equity' Issues in Metropolitan Areas," Douglas L. Anderton, Andy B. Anderson, Peter H. Rossi, John Michael Oakes, Michael R. Fraser, Eleanor W. Weber, and Edward J. Calabrese, Social and Demographic Research Institute and Northeast Regional Environmental Public Health Center, Evaluation Review, Volume 18, Number 2, April 1994, pp. 123-140. The research reported in this article was also supported by a grant from Waste Management, Inc., to the Northeast Regional Environmental Public Health Center, University of Massachusetts at Amherst.

RESULTS

The principal finding of the study was that no consistent national-level association existed within SMSAs between the location of commercial hazardous waste facilities and the percentage of either minority or economically disadvantaged populations.

When the unit of analysis was census tracts in all SMSAs, the study found almost no support for the general claim of environmental inequity, as the first two columns of table VIII.1 show. For SMSAs containing at least one facility, the study found no significant

difference in the percentage of the population that was black between tracts containing facilities and tracts not containing facilities. The difference in the percentage that was Hispanic was higher in tracts with facilities, but the difference was only marginally significant. The study found no significant difference between the mean percentage of families below the poverty line in tracts with facilities and tracts with no facilities.

Table VIII.1: Percentage of Population in Tracts With Facilities, in All Tracts Without Facilities, and in Tracts Without Facilities in Surrounding Areas, for all SMSAs

Percentage of population that was	Mean for tracts with facilities	Mean for all tracts without facilities	Mean for other tracts without facilities in surrounding area
-- black	14.5%	15.2%	25.7%
-- Hispanic	9.4	7.7	10.8
-- a family below the poverty line	14.5	13.9	19.5

Note: For race and ethnicity, the figures are based on 408 tracts with facilities, 31,595 tracts without facilities, and 4,239 tracts without facilities in the surrounding areas. For poverty status, the figures are based on 404 tracts with facilities, 31,269 tracts without facilities, and 4,208 tracts without facilities in the surrounding areas.

In contrast, when the tracts with facilities were compared with tracts without facilities in the surrounding areas (a circle with a radius of 2.5 miles), the study produced a different result, as shown in the first and third columns of table VIII.1. The study showed a significant difference between the mean percentage of blacks in tracts with facilities and the percentage in tracts without facilities in surrounding areas. The average percentage of Hispanics was greater in the surrounding areas, although the difference was not significant. A significantly lower percentage of families were below the poverty line in the tracts with facilities than in the tracts without facilities in the surrounding areas, on average.

The findings based on census tracts for all SMSAs containing at least one facility differed substantially from the results of previous studies based on ZIP code areas. However, when the tracts

with facilities are combined with tracts in their surrounding areas and the resulting units compared with the remaining tracts in SMSAs, the results are more similar to those of previous studies based on larger geographic units of analysis, as table VIII.2 shows. The differences are all significant.

Table VIII.2: Percentage of Population in Tracts With Facilities Plus Their Surrounding Areas Compared With Percentage in Remaining Tracts Without Facilities

Percentage of population that was	Mean for tracts with facilities plus surrounding area	Mean for remaining tracts without facilities
-- black	24.7%	13.6%
-- Hispanic	10.7	7.3
-- a family below the poverty line	19.0	13.1

Note: For race and ethnicity, the figures are based on 4,647 tracts with facilities plus surrounding areas and 27,356 remaining tracts without facilities. For poverty status, the figures are based on 4,612 tracts with facilities plus surrounding areas and 27,061 remaining tracts without facilities.

The authors also examined SMSAs within each of EPA's 10 regions separately and found no consistent regional association between the location of commercial hazardous waste facilities and the percentage of either minority or disadvantaged populations. For 9 of the 10 regions, they found no significant difference between the mean percentage of blacks or families below the poverty line in tracts with facilities and tracts without facilities. In the one region that displayed a significant difference, the average percentage of blacks and the average percentage of families below the poverty line was significantly lower in the tracts with facilities. The mean percentage of Hispanics (1) was significantly lower in tracts with facilities in three regions of the country along the eastern seaboard, (2) was significantly higher only in the Southwest, and (3) was not significantly different in the rest of the country.

When the study focused on the 25 largest SMSAs, tracts with facilities showed a significantly lower percentage of blacks, on average. The study found a significantly higher percentage of Hispanics in tracts with facilities than in tracts without facilities. There was no significant difference between the

percentage of families below the poverty line in tracts with and without facilities, as table VIII.3 illustrates.

Table VIII.3: Percentage of Population in Tracts With Facilities and in Tracts Without Facilities in 25 Largest SMSAs

Percent of population that was	Mean for tracts with facilities	Mean for tracts without facilities
-- black	12.2%	16.4%
-- Hispanic	13.9	10.1
-- a family below the poverty line	12.5	13.5

Note: For race and ethnicity, the figures are based on 150 tracts with facilities and 17,406 tracts without facilities. For poverty status, the figures are based on 149 tracts with facilities and 17,211 tracts without facilities.

The authors found one variable with a strong, consistent, and often significant association with the location of facilities. The concentration of people in manufacturing occupations was consistently higher in tracts with facilities in 9 of the 10 EPA regions and in the nation as a whole.

To examine the strength of the relationship between each characteristic of a census tract and the presence of facilities, the authors used logit regressions, and the results largely confirmed the earlier analyses. The percentage of blacks was not significant in any of the logit regressions, and the percentage of Hispanics was significant in only one EPA region.

The authors stated that it was important that their research be neither misused nor misinterpreted. They emphasized that the study's results should not be construed as meaning that environmental racism does not exist. The study states that "for one particular aspect of the problem, if environmental racism exists the pattern is rather different from what has quickly become the accepted wisdom of the day." The authors also stated that their conclusions must be considered tentative and in need of further investigation.

METHODOLOGY

The authors selected the census tract as the basic geographic unit of analysis to avoid aggregation errors. As they note in the study, a census tract is a small statistical subdivision of a

county with clearly identifiable boundaries and a relatively homogeneous population of about 4,000 people. The authors also conducted analyses for larger areas referred to as surrounding areas, for SMSAs, and for EPA's 10 regions.

The authors focused their analysis on the commercial facilities for the treatment, storage, and disposal of hazardous wastes. They defined a commercial facility as one that is privately owned and operated and that receives waste from firms of different ownership. This definition excludes facilities that are primary producers of waste. The study included only facilities in the 48 contiguous states that (1) had opened for business before 1990, (2) were in SMSAs that had been subdivided into tracts in the 1980 census, and (3) were still in operation at the time of the study. Roughly 85 percent of all such commercial facilities were included in the study. The remaining 15 percent were located outside SMSAs in areas not subdivided into tracts and were therefore excluded from the analysis.

The authors further restricted their analyses to SMSAs that contained at least one facility, using the Environmental Institute's 1992 Environmental Services Directory as their primary listing. That directory listed 454 commercial facilities that met the first two criteria.

To analyze the area surrounding the facilities, the authors constructed a circle with a 2.5-mile radius from the center of any tract containing one or more facilities. The 2.5-mile radius was somewhat arbitrarily chosen to represent the surrounding area so that, on average, the surrounding area included the 10 nearest tracts.¹ If at least 50 percent of any tract fell within this 2.5-mile circle, the tract was considered to be in the surrounding area.

The study's census data base, the 1980 Census of Population and Housing Summary Tape, provides data on all tracts in SMSAs. This data base was used to identify 47,311 census tracts, of which 32,003 (68 percent) were in SMSAs that contained at least one facility from the analysis sample. The remaining 15,308 tracts were excluded from the analysis. Within each tract, seven characteristics were used in the analysis: the mean value of housing stock and the percentages of blacks, Hispanics, families at or below the poverty line, households receiving income from public

¹This choice represented a compromise between the following concepts: (1) the surrounding area should be larger than a single tract in order to represent a higher level of aggregation; (2) the area should include a few tracts; and (3) to avoid too large a leap in aggregation, the area should not be too large.

assistance, males age 16 and over in the civilian labor force who were employed, and such males who were employed in manufacturing and industry.

Initially, the authors compared tracts containing facilities with those without facilities for all SMSAs in the study's sample. Differences in both means and medians were tested for significance. The same analyses and tests were then repeated for the 25 largest SMSAs in the sample.

To investigate the reasons for the difference in their findings and the results of previous studies based on ZIP codes, the authors first repeated their analyses by aggregating census tracts into larger surrounding areas. If a tract in the area surrounding a facility also included a facility, it was considered a tract with a facility, not a tract in a surrounding area. The authors then combined the tracts with facilities with tracts in their surrounding area and repeated the analyses, comparing these units with the remaining tracts in SMSAs. The authors then repeated the analyses, using EPA's regions as the geographical unit, to investigate whether patterns in regions differed from patterns in the nation as a whole.

In the logit regressions the authors used to examine the strength of the relationship between each characteristic of a census tract and the presence of facilities, the dependent variable was a variable indicating the presence or absence of a facility in the tract. The seven variables summarizing the characteristics of census tracts listed above were the independent variables. The regressions were computed for the total sample and within each EPA region, and the results and their significance levels were presented.

ASSUMPTIONS, LIMITATIONS, AND OUR OBSERVATIONS

Because geographic data can be aggregated to produce information on larger regions, the authors chose to begin with an analysis of an area that was as small as practical and also meaningful--the census tract. Beginning with too large a geographic unit of analysis can introduce aggregation errors that can allow conclusions to be drawn that might not hold true in the analysis of smaller, more refined units.

At the level of the census tract, an aggregation problem can still occur. Using the smaller geographic unit--the block group--could further reduce the aggregation problem, although the authors told us that analysis at this level could encounter problems with data availability.

According to the authors, the analysis of the surrounding areas suggests how results at the census-tract level may be reconciled with the results of previous studies by using larger geographic units of analysis, such as ZIP code areas. They concluded that facilities appeared to be located in census tracts characterized by industrial activities. Also, the tracts surrounding these industrialized areas appeared to contain higher concentrations of minority and economically disadvantaged people. According to the authors, if it is a general feature of the social character and structure of cities that such groups are more likely to live near industrial centers, then the use of larger geographic areas in an analysis might obscure local neighborhood differences and indicate that this larger geographic unit contains both industrial enterprises, such as the waste facilities, and a higher average percentage of minority and disadvantaged people. In simpler terms, the authors noted that their results suggested that using the larger geographic units of analysis might capture certain social aspects of the residential structure of cities, while obscuring differences within these areas on the question of environmental equity.

The study presented results for blacks and Hispanics separately. Because Hispanics can be of any race, some double counting could occur when counting blacks and Hispanics if results are combined to arrive at one total result for minorities. By focusing on blacks and Hispanics, the study excluded all other minority groups, including Asian Americans, Native Americans, and Pacific Islanders. This exclusion precluded gauging a collective effect for the larger group of minorities.

AN ENVIRONMENTAL EQUITY STUDY FOR
INACTIVE HAZARDOUS WASTE SITES

This study analyzed the socioeconomic characteristics of populations near Superfund sites on the National Priorities List (NPL) in EPA's Region II.¹ It focused on New York and New Jersey. While the study also analyzed cleanup response rates at these sites, we did not review that aspect of the study because it was beyond the scope of our review.

AUTHOR/SPONSORSHIP

Rae Zimmerman, for the Emergency and Remedial Response Division, EPA, Region II, Revised Draft, Final Report, February 9, 1994.

RESULTS

On average, the areas within about 1 mile of sites on the NPL in the two states had a population density (characterized by the number of persons per square mile) above that of either New York State or New Jersey but below the density that typifies urban areas in these states. The same areas had, on average, lower house values and rents than what was typical for these states. Few other socioeconomic characteristics appeared to differ, on average, between the areas surrounding these sites and what was typical of the state, although the characteristics of the sites varied considerably.

Weighted and unweighted mean and median percentages for blacks, Native Americans, Asians, and Hispanics were below or about the same as the percentages in the state, regardless of which of the seven distances from the site used in the analysis (ranging from 1/4 to 4 miles) was evaluated.

The population within about 1 mile of the sites was, on average, 7 percent black (with a standard deviation, or SD, of 14 percent), 1 percent Native American (SD of 8 percent), 2 percent Asian (SD of 4 percent), and 5 percent Hispanic (SD of 9 percent). These means were not weighted by the size of the population, so that each site counted the same regardless of the number of people in the area.

When the averages were weighted by the size of the population within about 1 mile of the site--so that areas with greater populations counted more than sparsely populated areas--they changed to 12 percent for blacks, 0.2 percent for Native Americans, 4 percent for Asians, and 10 percent for Hispanics. The median

¹Region II consists of New York, New Jersey, Puerto Rico, and the Virgin Islands.

percentages were far below both the weighted and unweighted means, indicating that a few large areas with relatively large minority populations caused the means to be higher than the medians.

While the overall percentages of racial or ethnic minorities living near the sites were similar to the averages for the state, the author noted that in a number of cases, the percentages of racial or ethnic minorities exceeded the averages for the state or a substate area. For example, for 78 sites (about 40 percent of the total set of NPL sites in New York and New Jersey), the average percentage of the population that was black living within about 1 mile exceeded the percentage of the population that was black in the municipality in which the sites were located. The average percentage of blacks living around 30 sites exceeded the statewide percentages in New York and New Jersey.

For a majority of the sites, the percentage of the population that was Hispanic, Asian, and Native American was at or below the average percentage for all the sites. However, about 10 percent of the sites exceeded the average percentage for Hispanics, 33 percent exceeded the average for Native Americans, and 14 percent exceeded the average for Asians.

The author found that a significant number of sites were concentrated in a relatively small number of municipalities and counties. One quarter of the sites in New York and New Jersey were in 23 municipalities. These 23 municipalities made up only 0.2 percent of the 1,186 municipalities in New York and New Jersey combined. In addition, 7 of the 23 municipalities, containing 17 sites, exceeded the state's population percentages for either blacks, Hispanics, or both.

METHODOLOGY

The scope of the study was the NPL sites in EPA's Region II--New York and New Jersey, with some analysis of sites in Puerto Rico and the Virgin Islands. The socioeconomic characteristics of the populations near the sites were compared with those in Region II overall, the individual states, and substate areas such as urbanized areas and municipalities within which the sites are located.

The 200 sites analyzed had been "finalized" for inclusion on the NPL as of September 1993, in New York, New Jersey, and Puerto Rico (the Virgin Island site had not been finalized).² Some analyses

²A site is said to be "finalized" when EPA has assessed the threat of contamination and given the site a hazard ranking score that exceeds 38.5, the threshold for placement on the NPL.

also included four additional sites proposed for the NPL and six additional sites that had been deleted from the list. Sites on Puerto Rico and the Virgin Islands were not always included, since the census data for those two areas are not comparable with data for the continental United States.

Each site included in the analysis was assigned a longitude and latitude using data provided by EPA's Office of Policy and Management, supplemented with data from Region II on the sites' location. The author referred to the geographic point defined by this longitude and latitude as the "center" of a site, although the point may not correspond to the site's geometric center.

Census blocks within a specified distance of a site's longitude and latitude were analyzed. Seven radii were used to define the distance between the centers of the census blocks and the longitude and latitude assigned to each site. These radii were points of 0.25, 0.5, 0.75, 1, 2, 3, and 4 miles that represented the distance between the centers of the census blocks and the centers of the sites.

For sites located near the boundary between New Jersey and New York, data were accumulated from both states according to the distance criteria. However, no data on the populations outside New York and New Jersey were included for sites near the Pennsylvania and Connecticut borders. No sites were within 5 miles of Vermont or Massachusetts.

The study used the census centroid method of data extraction,³ in which data units are included in their entirety if they fall within a specified distance or area. For the study, longitudes and latitudes were converted into distances from the center of the site expressed in miles. This approach allowed all of the census tracts/blocks whose centroids fell within a 4-mile radius from the site to be identified. The author noted that since only centroids of census blocks have been assigned to distances around the sites, data aggregated at discrete distances around the sites were actually irregular rather than neat concentric circles. If no centroid of a census block fell within a small distance from a site--1 mile, for example--no data were extracted even though people may have lived within the 1-mile area.

The author analyzed socioeconomic characteristics for the sites, including race and ethnicity, age and family status, housing value, monthly rent, housing characteristics, and population density. The interrelationships between various of these characteristics were

³A centroid is the geographic center of an area such a census tract.

also examined. Information on the socioeconomic characteristics was obtained from 1990 census data aggregated at the level of the census block. The census block is the smallest geographic unit for which population data from the census are available.

Data for total population and various socioeconomic characteristics were aggregated cumulatively for the seven distances surrounding the sites. Each of the racial and ethnic characteristics was expressed as a percentage of the total population in the area contained within the specified distance. The category of Hispanic was independent of and therefore overlapped with the racial categories of black, Asian, and Native American.

Most of the analysis was done for areas 1 mile from the sites. The author supported this focus by noting that the characteristics usually vary little with distance beyond 1 mile when compared with those characteristics at 1 mile. The author also noted that at distances of less than 1 mile, the little variation that does occur exists because the method of extracting data used in the study tends to underaggregate population at small distances.

House values and rents were used as proxies for income. No direct analysis of income was conducted.

The author used several descriptive statistical measures, including unweighted means, in which each site is weighted equally regardless of the number of people at a given distance around each site. The median was used to portray any skewing of the data in any given direction. Also, a population-weighted mean was used, especially when medians and unweighted means were dissimilar. The analyses focused on one or two variables at a time.

ASSUMPTIONS, LIMITATIONS, AND OUR OBSERVATIONS

The magnitude of the standard deviations for the percentage of the population that was minority was large compared to their means. For example, at 1 mile from the site, the standard deviation for the percentage of the population by race and ethnicity was at least 1.5 times as large as the unweighted mean. Since racial and ethnic composition varies considerably from site to site, the author noted that attention to distributions rather than to strict averages was critical. In addition, the author noted that if the distribution of data was graphed for each distance, the shape of the distribution was somewhat similar, regardless of distance. In her subsequent comments to us, the author noted that this result justified focusing on the 1-mile distance in analyzing the characteristics of populations around Superfund sites.

In the study, the author noted that any errors in the longitude and latitude used to represent the location of a site could lead to substantial errors in the representation of the socioeconomic characteristics around the site since the data are defined at such small distances. She also noted that if location is assumed to be a surrogate for potential exposure to waste, then the center of concentration of waste or an exposure point associated with the site is perhaps a better location than the geographic center. However, the author subsequently told us that these data were not readily available.

RACE, ETHNICITY, AND POVERTY STATUS OF THE POPULATIONS
LIVING NEAR CEMENT PLANTS IN THE UNITED STATES

This study used data at the level of census blocks and block groups to analyze the proximity of minority and low-income populations to a sample of 41 cement plants, including 29 plants that burned hazardous waste as fuel and 12 plants that did not.

AUTHOR/SPONSORSHIP

ICF Incorporated and ViGYAN, Inc., August 31, 1994. This work was prepared for the Regulatory Analysis Branch, Office of Solid Waste, EPA.

RESULTS

For the 29 cement plants that burn hazardous waste as fuel, table X.1 shows the study's findings on how many plants had higher (or lower) percentages of minorities and people below the poverty line living within a 1- or 5-mile radius than lived in the county where the plant was located (host county).

Table X.1: Cement Plants Burning Hazardous Waste Where Percentage of Minorities and People in Poverty Living Nearby Was Higher or Lower Than in Host County

Number of plants where the percentage of the minority population living nearby was	Number of plants where the percentage of the population below the poverty line living nearby was	
	In a 1-mile radius	In a 5-mile radius
-- higher than in the county	14	12
-- lower than in the county	12	13

Note: N = 29. Numbers do not add to 29 because in some instances the percentage in the 1- or 5-mile area was equal to the percentage in the county.

The average percentage of the population that was minority within 1 mile of the facilities was 17.5 percent (with a standard deviation, or SD, of 22.6 percent); within 5 miles of the facilities, it was 17.3 percent (SD of 20.2 percent). The average for the host counties was 15.5 percent (SD of 15.6 percent). The study reported a national minority population of 24 percent.

The average percentage of population that was below the poverty line within both 1 mile and 5 miles of the facilities was 15.2 percent (SDs of 9.6 percent and 8.3 percent, respectively). The average for the host counties was 14.0 percent (SD of 5.6 percent). The study reported that nationwide, 13 percent of the population was below the poverty line.

For the 29 cement plants that burned hazardous waste as fuel, table X.2 shows the study's findings on how many plants had higher (or lower) percentages of minorities and people in poverty living in the two different-sized zones.

Table X.2: Cement Plants Burning Hazardous Waste Where Percentage of Minorities or People in Poverty Living Nearby Was Higher or Lower, Depending on Distance From Plant

Cement plants where the percentage of minorities living nearby was	Number	Cement plants where the percentage of the population below the poverty line was	Number
-- greater in the 1-mile area than in the 5-mile area	10	-- greater in the 1-mile area than in the 5-mile area	15
-- less in the 1-mile area than in the 5-mile area	14	-- less in the 1-mile area than in the 5-mile area	13

Note: N = 29. Numbers do not add to 29 because in some instances the percentages in the 1- and 5-mile areas were equal.

For the 12 cement plants that did not burn hazardous waste as fuel, table X.3 shows the study's findings on how many plants had higher (and lower) percentages of minorities and people below the poverty line living within a 1- or 5-mile radius than lived in the county where the plant was located.

Table X.3: Cement Plants Not Burning Hazardous Waste Where Percentage of Minorities and People in Poverty Living Nearby Was Higher or Lower Than in Host County

Number of plants where the percentage of minorities living nearby was	In a 1-mile radius	In a 5-mile radius	Number of plants where the percentage of the population below the poverty line living nearby was	In a 1-mile radius	In a 5-mile radius
-- higher than in the county	4	4	-- higher than in the county	4	4
-- lower than in the county	8	8	-- lower than in the county	7	7

Note: N = 12. Numbers do not always add to 12 because in some instances the percentage in the 1- or 5-mile area was equal to the percentage in the county.

The average percentage of the population that was minority within 1 mile of the facilities was 28.4 percent (SD of 77.8 percent), and within 5 miles of the facilities was 27.5 percent (SD of 72.0 percent). The average for the site counties was 29.3 percent (SD of 59.2 percent).

The average percentage of the population that was below the poverty line within 1 mile of the facilities was 9.1 percent (SD of 15.8 percent); within 5 miles of the facilities it was 9.3 percent (SD of 14.5 percent). The average for the host counties was 12.1 percent (SD of 9.0 percent).

For the 12 cement plants that did not burn hazardous waste as fuel, table X.4 shows how many plants had higher or lower percentages of minorities and people in poverty living in the two different-sized zones.

Table X.4: Cement Plants Not Burning Hazardous Fuel Where Percentage of Minorities or People in Poverty Living Nearby Was Higher or Lower, Depending on Distance From Plant

Cement plants where the percentage of the minority population was	Number	Cement plants where the percentage of the population below the poverty line was	Number
-- greater in the 1-mile area than in the 5 mile area	6	-- greater in the 1-mile area than in the 5-mile area	6
-- less in the 1-mile area than in the 5-mile area	5	-- less in the 1-mile area than in the 5-mile area	6

Note: N = 12. Numbers do not always add to 12 because in some instances the percentages in the 1- and 5-mile areas were equal.

METHODOLOGY

To further the objectives of the executive order on environmental justice (Feb. 11, 1994),¹ EPA collected data on the demographic characteristics of the populations near cement plants, focusing on minority and low-income people. The study addressed the proximity of these populations to a sample of 41 cement plants.

The study examined 29 facilities that burned hazardous wastes as fuel, drawn from a national list of hazardous waste incinerators, boilers, and industrial furnaces maintained by the Permits and State Programs Division (PSPD) of EPA's Office of Solid Waste. This list included 30 hazardous facilities as of May 1, 1994. One facility located in Puerto Rico was excluded from the study because comparable census data were not available.

A total of 84 plants did not burn hazardous waste as fuel in the United States, excluding one in Puerto Rico. The study included 12 of these facilities, with the following characteristics:

- seven facilities that were part of a random sample of 15 such facilities studied for the Report to Congress on Cement Kiln Dust (EPA, Dec. 1993);

¹The authors noted that the study furthered the order's objective to "improve research and data collection relating to the health and environment of minority populations and low-income populations."

- two facilities selected because they were close to other facilities already in the sample; and
- three facilities that were on the PSPD's list on March 1, 1994, but withdrew their RCRA permits before the list was updated on May 1, 1994. Since data collection had begun, the three facilities were retained in the sample.

The authors developed a two-tiered weighting scheme for this sample of 12 facilities. They said that this scheme allowed them to extrapolate from the sample facilities to produce unbiased estimates of the demographic characteristics of the total population of cement plants that did not burn hazardous waste as fuel.

The authors used 1990 census data at the block and block-group level (for data on minorities and poverty status, respectively). Geographic data provided the digital representation of the census tabulation area. The study's data on minority populations were derived by subtracting the total number of whites not of Hispanic origin from the total population. The number of people living in poverty was determined by totaling the data on the number of persons whose income in 1989 was below the poverty level.

The authors used GIS software to develop the locations of facilities and descriptive statistics by (1) identifying the largest building within the boundaries of the facility's site, (2) generating a surrogate boundary for the site by generating a circle equivalent in area to the site's acreage, (3) generating concentric circles for six radii (0.5, 1, 2, 3, 4, and 5 miles) around the site, and (4) computing population estimates for the surrogate site boundaries and the six concentric circles.

The study used the Bureau of Census 1990 Census Block/Block Group Method to estimate population, noting that this is the most accurate method. The method assumes an equal distribution of population within census blocks and block groups; if an area occupies 50 percent of a block, it will be assumed to have 50 percent of the block's population.

ASSUMPTIONS, LIMITATIONS, AND OUR OBSERVATIONS

The authors noted that the reason for excluding facilities in Puerto Rico was that the census data required for the analysis were not available. They also said that because there were very few Puerto Rican facilities in the study's universe (2 of 114), they believed the bias would be small.

According to the authors, the assumption that the population is evenly distributed within a census block or block group is a limitation of the method used to estimate population. They also noted that the census does not determine poverty status for all people (persons in college or in prison are not accounted for in poverty status). As a result, the percentage of people below the poverty line was calculated on the basis of the total population for which poverty status had been determined, not the total population.

The authors also said that the accuracy of the information about the facilities' location and the use of surrogate site boundaries affected the results of the population estimates.

Finally, because the study did not provide pertinent details on the methods used to select 7 of the sample of 12 cement plants not burning hazardous waste as fuel, the results for these facilities may not be representative of all facilities of this type.

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