Warren County Landfill: Still Provocative After All These Years

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Abstract

Protest over the burial of polychlorinated biphenyl (PCB)-contaminated soil in the Warren County PCB Landfill, a hazardous substance landfill near the small town of Afton, North Carolina, "jump-started" the environmental justice movement. A grassroots coalition of predominantly African-Americans in Warren County joined with national groups headed by the United Church of Christ's Commission for Racial Justice, the Southern Leadership Conference, and the Congressional Black Caucus to protest the development of a hazardous substance landfill and the decline of their neighborhoods. The decades-long resentment felt in minority communities over unfair siting practices, redlining practices, residential segregation, and other forms of discrimination had fueled the depth of concern in this community and galvanized it into activism. Two truck operators had illegally dumped 30,000 gallons of PCB-laced oil along a scattered 210-mile segment of roadways. (They went to prison for illegal dumping.) Roughly 32,000 cubic yards of soil contaminated with PCBs were removed from the rural roads and trucked to the landfill. After 16 years, concern within these communities that they may suffer from increased health risks continues. One question was unanswered: How do the sociodemographic profiles of the neighborhoods where the PCB-laced oil was dumped now compare with the community around the landfill? We conducted a geographic information system (GIS) study of 14 counties in north central North Carolina—the counties affected by the original dumping—to address this question. Using notes from sampling site documentation and hand-drawn maps, we created coverages of the formerly contaminated roadways and half-mile buffers to examine the demographic characteristics of these areas. The results do indeed show a higher concentration of minority population along the union of Nash, Halifax, and Warren Counties, but the other sampling sites show varying proximity to minority populations. While the roadside spill areas do show a strong concentration of minority neighborhoods, poverty was less concentrated than expected.

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Introduction

The Warren County (North Carolina) PCB Landfill has been controversial since its inception back in September 1982, when trucks began to deliver polychlorinated biphenyl (PCB)-contaminated soil to it.

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Waste haulers, attempting to save the expense of legal disposal, had decided to mix their problematic chemicals with oil and spray the mixture on a 210-mile network of rural roads in 14 counties of North Carolina (Figure 1). The significance of this event is evident in its chronology. The contaminated soil and pavement was discovered on July 30, 1978, in a remote section of the Fort Bragg Military Reservation. Four days after the initial discovery, a laboratory confirmed the presence of PCBs. Sixteen days later, the governor asked the president to declare the 14 affected counties disaster areas.

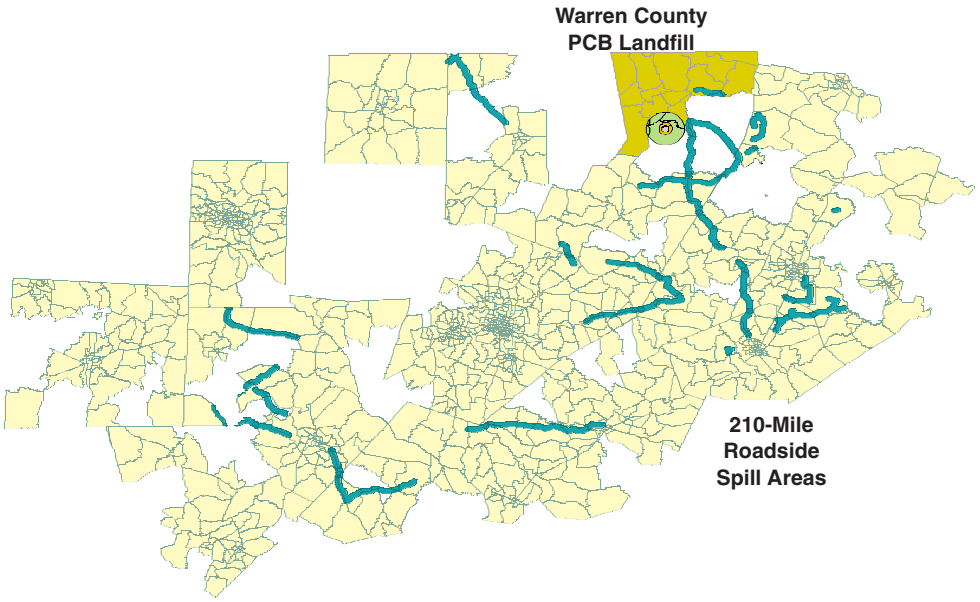

Figure 1 Buffers of the Warren County (NC) PCB Landfill and affected roadside spill areas.

A final decision to build a landfill in Warren County for the burial of the PCB-laced soil led to great controversy because the county was predominantly black. For the first time, nationally known civil rights activists and leaders joined local groups to protest the development of a hazardous substance landfill using a 1960s style of nonviolent civil disobedience.

This descriptive study is a direct reflection of the continuing controversy over the Warren County PCB Landfill. In early 1998, we conducted a demographic analysis both of the 210-mile roadside spill areas and of the landfill, using 1990 block group-level and 1980 county-level census data. Geographic information system (GIS) technology was vital to the delineation of these areas and to the examination of demographic characteristics. We sought to address three questions. First, do demographic characteristics vary when examined at the county level versus the block group level? Second, what is the minority and poverty composition of the populations in the spill areas? Third, how do the demographics of the roadside spill areas compare with those of the area surrounding the Warren County PCB Landfill?

The seminal report of the United Church of Christ's Commission for Racial Justice (UCCCRJ) (1) provides key research on the proximity of minority communities and

hazardous waste facilities across the country, as well as research on the larger environmental justice movement, which evolved from the debate and concern over the Warren County PCB Landfill. Using a zip code scale of analysis, this statistically based study finds no hazardous waste facilities in US communities with only 11% minority composition, one facility in a community with 24% minority composition, and two or more facilities in a community with 38% minority composition. Bullard's *Dumping in Dixie* (2) investigated the Warren County situation using the county as his scale of analysis, and reported that the county was predominantly black (63.7%) and poor (its median family income falls in the 92nd percentile for North Carolina). The US General Accounting Office (3) conducted a study of the socioeconomic and racial characteristics surrounding four hazardous waste facilities in the South and, because minority communities surround these facilities, found race to be a significant predictor for the presence of such facilities. Anderton et al. (4), using a census tract-level scale of analysis, examined the demographics around hazardous waste treatment, storage, and disposal facilities. Their findings show the percentage of population engaged in manufacturing to be a better predictor of hazardous waste facility presence than was race.

The probability of white migration out of urban areas increases as the proximity and percentage of minority population increases (5). Some researchers believe that the black middle class accompanies whites in their out-migration, further exacerbating the economic and spatial isolation of low-income minorities (6,7). According to Ottensmann (8), many studies have provided a threshold for the percentage of blacks in an area above which the racially mixed neighborhood would exhibit a strong tendency to transition to become predominantly black. This transition point has been discussed as being near 10% and approaching 40%. While racial segregation has decreased during the 1970s and 1980s, it still remains high (5,8,9). Likewise, economic and social disinvestment in minority communities is associated with increasing racial segregation (5,10). The aggregation intervals of 10–19%, 20–29%, and 30% and over are used to identify the effects of poverty and its isolation of minority communities (7,11,12).

The definition of a minority community varies in these studies as much as the scale of analysis used. Researchers often discuss minority communities in terms of how different neighborhoods are affected, either through poverty, isolation, or societal disinvestment. The findings of the UCCCRJ (1) and Massey and Denton (5) characterize minority communities by their proximity to potentially hazardous facilities and their increasing isolation from the amenities of the suburbs. Unlike William Julius Wilson's poverty categories (7) (which include the aggregation intervals identified in the previous paragraph), this method of describing minority communities is not well established. Consequently, we suggest merging concepts from the UCCCRJ and Massey and Denton studies to create the following categories:

1. Non-minority neighborhood: minority composition 0–14%.
2. Transitional zone: minority composition 15–24%.
3. Medium-high minority neighborhood: minority composition 25–34%; has a medium-high likelihood of white out-migration and of increasing proximity to a hazardous waste facility.
4. High minority neighborhood: minority composition 35% or higher, indicating a high propensity for two or more hazardous waste facilities.

Data and Methodology

For this project, the data consist of the 1990 Summary Tape File 3A (STF3A) from the US Census Bureau (13) and enhanced census boundary files from GDT's Dynamap/2000 (Geographic Data Technology, Lebanon, NH), which is a street network file for the state of North Carolina. Additional data include maps from sampling site information (14), paper-based USGS 7.5-minute quadrangles, and the County and City Data Book 1983 (15) for county-based 1980 census data. Windows NT-based GIS products, specifically ARC/INFO, ArcView, and ArcView Spatial Analyst (all from ESRI, Redlands, CA) were used to conduct the spatial analyses.

Using a GIS, we selected the road segments of the affected areas both through on-screen processes and through the use of structured queries. The road segments were developed as separate coverages, treated with half-mile buffers, and overlaid with block group boundaries. This process allows area calculations for the block group segments in the half-mile buffer and comparisons with the entire block group. The variables to be evaluated in these derived areas were percent nonwhite and percentage of persons living in poverty.

Two basic questions had to be addressed to evaluate the affected area. First, the characterization of minority communities needed meaningful aggregation ranges. For this study, the percentage ranges of 0–14%, 15–24%, 25–34%, and 35%+ appeared most relevant. Second, population estimates for these rural areas were needed.

Assuming a homogeneous distribution of population across each block group, the percentage of each census block group's area that was affected by roadside spills was calculated. Each block group's population count was then multiplied by this percentage-of-area number to derive estimates for the total affected population, total affected nonwhite population, and total number of affected persons living in poverty. (In the tables, the word "calculated" refers to this process of estimation.) All percentages were by dividing the calculated numerator by the calculated total population.

Two methods were used to test these estimates using regression analysis. The first was to select block groups randomly and to test the relationship between a block group's total population and its area. The second was to count each house in the half-mile buffer on USGS 7.5-minute quadrangles, whose published release dates range from 1967 through 1986. Seventeen block group segments were selected (with bias) on the basis of their high and low road density. Because most of these maps were dated closest to the 1980 census, the county-based 1980 persons-per-household statistic was multiplied by the house count in each block group segment. These multiplied counts were averaged and compared with the area contribution for each block group. These counts were also regressed against the area in each partial block group to test our surrogate measures. These measures were used in lieu of field-checking (physically counting houses within a half-mile of the affected roadside area) these segments on a random basis for house counts, which time in the initial phase of the project did not permit. To verify our use of the percentage of area as a multiplier, we required an R-square of 0.60 and a significance of $p \leq 0.20$.

Results

To characterize the segments, we sought a reasonable rural population surrogate. The

percentage of the sub-block group compared with the original block group proved to be the best indicator, with an R-square of 0.99 and a $p \leq 0.05$. The house count was not as useful, which, given the age of the maps, was not surprising.

Demographic characteristics are presented below for scale comparisons at the state, county, and block group level. Variations are evident, because political boundaries mask trends occurring at smaller aggregation units.

At the state level, the 1980 (15) and 1990 (13) decennial censuses both report the North Carolina population as 24% nonwhite. In 1980, the percentage of persons living in poverty was 12.5%; in 1990, it was 14.8%.

The county-based contributions to the overall sociodemographic characteristics show four counties—Chatham, Franklin, Nash, and Warren—each having 10% or more of the affected area (Table 1). Of these counties, Warren County has the greatest percentage of minority population (75.4%) and a medium-high poverty rate of 27.5%. Granville and Halifax Counties each have approximately 6% of the total affected area and a minority population base exceeding 50%. Franklin, Edgecombe, and Wake Counties each have minority populations exceeding 25%.

An examination of minority communities at the county level (Table 2) shows that approximately 50% of the affected area and population occur in a transitional zone (15–24.99% minority population). Communities with medium-high (25–34.99%) or high (35%+) minority composition each have an approximate 23% share of the affected area. The calculated population shows a different trend, but the highest representation (53% of the population) remains in the transitional zone. According to a county-level analysis, non-minority areas occupy less than 10% of the affected spill area, and compose approximately 10% of its population.

Table 1 Demographic Characteristics of the Roadside Spill Areas for Each County

County	Percent of Entire Affected Area (%)	Calculated Percent Nonwhite within Half-Mile Buffers (%)	Calculated Percent of Persons Living in Poverty within Half-Mile Buffers (%)
Chatham	16.4	20.77	12.52
Franklin	12.8	28.88	14.18
Nash	12.0	19.60	13.04
Warren	10.1	75.40	27.46
Harnett	7.6	20.18	14.69
Johnston	7.5	14.32	14.07
Wilson	6.6	19.40	12.00
Edgecombe	6.5	33.78	18.45
Granville	6.3	54.46	11.70
Halifax	6.0	92.03	36.78
Lee	4.2	20.77	10.54
Wake	3.9	28.88	10.04
Person	0.1	36.24	7.00
Moore	0.1	10.47	1.52
All counties	100.1		

Table 2 Minority Community Typology of Counties Affected by Roadside Spill

Minority Community Typology	Percent of Entire Affected Area (%)	Total Block Group Population[a] (n)	Calculated Total Population of Affected Areas (n)	Calculated Percent of Total Population of Affected Areas (%)	Counties
Non-minority (0–14.99%)	7.6	13,629	1,994	9.9	Johnston, Moore
Transitional (15–24.99%)	46.8	70,871	10,787	53.4	Chatham, Nash, Harnett, Wilson, Lee
Medium-high (25–34.99%)	23.2	40,527	5,347	26.5	Franklin, Edgecombe, Wake
High (35%+)	22.5	18,193	2,079	10.3	Warren, Granville, Halifax, Person
Total	100.1	143,220	20,207	100.1	

[a] 1990 US Census data (13)

When these areas are examined at the block group level, results differ (Table 3). Non-minority, transitional, and high-minority communities each occupy approximately 30% of the affected area; medium-high minority communities occupy approximately 12%. Roughly 38% of the area's total population is in the non-minority group, 27% in the transitional group, 9% in the medium-high group, and 26% in the high group.

When the same block group data are reorganized according to established poverty levels (Table 4), they follow the county-level trends. The low-poverty zone covers

Table 3 Minority Composition of Roadside Spill Area by Individual Block Group

Block Group Minority Community Typology	Percent of Entire Affected Area (%)	Calculated Total Population of Affected Areas (n)	Calculated Percent of Total Population of Affected Areas (%)	Percent Nonwhite of Entire Affected Area[a] (%)	Calculated Percent Nonwhite of Entire Affected Area (%)	Percent Below Poverty of Entire Affected Area[a] (%)	Calculated Percent Below Poverty of Entire Affected Area (%)
Non-minority (0–14.99%)	27.2	8,171	37.7	9.25	11.09	20.25	24.66
Transitional (15–24.99%)	29.2	5,879	27.2	15.64	17.75	20.03	23.46
Medium-high (25–34.99%)	11.7	1,988	9.2	9.03	10.43	10.44	9.13
High (35%+)	31.9	5,612	25.9	66.09	60.72	49.28	42.76
All block groups	100.0	21,650	100.0	100.01	99.99	100.00	100.01

[a] 1990 US Census Data (13)

Table 4 Percentage of Persons Living Below Federal Poverty Levels in Roadside Spill Area

Block Group Poverty Typology	Percent of Entire Affected Area (%)	Calculated Total Population of Entire Affected Area (n)	Calculated Percent of Total Population of Entire Affected Area (%)	Percent Nonwhite of Entire Affected Area[a] (%)	Calculated Percent Nonwhite of Entire Affected Area (%)	Percent Below Poverty of Entire Affected Area[a] (%)	Calculated Percent Below Poverty of Entire Affected Area (%)
Non-poverty (0–9.99%)	22.2	7,280	33.6	20.31	13.81	15.54	15.17
Low (10–19.99%)	54.8	10,392	48.0	34.24	40.61	42.87	47.80
Medium (20–29.99%)	10.2	1,996	9.2	24.24	20.70	21.75	15.42
High (30%+)	112.8	1,983	9.2	21.21	24.88	19.83	21.61
Total	100.0	100.0	100.0	100.00	100.00	100.00	100.00

[a] 1990 US Census Data (13)

roughly 55% of the entire spill area and contains 48% of the total population; 41% of all nonwhite persons in the spill area live in this zone. The non-poverty zone follows, with 22% of the total area and 34% of the total population.

Three points are evident when comparing the roadside spill areas with the landfill area. First, the population is sparse in the landfill's immediate area. We examined the population demographics using one-half-, one-, and three-mile buffers around the landfill (Table 5). Within the three-mile buffer, 779 people are estimated to reside, in a

Table 5 Demographic Characteristics in Buffers around Warren County PCB Landfill

Buffer	Calculated Total Population of Entire Affected Area (n)	Calculated Percent of Total Population of Entire Affected Area (%)	Percent Nonwhite of Entire Affected Area[a] (%)	Calculated Percent Nonwhite of Entire Affected Area (%)	Percent Below Poverty of Entire Affected Area[a] (%)	Calculated Percent Below Poverty of Entire Affected Area (%)
Half-mile	23	100.0	73.07	73.07 High minority	31.28	30.76 High poverty
One-mile	75	100.0	73.07	73.07 High minority	31.28	30.76 High poverty
Three-mile	779	100.0	69.60	71.14 High minority	27.16	27.68 Medium poverty

[a] 1900 US Census Data (13)

community whose population base is estimated to be 70% nonwhite and 28% living in poverty. The population estimates for the one-mile buffer and half-mile buffers are 75 and 23, respectively. These two smaller buffers both fall within a single block group that has a 73% minority population and 31% living in poverty.

Second, all the block groups around the landfill are in high-minority and medium-to-high poverty zones. The percentage of persons living in poverty and the percentage of nonwhite persons in the total population decline slightly between the half-mile and three-mile buffers.

Third, the difference in area between the landfill and the original 210-mile segment means that more communities are affected along the roadside spill areas. For instance, the half-mile buffered area around the landfill occupies only one block group, and is only 0.4% of the size of the original affected roadside spill region. The three-mile buffer crosses two block groups and is only 11% of the size of the original roadside spill region. The entire buffered roadside spill area intersects 111 block groups and is 80 times larger than the half-mile buffered landfill area.

In the affected spill areas, 32% of the block group portions have high minority populations (Table 6). An estimated 5,612 persons reside in these high-minority block group segments, which have 26% of the population of the entire affected area. These segments have 61% of all nonwhite persons and 43% of all the people living in poverty in the affected area. The correlative medium-to-high poverty groups occupy 23% of the entire affected area. In these zones, 18% of the entire area's population, or 3,979 persons, resides. The estimated percent nonwhite and percent below poverty in these zones are 46% and 37%, respectively.

Table 6 Minority and Poverty Characteristics in Buffers of the 210-Mile Roadside Spill Areas Area Typology along Affected Areas

Area Typology along Affected Areas	Percent of Entire Affected Area (%)	Calculated Total Population of Entire Affected Area (n)	Calculated Percent of Total Population of Entire Affected Area (%)	Calculated Percent Nonwhite of Entire Affected Area (%)	Calculated Percent Below Poverty of Entire Affected Area (%)
High minority	32	5,612	26	61	43
Medium-to-high poverty	23	3,979	18	46	37

Conclusions

The analysis shows a high representation of minorities and poor people along the 210-mile stretch of PCB-contaminated spill area. Not too surprisingly, differences do exist depending on the denominator or the scale chosen. While high minority representation occurs in the affected areas, poverty is not as strongly evident. The demographics of the roadside spill area show a greater variety of communities affected simply because the area involved is far greater than that of the landfill.

Central factors in any study surround the scale of analysis and the questions asked. Analysis of county-level data shows the highest proportion of the area to be in the

transitional zone. The block group-level analysis shows a different pattern, with an almost equivalent distribution in the non-minority, transitional, and high-minority groups. The removal of county boundaries provides a clearer idea of the minority representation of the affected area.

An examination of minority and poverty zones in the original roadside spill areas shows a higher correlation between spill area and minority areas than between spill area and poverty. High-minority zones account for only approximately one-third of the entire area, but they contain one-fourth of the calculated total affected population and two-thirds of the nonwhite population. The medium-to-high poverty zones show fewer people being impacted. They constitute approximately one-fourth of the affected block groups, less than one-fifth of the total population, and more than one-third of all those living in poverty in the affected area.

The landfill occupies a relatively minimal area compared with the affected roadside spill area, which makes a realistic comparison difficult. The single block group surrounding the landfill is predominantly nonwhite (73%) with medium-to-high poverty. The roadside spill cleanup area shows high-minority communities composing approximately 32% of the 111 affected block groups across an area 80 times the size of the half-mile buffer of the Warren County PCB Landfill.

A non-homogeneous population distribution within a given block group may introduce error. Population tends to follow roadways, and the density of roads within the buffer will vary. In rural areas, houses flank roadways and are found within approximately 200 feet of the road. The issues raised by non-homogeneous distribution and varying road density will be addressed in further GIS and statistical analyses. The population estimates need further evaluation, especially when areas under investigation do not conform to typical reporting units.

The delineation of minority communities using the merged theories from the urban underclass and environmental justice debate presents a useful typology. However, the urban underclass and racial segregation theories are based upon studies of urban areas, not poor rural areas in the South. Further research should examine this linkage to further test its validity.

While the primary idea of the study was to see if PCB-contaminated soil was removed from non-minority zones and dumped in high minority areas, the results show that a range of communities was affected across the 14-county area of the original spill.

The assumption of increasing isolation and decreased political power does underlie the theoretical base of environmental equity studies, but the political landscape has been changing over the years. Indeed, the controversy over the Warren County PCB Landfill helped to change the political dialogue about the siting process. Questions that previously had not been asked now have become standard. The question of who lives where is now part of the process.

References

1. United Church of Christ Commission for Racial Justice. 1987. *Toxic wastes and race in the United States.* New York: United Church of Christ.
2. Bullard RD. 1990. *Dumping in Dixie: Race, class, and environmental quality.* Boulder: Westview Press.

3. US General Accounting Office. 1986. *Hazardous waste: EPA has made limited progress in determining the wastes to be regulated.* December 1986. Washington, DC: GAO/RCED-877-27.
4. Anderton DL, Anderson AB, Oakes JM, Fraser MR. 1994. Environmental equity: The demographics of dumping. *Demography* 31(2):229–48.
5. Massey DS, Denton NA. 1993. *American apartheid: Segregation and the making of the underclass.* Cambridge, MA: Harvard University Press.
6. Auletta K. 1982. *The underclass.* New York: Random House.
7. Wilson WJ. 1987a. *The truly disadvantaged: The inner city, the underclass, and public policy.* Chicago: University of Chicago Press.
8. Ottensmann JR. 1995. Requiem for the tipping-point hypothesis. *Journal of Planning Literature* 10(2):131–42.
9. Galster GC. 1990. White flight from racially integrated neighborhoods in the 1970s: The Cleveland experience. *Urban Studies* 27(3):385–99.
10. Kasarda JD. 1990. Structural factors affecting the location and timing of underclass growth. *Urban Geography* 19:21–40.
11. Johnson JH Jr, Oliver ML. 1991. Economic restructuring and black male joblessness in the US metropolitan areas. *Urban Geography* 12:542–62.
12. Johnson JH Jr, Oliver ML. 1990. Modeling urban underclass behaviors: Theoretical considerations. *Occasional Working Paper Series* 1(2).
13. US Department of Commerce. 1990. *Decennial Census of Population and Housing, Summary Tape File 3A (STF3A).* US Census Bureau. Washington, DC: US Government Printing Office.
14. State of North Carolina. 1980. Final Environmental Impact Statement, Removal and Disposal of Soils Contaminated with PCBs along Highway Shoulders in North Carolina. November 3. Raleigh, NC: DEHNR.
15. US Department of Commerce. 1983. *County and city data book 1983.* US Census Bureau. 10th ed. Washington, DC: US Government Printing Office.