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# Burning and Burying in Connecticut: Are Regional Solutions to Solid Waste Disposal Equitable?

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## Are Regional Solutions to Solid Waste Disposal Equitable?

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*To comply with federal legislation, states throughout the country are replacing old town dumps with a regional system for municipal solid waste disposal. This system includes trash-to-energy incinerators and ash landfills as well as recycling and reduction facilities. While these new types of facilities are expected to be environmentally safer, they have concentrated the disposal process of waste generated throughout the state in fewer locations. State leaders champion the use of newer, cleaner disposal methods, while local community groups complain that they have become the dumping grounds for the state. This is the first environmental equity study to examine whether these newer types of facilities are being disproportionately located in racial/ethnic minority or low-income Connecticut neighborhoods. Our analysis indicates that regional facilities are located nearer to neighborhoods with high percentages of minority and poor residents. Employing multivariate techniques, we found that when we control for other variables, the percentage of racial/ethnic minorities remains a predictor of distance to these regional facilities, while poverty and income do not.*

Think globally and act locally has become a rallying cry for the U.S. environmental movement. Dominated largely by the white middle class, the movement has nonetheless begun to pick up steam in racial minority communities where charges of environmental racism have been leveled at economic and political elites. International environmentalism has drawn attention to depleted world resources, disappearing rain forests, global warming, and neglectful fishing, while minority groups have embraced environmental justice to protest the siting of hazardous and solid waste disposal facilities, energy generators, and sewage treatment and chemical plants in or near their neighborhoods. These latter concerns received support from President William Clinton in 1994 when he ordered federal agencies to reduce environmental injustices that have disparate impact on racial minority communities. Subsequent Environmental Protection Agency (EPA) guidelines have empowered its

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Civil Rights division to decide on discrimination cases filed under Title VI of the Civil Rights Act of 1964. Despite opposition from state leaders, who argue that the policy has resulted in a proliferation of court cases and stymied commercial development in poor urban areas, Vice President Albert Gore reinvigorated the administration's directives on Earth Day in 1998, arguing that "there have been strong expressions of concern from community leaders that our efforts to date have not been sufficient."[1]

Researchers have taken up these concerns and attempted to assess the claims of environmental racism or environmental inequity empirically. This research, still in its infancy, has generated a variety of methodological strategies and debates about how to assess environmental justice. No one strategy is likely to emerge as the best methodology; together, however, these strategies can help to inform the policy debates concerning the production, storage, transfer, and disposal of waste. These debates are essential to understanding unequal distributions of burden, just as they are useful in the development of interpretive frames for understanding the interrelationship between economic production, land use, and population distribution.

Our work in Connecticut focuses on the rapidly changing system for disposing of solid waste. The old town dumps have become virtually obsolete and have been replaced by a regional system for processing waste. New technologies, federal legislation, and declining landfill area have driven these changes. State agencies and waste facility operators champion these new developments as environmentally safer, while neighborhood groups protest the use of their communities as dumping grounds for waste generated in other towns, even other states. We document these changes by identifying the location of all the Connecticut facilities that constitute its system of solid waste management and the distribution of populations around these facilities. Further, we particularly focus on newer developed regional facilities to determine if they are being placed disproportionately in minority or lower-income communities. Connecticut provides a unique opportunity for research to inform public policy on these issues because the selection and development of regional facilities are continuing. If environmental equity is a serious concern among state agencies and the public, it is vital that independent researchers carefully document site locations and test for disproportionate burdens.

## Rationale for the Study: The Local Scene

Neighborhood groups throughout Connecticut have organized to protest the presence of waste disposal facilities. The most contentious battle has been in Hartford, the site of the largest landfill in the state, where ash and bulky waste are deposited. ONE/CHANE, a Hartford neighborhood organization, filed a Title VI complaint with the EPA in 1996, claiming the state had issued a permit for a landfill expansion that would result in a "disparate impact" on racial minorities residing in the vicinity of the facility.[2] Actions taken by organizations like ONE/CHANE raise the question Has the Clinton administration aided neighborhood groups in effectively fighting environmental racism or has the executive order resulted in expensive public accommodations, disinvestment in poor urban areas, and a venue for small resource redistributions to compensate larger structural injustices underlying poverty?

The challenge of trying to sort out the complexities of environmental justice is no small matter, the Hartford case illustrates. The Connecticut Resources Recovery

Authority (CRRA), the quasi-public agency that operates most of the state's regional solid waste disposal facilities, spent $12 million over the past five years for improvements at the landfill to address neighborhood complaints, a half million dollars for local health studies, and $9.7 million so that ONE/CHANE would drop its complaint, paving the way for the landfill's expansion. The president of the CRRA claims that improvements to the controversial landfill, including a ground protection system and a gas extraction system "render the area virtually impervious to the air, ground and water."[3] On the basis of a study conducted by the federal Agency for Toxic Substances Disease Registry, the CRRA argues that landfill emissions do not pose any short- or long-term health effects to area residents.[4]

Nonetheless, residents on the west side of the Hartford landfill, primarily African-American, have argued that ash dust emitted in the trucking and dumping process has contaminated the air in their neighborhoods, that leachate from the landfill has contaminated soil and water, and that the disposal of ash has increased the emissions of hydrogen sulfide. Residents trace the prevalence of heart illnesses and respiratory problems to air emissions from the landfill and claim that lead poisoning has likewise resulted from soil and water contamination.[5]

Similarly, a trash-to-energy plant is located on the south side of the city, close to some of Hartford's Latino neighborhoods. Connecticut's Department of Environmental Protection (DEP) claims that emissions from the trash-to-energy plants in Hartford and throughout the state are far below the permitted maximums.[6] Dr. Mark Mitchell, former city health director and director of the Hartford Environmental Justice Network, points out that asthma rates in Hartford are 17 percent for the total population and 25 percent for Latinos, far exceeding the national asthma rate of 7 percent.[7] Health studies, such as that cited by the CRRA, which claim there is not sufficient presence of a given substance to cause inordinary illnesses are not about to persuade local residents where health problems have reached epidemic proportions, especially in African-American communities where distrust of government is common.

Health concerns are augmented by perceived inequities as regional facilities that burn and bury the waste of surrounding towns (and in some cases states) are chosen. Irrespective of how much safer regional facilities such as trash-to-energy plants and ash landfills may be, they must be sited somewhere in the state where large volumes of waste will be trucked, incinerated, and dumped. Citing a 1993 study conducted by the DEP, Mitchell argues that when examining data on seven different types of permitted pollution facilities in Connecticut, minority residents live in towns that are far more likely to include at least one of these facilities. Edith Pestana, the environmental equity program administrator at the Connecticut DEP concurs: "Data indicate that there are over 600 potential pollution sources in each of the top five major metropolitan cities in the state . . . These five cities contain 51 percent of the state's population living in poverty and 77 percent of the state's minority population."[8]

In Hartford, the residents' concerns are bolstered by increasing reliance on the city to assume the bulk of the state's waste disposal. The current trash-to-energy plant and associated landfill in Hartford are contracted to burn and bury the waste of 66 towns, or 46 percent of all Connecticut towns that are under contract and also receive trash from other states.[9] In his testimony to contest a proposed energy generator in Hartford, Dr. Mitchell points out that the issue is no longer the amount of toxic emissions from a single facility that will be permitted but rather the combined

emissions from several sources as increasing numbers of regional facilities are located in concentrated areas within the state.[10] The Hartford trash-to-energy plant burns at least four times as much solid waste as any of the other trash-to-energy plants in the state with the exception of the other large plant in Bridgeport. Of the seven trash-to-energy plants in this study, these two burn 65 percent of the waste incinerated in Connecticut.[11] The use of urban areas as dumping grounds for the state's garbage was the concern of a recent article in the *Hartford Courant.* The *Courant* reported that of all the municipal trash burned and buried in Hartford, only 15 percent comes from the city and that only 30 percent of sewage sludge and 4 percent of recyclables processed in Hartford are generated by the city.[12]

Of course, public objection to waste disposal facilities is not limited to Hartford. Citizen groups in Canterbury and New Milford are fighting the owners of local waste facilities, claiming that odors emanating from the dumps have caused illnesses and reduced property values.[13] In Bethel, a community group is fighting the owners of a Danbury bulky waste landfill over releases of hydrogen sulfide from a landfill that was established in 1906. Large quantities of building debris, heavy rains, and growing numbers of fires deep within the landfill are apparently causing the releases, which local residents and a public health official claim are causing sore throats, asthmatic reactions, and conjunctivitis.[14] A resident group in Mansfield is pressing the federal government to investigate the chemical contamination of an abandoned dump, claiming collusion between University of Connecticut officials and the state DEP. Irrespective of technological improvements and new regulations, waste facilities remain LULUs (Locally Undesirable Land Uses) and the public mistrust of regulating agencies persists. As the waste disposal system becomes more regionalized, the public increasingly questions where these facilities will be located. Questions of environmental justice or environmental racism loom large as state agencies and waste operators search the landscape for cost-effective and geologically sound locations.

We are interested in tracking the movement of municipal trash in Connecticut and in identifying the characteristics of communities closest to the facilities that collect, recycle, transfer, burn, and bury this waste. We are particularly interested in the social-demographic characteristics of communities surrounding new regional waste disposal facilities. In addition to identifying the social-demographic characteristics of neighborhoods nearest to these regional facilities, we also use multivariate techniques to control for the effects of alternative factors. If environmental justice is indeed an integral part of decision-making processes, the policy ramifications of this type of empirical research should be useful in guiding future site selections. Several current waste disposal facilities are reaching capacity and new regional facilities are being planned. These processes will be ongoing in Connecticut as well as in states throughout the country.

## Environmental Equity Studies

While several environmental equity studies, especially concerning air pollution, were made in the 1970s, the first study to receive widespread recognition was conducted by the United Church of Christ (UCC) in 1987. This undertaking was the first national study to assess the location of hazardous waste facilities. A groundbreaking study, it supported the claim of environmental racism by establishing that minorities

were disproportionately represented in zip code areas where commercial hazardous waste facilities were located. The percentage of racial minorities in these areas was twice as large as in areas without a facility and more than three times larger in areas where two or more facilities were located or where one of the five largest landfills was located. Moreover, a discriminant function analysis indicated that race was the best predictor of the presence of these facilities, even when including measures of social class.[15]

Douglas Anderton and his colleagues at the University of Massachusetts Amherst followed with the next *national* study but chose census tracts as their units of analysis rather than zip codes. Tracts are smaller geographical units that permit a more refined analysis of residential areas located in close proximity to waste facilities. Anderton et al. argued that this reduced the potential for "aggregation errors" or "ecological fallacies."[16] Their results differed from the UCC report. Anderton et.al. found that when comparing the social-demographic characteristics of 1980 census tracts in SMSAs containing commercial hazardous waste facilities to tracts without facilities, racial minorities were not disproportionately located in tracts with facilities, nor did their percentages increase significantly in abutting tracts. Only when they included tracts within a radius of 2.5 miles of a facility were black and Hispanic populations significantly higher than in the rest of the Standard Metropolitan Statistical Areas (SMSAs).[17] Instead, the population living in tracts with commercial hazardous waste facilities disproportionately included fewer employed men, more adults working in manufacturing jobs, and a lower valued housing stock among owner-occupied homes. When they limited their analysis to the largest twenty-five SMSAs, the same variables were significant, but they also found that blacks were significantly *less* likely to live in tracts with facilities while Hispanics were *more* likely to reside in host tracts. Further, when they conducted the same analysis using 1990 census data, their study again indicated that more residents in host tracts were employed in manufacturing jobs and housing values were significantly lower, but in 1990, the percentage of families below the poverty line and the percentage of families residing in public housing were significantly higher in tracts with facilities — race, however, was not found to be significantly different.[18]

In each of their analyses, Anderton and his colleagues found that the variable indicating the greatest difference between tracts with and without facilities was the percentage of employees in manufacturing employment. This was confirmed in their multivariate analysis. Using logit regression on their 1980 data, they found that the only variable which increased the odds of a tract containing a Transfer Storage Disposal Facility was an increase in the percentage employed in manufacturing.[19] Anderton and his colleagues concluded that racial minorities were not likely to live in neighborhoods with commercial hazardous waste facilities, but were more likely to be concentrated in areas one to three miles from these facilities. Instead, neighborhoods with facilities were more likely to be white, industrial, working-class neighborhoods that by the 1990s were becoming poorer. Their analyses within EPA regions also largely supported their interpretation. In 1980, race was not found to be a predictor of facility location in any of the ten EPA regions in the country, while the percentage of manufacturing workers increased the likelihood of a tract containing a waste facility in seven of the ten regions.[20] In their 1990 analysis, they did find significantly more blacks in host facilities in the EPA's southeast region of the United States and significantly more Hispanics in neighborhoods with facilities in

the southwest United States. Nevertheless, employment in industrial or precision manufacturing occupations was significantly greater in host tracts in all ten of the EPA regions in 1990.

The different outcomes reported by the UCC and the UMASS studies set the stage for a plethora of studies that have attempted to distinguish racial and class effects on waste facility sitings. Evan Ringquist used zip code areas in his national study of Toxic Release Inventory (TRI) sources.[21] In addition to several race and income variables, he included important control variables to predict three aspects of the TRI data: the presence of a TRI source, the number of TRI sources, and the amount of TRI releases. Furthermore, he compared the effects of using a national or state reference group in his sophisticated analyses. The results strongly indicated that even after controlling for other variables, zip code areas with more African-American, Hispanic, or poor residents were more likely to contain a TRI source or have larger chemical releases. Unfortunately, he did not report standardized coefficients or actual significance levels, so it is not possible to assess the relative importance of these different predictors.

John Hird and Michael Reese conducted a national study of counties and their exposures to a large and diverse set of pollution indicators, twenty-nine in all, including the number and capacity of commercial landfills. Their multivariate analyses of each pollution indicator found a very consistent tendency for counties with more minorities to have higher pollution potentials although other control variables, such as the percentage of owner-occupied housing or the population density, were usually more important predictors.[22] In addition to these national studies, several regional studies of air pollution, Superfund sites, medical waste facilities, and landfills have also attempted to assess the relative effects of race and income on site locations.[23] But only a few studies that examine population distribution around *municipal solid waste disposal facilities* have been conducted. These facilities differ from commercial hazardous waste facilities in that the waste processed and disposed cannot exceed specified quantities of hazardous waste. Contractors usually monitor this themselves with the expectation that they will not exceed regulatory guidelines. Siting these types of facilities in neighborhoods often provokes community resistance, or as Michael Greenberg explains, trash-to-energy plants "should be the type of pariah land use that so outrages most people that they would be sited into neighborhoods and towns occupied by relatively powerless people."[24]

Robert Bullard examined the siting of solid waste facilities in Houston, Texas.[25] He found that permitted facilities were disproportionately located in predominantly racial minority neighborhoods and near schools with large racial minority enrollments. Vicki Been provided a secondary analysis of Bullard's work, claiming that he had mistakenly counted some facilities more than once in his analysis and that he had used neighborhoods as his unit of analysis without explaining how they were defined.[26] Further, Been's study was particularly concerned with the issue of whether the siting process was guided by racial prejudice or by market dynamics. Been estimated that 17 to 20 percent of U.S. households move each year and that it was therefore difficult to determine from cross-sectional data whether facilities were being sited in black communities or whether white flight combined with decreasing housing values in areas around facilities were producing higher concentrations of black residents in these areas. She explained that "as long as the market discriminates on the basis of race, it would be remarkable if LULUs did not eventually impose a disproportionate burden upon people of color."[27]

In her secondary analysis of Bullard's work, Been used census tracts as her unit of analysis and compared racial compositions in ten tracts with facilities (three incinerators and seven landfills) to the racial population in the city as a whole. She found that one-half were sited in neighborhoods with significantly larger populations of African-Americans than reside in the larger city. Further, she found that in three of the ten facilities, the poverty rates for the census tract were significantly greater than the overall poverty rate in the corresponding county. She also found that the percentage of African-Americans residing in host tracts increased dramatically (223 percent) between 1970 and 1980 compared with increases in the overall African-American population in the city (7 percent). Increases in the African-American population in host tracts also continued in the eighties while the city population of African-Americans stayed about the same. Been also demonstrated that by the 1990 census, seven of the host tracts had become significantly poorer and that median income had fallen more in nine of the ten host tracts when compared with the county population. While there is some support that the siting process itself may have had a disproportionate effect on minority communities, there is also strong support that market dynamics which resulted in white flight and lower housing values may also have had a major effect after the facility was sited. Thus, Been underscores the importance of longitudinal studies that account for population changes which occur after the siting of facilities.

In addition to Bullard's research in Texas, there have been three national studies of solid waste facilities. Greenberg's study examined towns where trash-to-energy facilities are located and used both service areas outside of these towns and the U.S. population as comparisons. His article illustrates criteria in five parts for measuring environmental equity. In applying his criteria, Greenberg found that the poor and minorities were more likely to reside in towns with large trash-to-energy plants than in the surrounding service area but found no differences for towns with smaller plants. When comparing all towns with facilities to the service areas and to the U.S. population, he found that per capita income was lower in towns with facilities across both comparisons. However, the results for minorities differed. Minority populations in towns with facilities were significantly greater than in the service areas, but lower than the minority population in the United States. However, when the population in towns was weighted in the analysis, the percentage of minorities in towns with facilities was significantly greater than in the larger United States. To illustrate the importance of testing for different populations, he also found that the percentage of elderly was a better predictor of facility location than race or poverty.[28]

In 1995, the U.S. General Accounting Office (GAO) published its study of nonhazardous waste facilities.[29] Using census block groups — even smaller geographical areas than census tracts — as the unit of analysis, it analyzed block groups within one mile, then within three miles of 295 nonhazardous landfills throughout the nation. The study found that racial minorities were *less* likely to reside within one mile or three miles of landfills when compared with the racial minority population residing in U.S. metropolitan counties. In a second analysis, the GAO compared racial minority populations in block groups within one mile to the population in the remainder of the corresponding county. It found that the racial minority population within one mile of a landfill was greater than the surrounding county in only 27 percent of cases, while the median income was lower in 44 percent of cases. It concluded that areas around nonhazardous landfills throughout the nation were more

likely to have fewer racial minorities and higher incomes than the surrounding county population.

The most recent equity study of a municipal solid waste disposal, including sewage treatment plants, was prepared by William Markham and Eric Rufa.[30] They examined forty-nine randomly selected U.S. cities, comparing race, ethnicity, income, and housing variables in census tracts where facilities existed with town data. They characterized their study as an assessment of "waste streams," or an examination of waste originators and waste recipients, in an effort to determine "whether the more privileged dumped their wastes on the less privileged."[31] In their assessment of landfills and incinerators, the results were in the opposite direction than they expected, with fewer minorities and less poverty found in tracts with facilities. They did find a modest bivariate relationship between education and the destination tracts. This pattern held up in their examination of sewage treatment plants and in their separate analysis of facilities in the southern United States, with the exception that they found Hispanics slightly more likely to live in tracts with sewage treatment facilities. The most consistent finding across these analyses was that less-educated residents were more likely to live in facility tracts.

As we see, the outcomes of these studies are mixed, as are the methodologies chosen. Our study draws on this research, especially in informing our methodology. We focus on one state, but our study is particularly timely as we attempt to examine the state's transition to a regional system of solid waste disposal, which has occurred rapidly in the past fifteen years. Although the regional authority overseeing the majority of solid waste disposal facilities was legislatively established in 1972, the first regional trash-to-energy plants and ash landfills did not begin operation until the mid-1980s. The rapidity and scope of this change is reflected by the closures of Municipal Solid Waste (MSW) landfills during this time. In 1980, there were more than one hundred operating MSW landfills; in 1996, when we established our data set for this study, there were three remaining MSW landfills and six ash landfills. Similarly, our data set includes seventy-three bulky waste landfills, where waste and debris from land-clearing activities are disposed, but the recent solid waste management plan published by the DEP indicates that the number of these facilities will likely be reduced to four in the near future. Thus, we are attempting to document ground that is constantly shifting as we collect data and write. While this can make research difficult, conducting research at a time in which so many facility sitings are occurring provides a more accurate profile of the neighborhoods where facilities are being located as well as the opportunity to track demographic changes in these neighborhoods over time.

## Analyzing Solid Waste Disposal in Connecticut

In our analyses, we include Connecticut facilities used in the management of municipal solid waste. The different types of facilities are as follows:

1. RRFs: Resource Recovery Facilities that incinerate solid waste and generate electricity;
2. Ash LFs: Ash Landfills where the ash produced from the incineration process is deposited;
3. TS: Transfer Stations where waste is collected for transportation to RRFs;

4. VRFs: Volume Reduction Facilities where construction and/or demolition waste is processed to recover materials that can be reused, recycled, or burned;
5. IPCs: Intermediate Processing Centers where recyclable waste is gathered and bundled to be sold on the market;
6. BWLFs: Bulky Waste Landfills where construction and demolition debris are deposited.

Here we examine whether environmental justice issues are apparent in what we refer to as the regionalization process for disposing of Connecticut's solid waste. We provide three different analyses. First, we examine the locations of seven RRFs along with their ash landfills, which together constitute the heart of the regional system. The second grouping combines the same facilities with the remaining elements of the regional system (TSs, VRFs, and IPCs). Finally, the remaining bulky waste landfills are examined separately. These facilities are remnants of the older municipal system for waste disposal and can be used as a proxy measure for comparing the older system with the newer regional system to determine whether newer facilities are more or less likely to be located in poor and racial minority areas.

## Data Collection and Methods

As indicated above, previous quantitative studies of the locations of waste disposal sites have employed a variety of methodological approaches. Almost all employ an ecological correlation analysis where the units of analysis are geographic areas that are compared on the basis of social-demographic characteristics of individuals, families, or households within the unit. Four aspects of these studies are particularly important: (1) the size of the geographic unit of analysis; (2) the number and variety of variables measured for each geographic unit; (3) the type of dependent variable examined and the statistical analyses used; and (4) how "comparison" geographic units were defined and used in the statistical analyses. We discuss how our study compares with each of these issues.

### *Block Group Unit of Analysis*

Some studies have employed fairly large geographic units such as zip code areas, towns, or even counties, as their units of analysis. These larger units have some disadvantages. First, they tend to be less homogeneous than smaller units, such as census tracts or block groups, and therefore do not provide good social-demographic profiles of local populations. In addition, describing the characteristics of populations across larger geographical areas increases the risk of committing the ecological fallacy. For example, suppose two studies reported that the geographic units with a high percentage of minorities are more likely to have landfills, but one study used counties and the other used census block groups. With the county data, there is less certainty that the minorities are actually located nearer the landfills. These uncertainties decline as smaller units of analysis are used. However, data availability problems start to appear with smaller units. For example, to protect the confidentiality of households reporting to the U.S. Census, some information is not reported at the census block level. In addition, some variables might be missing at these smaller

units, for example, the value of owner-occupied housing may be lacking if all the residents in a block area are renters.

As our unit of analysis, we use block groups, which divide the state into 2,909 units. The land area for block groups is very skewed with a mean of 1,130 acres and a median of 309 acres. The mean and median population sizes are 1,131 and 1,032, respectively. Our analysis includes selected variables created from the 1990 U.S. Census for each of these geographic units.

***Number and Types of Variables Selected***

In one sense, we only need measures of race, ethnicity, and poverty for each block group and its distance from a solid waste facility to assess environmental inequity. If we find that minorities or the poor are more likely to live closer to facilities, this would provide direct evidence that the burdens of environmental pollution are not shared equally among all social groups. The implications for social policies are quite different, however, if the facilities were originally placed in minority neighborhoods than if minorities arrived after the facilities were developed. Similarly, if the correlation between distance from facilities and race disappears when controlling for the effects of other variables such as level of education, this reduces support for racial injustice. The latter result might indicate that residents in areas with more educated members are better able to resist the placement of waste disposal facilities near them or are better able to relocate if a facility is sited in their neighborhoods. Thus, multivariate analyses can provide helpful, although not definitive, evidence for different explanations of observed bivariate patterns.[32]

We used or created a number of variables from the 1990 census that might provide likely explanations for the location of waste facilities.[33] For instance, besides measures of race, ethnicity, poverty, and income, we included measures of education, industrial areas, housing and social density, and neighborhood stability. If we find, after controlling for these other variables, that race/ethnicity and/or poverty remain correlated with distance from a facility, we have a stronger basis for raising concerns about environmental injustice. We offer a brief description of each variable.

*%Minority:* Non-Hispanic whites are the "majority" and all other racial or ethnic groups are classified as minorities. In Connecticut, minorities includes mainly African-American and Hispanic groups.
*%Poverty:* The percentage of persons living below the 1989 federally established poverty line.
*Income/Cap:* Per Capita Income (in thousands) for individuals over fifteen years of age.
*%BA+Deg:* The percentage of residents twenty-five years and older with a bachelor's degree or higher.
*HomeValue:* The median value (in thousands) of *owner-occupied* homes.
*HousingAge:* The median age of the housing units in 1990.
*%SameHome:* The percentage of residents living in the same home for at least five years.
*%Manufacturing:* The percentage of workers employed in the durable and nondurable manufacturing sector.
*ChemSpills:* The number of chemical or oil spills per acre of land. This measure is based upon the CT Department of Environmental Protection's

GIS database of spills or leaks.
*HU/Acre:* The number of housing units per acre.
*Persons/HU:* Average number of persons per occupied housing unit.
*TotalArea:* The total size of the block group (in acres). Urban block groups tend to be smaller and more densely populated.
*%AreaInWater:* The percentage of the unit area that is water.

## Dependent Variables and Methods of Analysis

Previous studies have employed a variety of dependent variables and statistical techniques. Some have used simple t-test to compare the features of the geographic units containing facilities to adjacent units (or the units in the same metropolitan area). The more sophisticated analyses used logistic regression to make multivariate comparisons between geographic units with (or near) facilities to those farther away.

Our dependent variable is the actual distance in miles between the center or "centroid" of the block group and the *nearest* disposal facility. There are several advantages to this strategy. First, since the effect of a facility does not stop at the boundary of the geographical unit of analysis, we have better control by using distance itself. For example, rural block groups are much larger than urban block groups, so a contrast of host versus nonhost block groups can involve much larger distances in the rural setting. It would seem better to measure distances as directly as possible. Furthermore, some facilities might be close enough to the edge of a large block group that an adjacent, small block group *without facilities* is actually closer to the facility than the centroid of the host block group. Finally, by using distance as a quantitative dependent variable we can use regression analysis with its easy interpretations of the effects of the predictor variables.

### *Comparison Groups*

Research results may depend on how "comparison" units are defined. In a logistic analysis, the comparison group defines which geographic units without facilities are contrasted to those with facilities (or near facilities). For example, the comparison group might be all other units without facilities but in the same town, SMSA, county, state, or nation. One of the criticisms made about environmental equity studies is that they assume that a facility could be located anywhere within a large geographical area — a state, for instance. However, some areas might not be feasible locations because they are not located close to transportation routes, don't meet geological requirements, or are not located close to populations where waste is generated.[34] Since distance from the facility is our dependent variable, we use it to define our comparison group. Our analysis uses block groups within a ten-mile radius of a facility for several reasons.

First, it is reasonable to assume that locations within ten miles are more feasible alternative sites than any location within the state, county, or metropolitan area. Choosing an alternative location within ten miles of a facility is not likely to increase transportation costs by much, should still locate the facility close to consumer populations, and is less likely to provide radically different geological conditions. Second, a ten-mile radius should also provide enough variation in population characteristics to make our analysis meaningful. Finally, since the number of comparison

units will increase as a square of the distance (assuming geographic units tend to be the same size), without some mileage limit the comparison group may become so large and diverse that the more refined contrasts within ten miles are "washed out" by the features of the more distant block groups. We thought it was more important to capture variation in population characteristics in areas more immediately around facilities, where reasonable alternative locations might be more plausible. Thus, we restricted the regression analysis to block groups within ten miles of the current facilities. Table 1 shows the number of sites of each type of facility and the number of block groups located within ten miles of each of the four groupings of facilities.

*Table 1*

Types of Solid Waste Disposal Facilities by Number of Sites, and Number of Surrounding Block Groups within 10 Miles

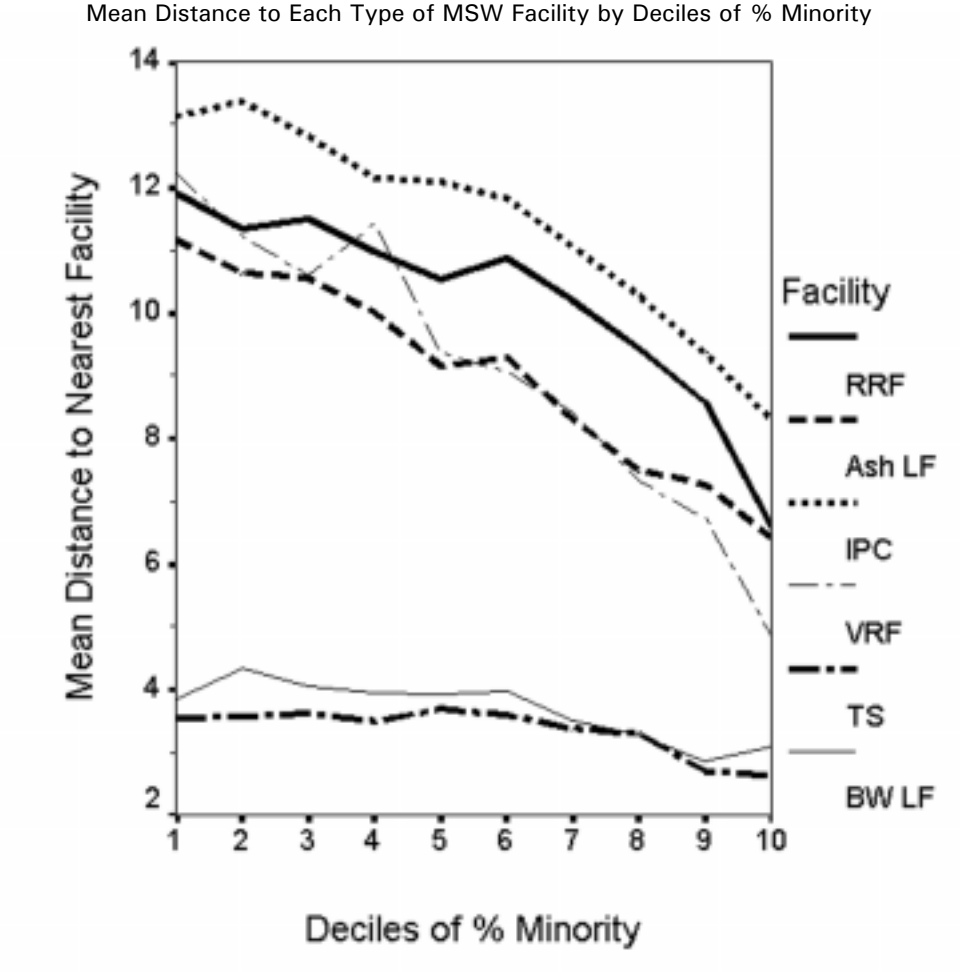
| Regional Facilities | No. of Sites | No. of Block Groups within 10 miles |
|---|---|---|
| RRF | 7 | |
| Ash LF | 6 | 2000 |
| TS | 88 | 2821 |
| VRF | 13 | |
| IPC | 6 | |
| Local Facilities | | |
| BW LF | 73 | 2769 |

***Analysis***

Figure 1 provides a broad overview of the bivariate relationships between the distances to each type of MSW facility and the minority percentage. The vertical axis gives the mean distance to the nearest facility of each type for ten sets of block groups, which are arrayed along the horizontal axis. On the horizontal axis the first set of block groups is composed of the 10 percent or "decile" of the block groups with the lowest minority percentage. The last set is the top decile of the block groups with the most minorities. This figure indicates that the block groups with more minorities are generally closer to the RRFs, IPCs, VRFs, and ash landfills. On average, the highest decile is about five miles closer to these facilities than the lowest decile, or nearly half the distance. The remaining component of the regional system is the set of transfer stations, which are more numerous but show a more modest relationship with the minority percentage. The older bulky waste landfills, which are taken as continuing remnants of the old town-based disposal system, show a pattern similar to that of the transfer stations. This consistency between these two types of facilities is not surprising because most transfer stations are located at closed landfills or a few of the current bulky waste facilities. Figure 2 provides the same information for deciles based on the percentage of persons in poverty in the

block groups. Here the relationships between poverty and proximity to various solid waste facilities are much weaker and only appear at the highest levels of poverty.

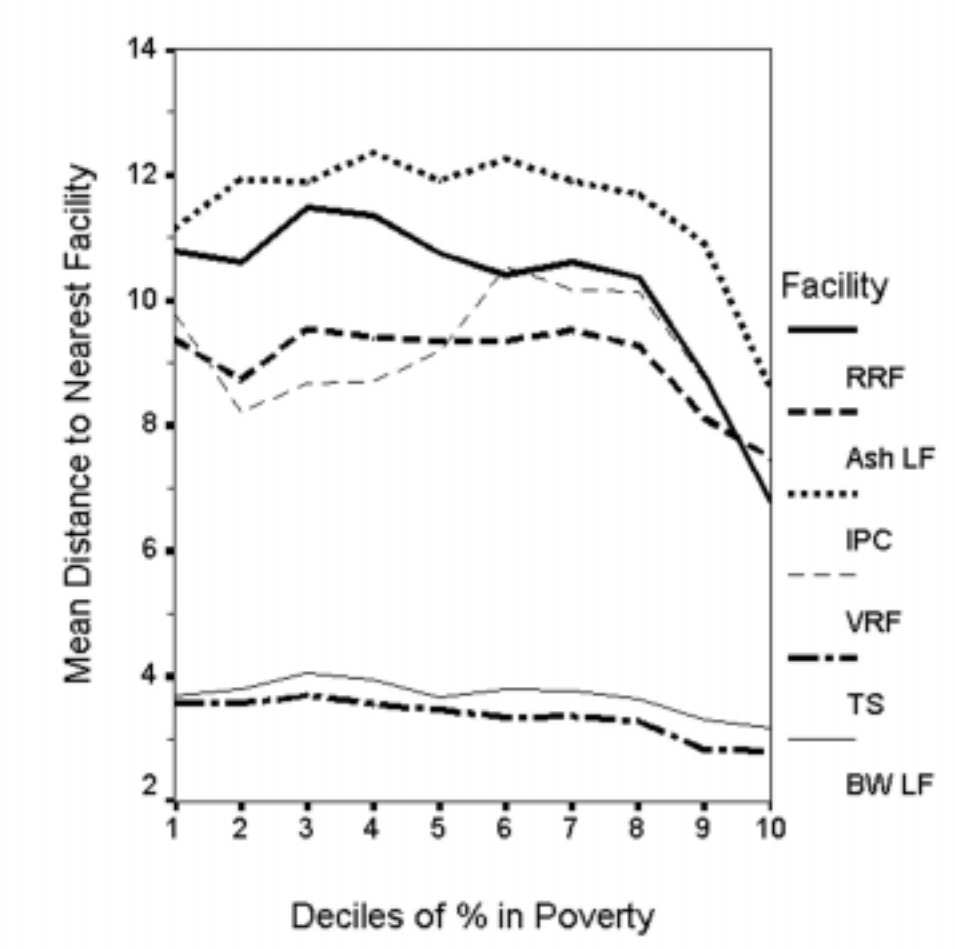
*Figure 1*




These *bivariate* plots indicate that block groups with the highest percentages of minorities (or levels of poverty) are generally closer to most elements of the regional municipal solid waste disposal system. This association should raise some concern about environmental equity issues, especially if these relationships remain after controlling for the effects of other variables.[35] To test whether these relationships are spurious, we used the previously described variables in a regression analysis predicting the distances to the nearest facility within various facility groupings: (1) the "burn and bury" heart of the regional system (the RRFs and their ash landfills); (2) all components that made up the regional system of handling municipal

*Figure 2*

Mean Distance to Each Type of MSW Facility by Deciles of % in Poverty




solid waste in the mid-1990s (see Table 1 for a breakdown by types); and (3) the seventy-seven bulky waste landfills remaining from the previous town-based disposal system.

Table 2 gives the descriptive statistics for the block groups within ten miles of each of these three groupings of facility types. The mean scores for most variables are remarkably similar across these different groupings even though the number of block groups in them vary and the focal facility types are different. This indicates that the ten-mile comparison groups are similarly diverse, which reduces the likelihood that our later results are influenced by differences in the comparison groups. The largest difference is in the means for the total area of the block groups. The much lower means for the RRFs and their ash landfills reflect their locations in more urban surroundings. However, the interesting differences between these groupings appear in the regression results given in Table 3.

*Table 2*

Means (and Standard Deviations Below) for Block Groups within 10 Miles of Different Types of Solid Waste Disposal Facilities

| | TYPES OF FACILITIES | | |
|---|---|---|---|
| VARIABLES | RRF & Ash LF | Regional | Bulky Waste LF |
| Distance in Miles | 5.38<br>2.58 | 2.55<br>1.49 | 3.54<br>2.20 |
| %Minority | 19.54<br>26.39 | 15.29<br>23.51 | 15.51<br>23.67 |
| %Poverty | 7.73<br>10.67 | 6.65<br>9.49 | 6.67<br>9.55 |
| Income/Cap | 20.37<br>11.08 | 20.77<br>10.84 | 20.84<br>10.92 |
| %BA + Deg | 26.31<br>18.27 | 27.27<br>17.49 | 27.43<br>17.55 |
| %SameHome | 58.00<br>15.22 | 58.26<br>14.53 | 58.22<br>14.58 |
| HomeValue | 185.4<br>91.55 | 188.2<br>87.15 | 188.8<br>87.62 |
| HousingAge | 34.38<br>12.25 | 33.05<br>12.39 | 33.05<br>12.36 |
| HU/Acre | .798<br>.937 | .643<br>.849 | .648<br>.854 |
| Persons/HU | 2.62<br>.428 | 2.63<br>.418 | 2.63<br>.418 |
| %AreaInWater | 3.34<br>10.97 | 4.41<br>12.98 | 4.46<br>13.09 |
| TotalArea (acres) | 693.2<br>1413 | 1143<br>2165 | 1133<br>2165 |
| %Manufacturing | 19.99<br>8.84 | 20.41<br>8.74 | 20.32<br>8.71 |
| ChemSpills | .0015<br>.0049 | .0013<br>.0044 | .0013<br>.0043 |
| Sample Size (N) | 2000 | 2821 | 2769 |

Table 3 presents both the unstandardized and standardized regression coefficients for all the variables described in the Methods section.[36] The most important result is the significant impact of *%Minority* in all three equations. Furthermore, it is important to note that *%Poverty* is significant in only one equation *and* is not in the predicted direction: block groups with more people in poverty tend to be *farther away* from RRFs and their ash landfills. Thus, race/ethnicity continues to be a sig-

nificant predictor of distance from a facility with a relationship that supports concern about environmental equity issues and raises the question How important is this effect?

*Table 3*

Regression Equations Predicting Distance from Different Types of Solid Waste Disposal Facilities fro Block Groups within 10 Miles of the Facility Types.†

| | TYPES OF FACILITIES | | |
|---|---|---|---|
| VARIABLES | RRF & Ash LF | Regional | Bulky Waste LF |
| Constant | 4.97*** | 2.40*** | 2.28*** |
| %Minority | -.0076* | -.00969*** | -.00632* |
| %Poverty | .0146*<br>.061 | .00917<br>.058 | -.000033<br>-.000 |
| Income/Cap | -.00692<br>-.030 | .0040<br>.029 | .00674<br>.033 |
| %BA + Deg | .0353***<br>.251 | .0168***<br>.197 | .00638<br>.051 |
| %SameHome | -.00288<br>-.017 | .00107<br>.010 | -.00627<br>-.042 |
| HomeValue | -.00290*<br>-.103 | -.00328***<br>-.192 | .000734<br>.029 |
| HousingAge | -.00495<br>-.024 | -.0112***<br>-.093 | .00362<br>.020 |
| HU/Acre | .0608<br>.022 | -.167***<br>-.095 | -.0832<br>-.032 |
| Persons/HU | -.0928<br>-.015 | .237***<br>.066 | .348**<br>.066 |
| %AreaInWater | .00118<br>.005 | .00240<br>.021 | -.0118***<br>-.070 |
| TotalArea (acres) | .000229***<br>.125 | .000108***<br>.175 | .000133***<br>.130 |
| %Manufacturing | .0289***<br>.099 | -.000409<br>-.002 | .0104<br>.041 |
| ChemSpills | -5.27<br>-.010 | -16.69**<br>-.049 | -11.8<br>-.023 |
| R-Square (Adjusted) | .044 | .152 | .050 |
| Sample Size (N) | 2000 | 2821 | 2769 |

†The standardized regression coefficients are given below the unstandardized coefficients.
*Significant at the .05 level or better.
**Significant at the .01 level or better.
**Significant at the .001 level or better.

The minority percentage ranges from zero to 100 percent among the block groups. The unstandardized coefficients indicate that the average effect of moving from zero to 100 percent minorities will be about .76, .97, and .63 miles closer, respectively, to the RRFs and their ash landfills, all the components of the regional

system, and the bulky waste landfills. These shifts appear quite modest, but they might be large in a relative sense; for example, a one-mile shift is large in a relative sense if it is from 1.5 miles to .5 miles (or a 67 percent decrease in distance from the facility). The largest relative shift is for the regional facilities, where the .97-mile shift moved the 100 percent minority block group about 36 percent closer to the facility.[37] Finally, the standardized coefficient for *%Minority*, –.153, in the regional equation indicates that its effects are stronger in the new regional system than in the older system indicated by the analysis of the bulky waste landfills, where *%Minority*'s standardized coefficient is only –.068.

These results suggest that regionalization has increased the proximity of minorities to the various components of the municipal solid waste disposal system. Some of our unreported analyses suggest that this occurred by bringing urban block groups with *higher* concentrations of minorities into closer contact with this system. The older system utilized landfills dispersed in rural settings, which had lower concentrations of minorities, whereas the addition of urban RRFs, IPCs, and even ash landfills has increased the proximity of urban minorities to the solid waste disposal system.[38]

The comparison of effects of minority percentage with other variables in the equation shows some interesting contrasts. For the analyses concerning the regional facilities, *the effects of education are much stronger* than the effects of minority percentage. Block groups with higher *%BA+Deg* scores are more likely to be farther away from RRFs and ash landfills or the combined regional facilities. This may reflect the fact that more educated residents have both the economic and political capital to avoid or resist these facilities.

Aside from *%Minority,* only one other variable — the *TotalArea* of the block group — has a significant effect in all three equations. Its strong and positive effect indicates that larger block groups are more likely to be distant from facilities of any type. Area was included as an important statistical control: the distance of a block group was calculated from its center, so larger block groups must be farther away on average than smaller ones. Since urban block groups are smaller than rural ones, it is possible that area's positive effect might also indicate a tendency for urban locations of the facilities. However, other variables may be a better measure of this aspect, such as housing units per acre (*HU/Acre*) and *HousingAge*. For the regional facilities as a whole, these two variables do have significant, negative effects, which indicate that the housing units near regional facilities are older and more densely located, both indicators of urban settings. However, the strongest predictor for regional facilities as a whole is the negative effect of median value of owner-occupied housing (*HomeValue*), which suggests that facilities are closer to more expensive homes, which generally tend to be found in more rural locations. Unreported separate analyses by specific facility type indicate that the negative effect of *HomeValue* occurs only for the locations of transfer stations and the ash landfills, which are more rurally located.

Three other variables reach significance in various equations. First, we find that the percentage of residents employed in the manufacturing sector (*%Manufacturing*) has a positive correlation with distance from an RRF or ash landfill. This opposes the pattern identified by Anderton and his colleagues, who found that tracts with many skilled and semiskilled operators were more likely to have commercial hazardous waste facilities, which they took as indicating a preference to locate these facilities in industrial areas. Our results may differ because we constructed our variable

differently, by using the percentage of the employed who work in economic sectors that manufacture durable or nondurable goods, which would include managers. In addition, we also used different statistical techniques and comparison groups. However, in the regional equation we do find results consistent with the Anderton interpretation. Block groups with many chemical and oil spills (*ChemSpills*) are more likely to be closer to facilities, and these spills are probably a more direct indicator of industrial activity than the types of workers living in the block group. Finally, the equation predicting the location of bulky waste landfills indicates that they are more likely to be located near block groups with a higher percentage of their area in water (*%AreaInWater*). This might indicate that such older landfills were often placed in "less valuable" lowlands and swamps.

* * *

It appears that the initial bivariate relationship between proximity to regional solid waste facilities and the percentage of poor is spurious, whereas the relationship with the minority percentage remains in the presence of substantial statistical controls. The effect of minority percentage is the highest in the equation for all regional facilities combined. Other variables, such as education, home value, and area, have equal or stronger effects, as reflected by their standardized coefficients, but the continued impact of minority percentage should raise concerns about the impact of regionalization on environmental equity.

Subsequent research will attempt to examine more closely the longitudinal development and consequences of the regionalization process. Adding census data from 1980 and 2000 will increase our ability to discern causes and effects. Identifying the exact locations of the older landfills and when they were closed will allow other types of analyses that may better characterize the regionalization process. For example, the vast majority of the current regional facilities are located at closed landfills. A logistic analysis contrasting the traits of the "reused" and "abandoned" landfills would help illuminate the causal processes producing our present results.

## Notes

1. John Cushman, Jr., "Pollution Policy Is Unfair Burden, States Tell E.P.A.," *New York Times,* May 10, 1998, A1,16.
2. Tom Condon, "ONE/CHANE Right to Take Settlement," *Hartford Courant,* August 22, 1999, B1, 5.
3. Robert E. Wright, "Finding Common Ground at the Landfill," *Hartford Courant,* November 3, 1999, A21.
4. Ibid.
5. Johnny Mason, Jr., "A Residue of Betrayal," *Hartford Courant,* August 28, 1999, A1, 14.
6. State of Connecticut, Department of Environmental Protection, "Proposed Solid Waste Management Plan: Minimizing Disposal in the 21st Century" (Hartford: Department of Environmental Protection, 1999). The toxic emissions that are released into the air from trash-to-energy plants include particulates, dioxins, mercury, lead, and cadmium, to name a few.
7. Mark Mitchell, testimony before the Connecticut Siting Council, June 24, 1997.

8. Edith Pestana, "Environmental Racism and the Call for Justice," *Connecticut Law Tribune,* December 12, 1994, 10–14.
9. Many of the twenty-five towns not under contract, which sell their trash on the spot market, also dispose of their waste in Hartford.
10. Mitchell testimony.
11. Department of Environmental Protection, "Proposed Solid Waste Management Plan."
12. Mike Swift, "Hartford: Region's Dumping Ground," *Hartford Courant*, December 12, 1999, A1, 8.
13. Daniel P. Jones, "Landfills' Neighbors View DEP as Enemy," *Hartford Courant,* December 23, 1996, A1, 10.
14. Wayne D'Orio, "A Danbury Landfill Plagues Its Neighbors," *New York Times,* February 2, 1997, Section 13, 1, 12; Jones, "Landfills' Neighbors View DEP as Enemy."
15. United Church of Christ, Commission on Racial Justice, "Toxic Wastes and Race in the United States: A National Report on the Racial and Socioeconomic Characteristics of Communities with Hazardous Waste Sites" (New York: United Church of Christ, 1987).
16. Douglas L. Anderton, Andy B. Anderson, Peter H. Rossi, John Michael Oakes, Michael R. Fraser, Eleanor W. Weber, and Edward J. Calabrese, "Hazardous Waste Facilities: 'Environmental Equity' Issues in Metropolitan Areas," *Evaluation Review* 18, no. 2 (April 1994): 123–140.
17. Douglas L. Anderton, Andy B. Anderson, John Michael Oakes, and Michael R. Fraser, "Environmental Equity: The Demographics of Dumping," *Demography* 31, no. 2 (May 1994): 229–248.
18. Andy B. Anderson, Douglas L. Anderton, and John Michael Oakes, "Environmental Equity: Evaluating TSDF Siting Over the Past Two Decades," *Waste Age,* July 1994, 83–100.
19. Anderson et al., "Hazardous Waste Facilities."
20. Ibid.
21. Evan Ringquist, "Equity and the Distribution of Environmental Risk: The Case of the TRI Facilities," *Social Science Quarterly* 78, no. 4 (December 1997): 811–829.
22. John Hird and Michael Reese, "The Distribution of Environmental Quality: An Empirical Analysis," *Social Science Quarterly* 79, no. 4 (December 1998): 693–716.
23. Michael Gelobter, "Toward a Model of 'Environmental Discrimination,'" in *Race and the Incidence of Environmental Hazards,* edited by Barry Bryant and Paul Mohai (Boulder, Colo.: Westview Press, 1992), 64–81; Paul Mohai and Bunyan Bryant, "Environmental Racism: Reviewing the Evidence," in *Race and the Incidence of Environmental Hazards*, (Boulder, Colo.: Westview Press), 163–176; William M. Bowen, Mark J. Salling, Kingsley E. Haynes, and Ellen J. Cyran, "Toward Environmental Justice: Spatial Equity in Ohio and Cleveland," *Annals of the Association of American Geographers* 85, no. 4 (1995): 641–663; Eric J. Krieg, "The Two Faces of Toxic Waste: Trends in the Spread of Environmental Hazards," *Sociological Forum* 13, no.1 (1998): 3–33; Harvey L. White, "Hazardous Waste Incineration and Minority Communities," in *Race and the Incidence of Environmental Hazards*; Douglas L. Anderton, John Michael Oakes, and Karla L. Egan, "Environmental Equity in Superfund: Demographics of the Discovery and Prioritization of Abandoned Toxic Sites," *Evaluation Review* 21, no. 1 (February 1997): 3–26; Phillip H. Pollock III and M. Elliot Vittas, "Who Bears the Burdens of Environmental Pollution? Race, Ethnicity, and Environmental Equity in Florida," *Social Science Quarterly* 76, no. 2 (1995): 294–310; Tracy Yardle and Dudley Burton, "Reexamining Environmental Justice: A Statistical Analysis of Historical Waste Landfill Siting Patterns in Metropolitan Texas," *Social Science Quarterly* 77, no. 3 (1996): 477–492; Rae Zimmerman, "Social Equity and Environmental Risk," *Risk Analysis* 13, no. 6 (1993): 649–666; Francis O. Adeola, "Environmental Hazards, Health, and Racial Inequity in Hazardous Waste Distribution," *Environment and Behavior* 26, no.1 (1994): 99–126; Paul Stretesky

and Michael J. Hogan, "Environmental Justice: An Analysis of Superfund Sites in Florida," *Social Problems* 45, no. 2 (May 1998): 268–287; Douglas L. Anderton, John Michael Oakes, Michael R. Fraser, "Race, Class, and the Distribution of Radioactive Wastes in Massachusetts," *New England Journal of Public Policy* 15, no.1 (1999/2000): 79–96.

24. Michael Greenberg, "Proving Environmental Inequity in Siting Locally Unwanted Land Use," in *Risk: Issues in Health and Safety,* Summer 1993, 235–252.
25. Robert D. Bullard, "Solid Waste Sites and the Black Houston Community," *Sociological Inquiry* 53 (1993): 273–288.
26. Vicki Been, "Locally Undesirable Land Uses in Minority Neighborhoods: Disproportionate Siting or Market Dynamics," *Yale Law Journal* 103, no. 6 (1994): 1383–1411.
27. Ibid., 1390.
28. Greenberg, "Proving Environmental Inequity in Siting Locally Unwanted Land Use."
29. U.S. General Accounting Office, "Hazardous and Nonhazardous Waste: Demographics of People Living Near Waste Facilities," Washington D.C., 1995.
30. William Markham and Eric Ruffa, "Class, Race, and the Disposal of Urban Waste: Locations of Landfills, Incinerators, and Sewage Treatment Plants," *Sociological Spectrum* 17, no. 2 (1997): 235–248.
31. Ibid., 238.
32. Longitudinal data sets would also be helpful for understanding the social historical *dynamics* behind the observed patterns.
33. Data source was GeoLytics, Inc., "Census on CD" product, which is based on the "STF3" census data set.
34. Richard D. Clark, Steven P. Lab, and Lara Stoddard, "Environmental Equity: A Critique of the Literature," *Social Pathology* 1, no. 3 (1995): 253–269.
35. Even if they are found to be spurious, bivariate relationships would still be a source of concern. Racial minority and poor population distributions may turn out to be poor predictors of facility locations, but if facilities are disproportionately located in these communities, they will remain public concerns. Socioeconomic processes may produce these bivariate correlations or they could result from unintentional consequences of siting criteria rather than as intentional consequences.
36. We included all variables for two reasons. First, some readers may want to know the effect of a particular variable, even if it is not statistically significant. Second, one might argue that we are studying the entire population of block groups, so significance tests are irrelevant. We did do a backward elimination of less significant predictors and obtained essentially the same results. Furthermore, weighting block groups by the number of residents yielded very similar patterns of influence, but all variables became statistically significant with the increase in "sample" size to more than three million.
37. In order to calculate relative shifts, the initial or "starting" distance was calculated for the average, zero percent minority block group. This was done by using the means of all the predictor variables in the regression equation, except *%Minority,* which was set to zero. Then the effect of a change in percentage minority from zero to 100 percent was calculated and used to determine relative change.
38. The reported analyses represent an aggregated result. Each separate facility site could be analyzed in the same way as reported here, but we aggregated by type of facility. We discovered that the effect of *%Minority* varied drastically if we separated urban sites from rural sites. For rural sites there was a strong positive effect for *%Minority,* indicating that minorities were concentrated in the more distant urban areas. Just the opposite occurred for facilities located in urban settings. We do not report these separate results because we want to assess the *overall effects* of the total regional system and its various components. Reporting separate analyses would require aggregating them to reach an overall assessment.