Hazardous Waste Site Remediation, Neighborhood Change, and Neighborhood Quality

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We tested the hypothesis that neighborhoods with hazardous waste sites may no longer be undesirable places to live if they have been at least partly remediated. We collected 377 questionnaires (42% response rate) administered from within one-half mile of the number 1, 4, and 12 hazardous waste sites on the National Priority List (Superfund). These neighborhoods were rated higher quality than neighborhoods with unremediated hazardous waste sites and about the same as neighborhoods in northern New Jersey and the United States as a whole. Newer residents considered these formerly tainted areas to be opportunities to upgrade their housing and living conditions. Long-term residents retained the negative image of the blemished neighborhood. *Key words:* hazardous waste, locally unwanted land uses, neighborhood quality, remediation. *Environ Health Perspect* 102: 542–547 (1994)

The United States is expected to spend $750 billion and as much as $1.2 trillion during 1990–2020 to remediate active and inactive hazardous waste sites (1). Critics charge that these enormous costs are not balanced by evidence of health and environmental benefits (1–3). The responsible agencies need a process for calculating measurable benefits, especially improvements in public perception of affected neighborhoods which can be converted into increasing property values, retailing, and other direct and indirect social and economic benefits. The research reported here is a step in that direction. We applied an approach used by psychologists and social scientists to measure impacts on individuals. Rather than measure individual anxiety, depression, and other psychological and physical symptoms of stress (4,5), we concentrated on how these individuals translated their feelings into a neighborhood assessment.

We tested four hypotheses about the relationship between hazardous waste remediation, neighborhood change, and neighborhood quality. The conventional wisdom is to assume that neighborhoods with hazardous waste sites are not desirable places to live. Case studies of communities in California, Louisiana, Michigan, New Jersey, and New York with hazardous waste sites paint a picture of shocked, angry, and depressed people who want to escape their tainted neighborhoods (6–8). Economic analyses point to losses in property values, especially within one-quarter mile of sites (9–12). Yet there are reasons to suspect that many supposedly tainted areas may no longer be undesirable. Changes in neighborhood ratings have been documented (13,14). During the 1980s, the U.S. Environmental Protection Agency, state governments, and responsible parties began studies and initiated remediation at many abandoned hazardous waste sites. EPA has been criticized for moving slowly and for not consulting with local communities about cleanup plans (15). But it is plausible that remediation has eliminated the tainted neighborhood label. We hypothesized that Americans living near sites that had been substantially remediated (e.g., no longer imminent danger, no obvious odors, covered with a cap, grass, shrubs, and other barriers added to buffer the site) would rate their neighborhoods better than neighborhoods with sites that have not been remediated, and about the same as residents of neighborhoods in their region as a whole.

Based on studies of nuclear power stations, Greenberg et al. (16) argued that people who cannot tolerate living in a stigmatized neighborhood and can afford relocation will leave. They are replaced by new people who are less sensitive to the locally unwanted land use (LULU) and view relatively inexpensive housing as an opportunity to upgrade their living space and neighborhood. Our second hypothesis was that recent residents would not rate their new neighborhood as poor quality.

The neighborhood adjustment process leaves many angry long-term residents who feel trapped. They cannot dismiss the fears of health effects, nor can they forget the pervasive sights and smells and declining property values (6,8–10). Our third hypothesis was that longer-term residents (those who lived in the area when the site was first discovered) would identify the neighborhood with the tainted label and would rate the neighborhood as low quality.

Residents integrate neighborhood ele-ments they perceive as advantages (e.g., convenience to job and shopping, good schools, friends, nearby religious institutions, parks) and disadvantages (e.g., abandoned buildings, crime, unfriendly neighbors) (17–20). We expected hazardous waste sites to be more bothersome than other neighborhood characteristics because a hazardous waste site would be present in each area we studied. Abandoned housing, crime, and other stressors might not be present in each neighborhood. Yet, when present, other advantages and disadvantages would influence neighborhood rating. Our fourth hypothesis was that only long-term residents would focus on the nearby hazardous waste site as the underlying critical neighborhood characteristic. Other residents who did not like the neighborhood would focus on the site, crime, abandoned housing, and a variety of other characteristics which they found distressing.

Methods

Choice of Survey Questions

The U.S. Department of Commerce's biannual American Housing Survey for the United States (21) provided the format for our survey questions. The American Housing Survey (AHS) asks a sample of people about bothersome neighborhood conditions and for their overall neighborhood rating. The AHS does not include all the neighborhood characteristics present in our study areas. The AHS asks about the existence of odors or smoke, nonresidential land uses, motor vehicle noise and heavy traffic, litter, streets in disrepair, building conditions (two variables), and crime. Our neighborhoods had other characteristics that might bother people: periodic noise from airplanes and trains, uncontrolled animals, contaminated groundwater, traffic congestion, inadequate street lighting, unfriendly neighbors, utility towers with hanging wires, recreational areas that might attract vandals or disruptive people, areas subject to flooding, and, of course, at least one hazardous waste site.

Using the same format as the AHS, we added these 10 conditions to the eight already in the AHS. The 18 conditions

were randomly located on the survey instrument. The hazardous waste site was question number 13.

We used a five-point scale to measure three characteristics of the local hazardous waste site that typically disturb people: health effects, property devaluation, and sight, smell, and sound (10,22,23). Eight attributes that attract people to neighborhoods were listed as dichotomous variables. For example, we asked if they chose their neighborhood because it was convenient to their job. Convenience to friends and relatives, the availability of recreational facilities, public transportation and other services, good schools, and attractiveness of the neighborhood were included as dichotomous choices, as well as the availability of a dwelling unit at an affordable price.

We hypothesized that length of residence would influence neighborhood quality (hypotheses 2 and 3). However, other demographic characteristics influence people's perceptions of risk (10,18). Consequently, to fairly test our length of residence hypotheses, we also asked respondents to categorize their age, sex, educational achievement, and status as a home owner or renter. These demographic characteristics were independent variables in the statistical analyses.

Choice of Substantially Remediated Study Sites

We wanted to survey residents living near sites that had been considered sufficiently threatening to public health and the environment that they were listed among the highest priority on the U.S. EPA's National Priority List (NPL) of 1200 sites (Superfund). The sites had to be at least partly remediated and no longer could be perceived as continuing to pose a major threat to human health and the environment. We did not want to survey a neighborhood that had another obvious locally unwanted land use, such as a petroleum refinery or sewage plant, that would confound the role of the hazardous waste site.

After consulting with colleagues and state officials, we chose neighborhoods located next to three of the most controversial and highest-rated hazardous waste sites in the United States (24). The Lipari landfill is the number 1 site on EPA's NPL. Located in Mantua Township, New Jersey, the 16-acre site, formerly a sand and gravel pit, was converted into a waste disposal facility. Between 1958 and 1981, industrial and domestic wastes were disposed of at the site. Leachate migrated from the site into an adjacent creek that empties into a nearby lake. Aquifers beneath the site have been contaminated, including some potable groundwater wells

serving about 20,000 people (24,25). A New Jersey Department of Health study of people living within 1 km of the site was inconclusive. Some excess of adult leukemia and low birth weight babies were found. But normal or below-normal rates of other types of cancer were observed (26,27).

Homes are located within several hundred feet of the site, and new homes were being built about three-quarters of a mile from the site when we visited in mid-September and early October 1992. Except for warning signs, the area has the appearance of an affluent suburban neighborhood.

A record of decision, which is the agreed-upon methods chosen to remediate the site, was signed in June 1988. Initial site remediation consisted of a slurry wall and encapsulation by a synthetic membrane. This step reduced the unsightly appearance. A $16 million flushing system began operation in April 1992. In January 1993, three companies agreed to pay $52 million to partly pay for cleanup of contaminated creeks and marshes adjacent to the site (28).

The Helen Kramer landfill is located in Mantua Township, less than 5 miles from the Lipari landfill. Another former sand pit, the 66-acre site accepted liquid industrial waste, construction debris, septic tank pumpings, dewatered sewage sludge, hospital wastes, and municipal refuse during the 1960s. Leachate from the site contaminated both underground and surface water supplies (24). The Helen Kramer site is rated number 4 on the NPL.

The immediately surrounding area includes commercial food growing (pumpkins, corn, tomatoes), trailer parks, and scattered residential properties. We observed new developments under construction within one-half mile of the site.

The landfill was closed in 1981, and in 1985 the record of decision included groundwater and leachate collection and treatment, a slurry wall, removal of materials from leachate ponds, and construction of a clay cap over the 60-foot deep site. At the time of our visit, the $90-million remediation was nearly complete (29).

The Gloucester Environmental Management Services (GEMS) landfill covers a 60-acre site. Owned by Gloucester Township (New Jersey), the landfill accepted industrial and municipal waste for more than two decades. GEMS is ranked number 12 on the NPL. Ground and surface waters were contaminated.

Land use around this large site is mixed. We observed a firing range, children riding up and down the sides of the landfill on their mountain bicycles, new middle-income suburban housing, and expensive-looking housing with many for-

sale signs. Tractor noise and a sulfurlike, sweet smell were apparent.

After lengthy negotiations, settlement was reached with the responsible parties in 1989, which required capping the site, constructing a treatment plant on-site, bringing in a water line for homes whose wells were contaminated, and placing a fence around the site. The cost was approximately $40 million when we visited.

Overall, we chose three sites in southern New Jersey that should epitomize socalled "toxic time-bombs" that severely taint neighborhoods. But all have been substantially remediated and none have another obvious locally unwanted land use (LULU) nearby.

We summarize differences and similarities among the sites that undoubtedly influenced the results. Three elements were similar. The hazard was primarily water pollution. Each neighborhood did not have another obvious LULU, and the municipalities were all middle-income, primarily white neighborhoods. But there were obvious differences among the sites in visibility and site ownership and management. GEMS, the number 12 NPL site, appears more threatening than Lipari and Helen Kramer (numbers 1 and 4). It rises above the landscape, literally looms over some adjacent housing, and is not well shielded by trees. Lipari and Helen Kramer were both privately owned; GEMS was owned by the municipality, which was a principal responsible party. Furthermore, a controversy erupted at the GEMS site over use of state funds to pay for reduced property values (Singer G, personal communication, 1993). In short, we expected recovery of the perception of neighborhood quality to be most hindered at the GEMS site.

Seven Areas with Unremediated Sites

We compared the three study areas to seven areas we had surveyed 3 months earlier and to northern New Jersey and the United States as a whole (23). The seven neighborhoods are located in northern and central New Jersey 50 to 80 miles from the three sites in southern New Jersey.

There were three important differences between the two sets of sites. The first survey was made at seven sites with much lower NPL ratings (range 59–275) than those in our second survey (1, 4, and 12). Despite the much higher NPL ratings of the three sites in the second survey, we expected them to have higher neighborhood quality ratings for two reasons. First, much more site remediation has been done at the three sites in the present survey, and there has been extensive consultation between the federal and state agencies and the local populations. In addition, many of the sites in the seven-site survey had multiple

LULUs (e.g., sewage plants, oil and chemical tank farms, quarries, factories, major highways, adjacent airports, etc). We expected these facilities to dampen neighborhood enthusiasm, even in neighborhoods with remediated hazardous waste sites.

The AHS conducted a survey of northern New Jersey in 1987 (30). We provide these data, as well as data for the United States as a whole, to address the first hypothesis (neighborhood rating is not low). The northern New Jersey and U.S. data are not suitable for hypotheses 2–4 because we gathered considerably more data about neighborhoods than the AHS.

We used almost exactly the same questionnaire and the same protocol for distributing the survey in both studies. The difference between the survey instruments was that our three-site survey had eight questions about neighborhood characteristics that would attract people to the area. The earlier survey did not have these questions.

The cover letter, survey instrument, and a stamped return envelope were inserted into a brown envelope. We placed an envelope in every residential mailbox within one-half mile of each site. When the neighborhood was cut off by a major highway or nonresidential land use, we stopped distributing the instrument at that point. We distributed 332 questionnaires at the GEMS site, 233 at Helen Kramer, and 335 at Lipari. The comparison survey was done in areas with fewer homes. We distributed over 200 surveys in only 1 neighborhood, and less than 50 were distributed in 2 of the 7 (see Table 1 for details).

Statistical Methods

The first three hypotheses (neighborhood rating is not low, newer residents rate neighborhood excellent, long-term resi-

dents rate neighborhood poor quality) were tested by calculating average values and 95% confidence limits and comparing the averages. We used stepwise multivariate discriminant analysis to enhance the understanding of the interrelationship of neighborhood quality, neighborhood characteristics, and respondent characteristics. Respondents' ratings of their neighborhood as excellent, good, fair, and poor were selected as the categorical dependent variable for the fourth hypothesis (multiattribute causation of neighborhood quality ratings).

Discriminant analysis chooses the independent variables that most strongly discriminate among the categorical dependent of neighborhood quality. For purposes of the discriminant analyses, we aggregated fair and poor ratings into a single group because only nine respondents rated their neighborhoods as poor. The dependent variable had three categories: excellent (128 or 34%), good (197 or 52%), and fair/poor (52 or 14%).

The independent variables were the 18 neighborhood characteristics, the 8 factors that might attract people, and the 5 demographic characteristics. In addition, each respondent's site was recorded as a dichotomous variable (1 or 0) to capture unique characteristics of the site.

Results

We distributed 900 surveys in late September and early October 1992. A total of 377 usable surveys were returned by the end of 1992. The 42% response rate substantially exceeded the return of the typical mailed survey (31). The response rate was 40% at GEMS (132 of 332), 34% for the Helen Kramer area (80 of 233), and 49% at Lipari (165 of 335). The earlier survey had a response rate of 32% with a range of 24–42%. We cannot account for the vary-

ing response rates. We found no correlation of response rate with socioeconomic status, age of the population, and type of housing.

Using the census tracts hosting the 10 waste sites and the 1990 United States census data (32) to represent the population of residents, we found that the 683 respondents were not representative of the population of the census tracts. Seventy-eight percent of area residents graduated high school compared to 93% of respondents ($p < 0.01$); 51% were female compared to 58% of respondents ($p < 0.01$); 69% of census tract residents were home owners compared to 81% of respondents ($p < 0.01$); 24% were 18–30 compared to 15% of respondents ($p < 0.01$); and 9% of residents were more than 70 years old compared to 7% of respondents ($p < 0.05$). Overall, our respondents were more likely to be more educated, home owners, female, and between the ages of 31 and 70. We present the results in the order of the four hypotheses. To simplify the terminology, we refer to the 377 respondents to our survey as the samples.

Quality of Neighborhoods

Table 1 shows that 86% of the samples rated their neighborhoods as excellent or good. This proportion is almost identical to northern New Jersey (88%) and the United States as a whole (85%). More important, it is higher ($p < 0.05$) than the seven-site survey respondents (64%). Thirty-four percent of the samples rated their neighborhoods as excellent, compared to 15% of the residents surveyed in the previous study. The corresponding percentages of residents who rated their neighborhoods "fair" were 11% and 31%.

There were major differences among the three sample sites. Almost all Lipari respondents considered their neighborhood excellent (53%) or good (43%). More Helen Kramer and GEMS respondents rated their areas fair and fewer rated them excellent ($p < 0.05$). Indeed, a larger proportion of residents of the Lipari area (the site of the highest ranked NPL site) rated their neighborhood as excellent than did residents of northern New Jersey and the United States as a whole. Overall, these results are consistent with our expectation that neighborhoods with substantially remediated sites are no longer considered to be undesirable places to live.

Length of Residence

We observed the expected strong association between length of residence, neighborhood quality, and the presence of the hazardous waste site (Table 2). Fifty-seven percent of recent residents (< 2 years) rated their neighborhood as excellent compared to only 26% of long-term ones (>10 years)

Table 1. Neighborhood quality ratings (percent of reported respondents)

Rating	Three neighborhoods[a]				Seven neighborhoods[b]	Northern NJ 1987	USA, 1981–89[c] (avg)
	Total	GEMS	Helen Kramer	Lipari			
Excellent	34.0 (29.2–38.8)[d]	14.4 (8.4–20.4)	26.3 (16.7–35.9)	53.0 (45.4–60.6)	15.0 (11.0–19.0)	37.1	35.6
Good	52.3 (47.3–57.3)	62.1 (53.8–70.4)	53.8 (42.9–64.7)	43.4 (35.9–50.9)	49.2 (43.6–54.8)	50.7	49.0
Fair	11.4 (8.2–14.6)	18.2 (11.6–24.8)	17.5 (9.2–25.8)	3.6 (0.8–6.4)	31.0 (25.8–36.2)	9.7	13.0
Poor	2.4 (0.1–3.9)	5.3 (1.5–9.1)	2.5 (0.0–5.9)	0	4.6 (2.3–6.9)	2.6	2.5

[a]Based on 377 valid responses from three neighborhoods.
[b]Based on 306 valid responses from seven neighborhoods. For each municipality, the numbers of surveys received and distributed were as follows: Bayonne (42/100), Bound Brook (13/38), Brick (51/150), Bridgewater (11/42), Linden (62/170), Sayreville (72/295), and Toms River (55/155).
[c]Source of data: U.S. Department of Commerce, selected years (27). In 1981 and 1983, the U.S. surveys used the same categories that we used. In 1985, 1987, and 1989 the U.S. government survey used a 10-point scale.
[d]95% confidence limits in parentheses.

($p < 0.05$). In contrast, fewer than 6% of recent residents rated their neighborhoods as fair or poor compared to 18% of long-term residents. Respondents who had lived in the neighborhood for 2–10 years fell between the two poles in neighborhood rating.

The association of length of residence and neighborhood quality with hazardous waste sites is also shown in Table 2. Fewer than 6% of recent residents wanted to leave as a direct result of the hazardous waste site compared to 27% of long-term residents ($p < 0.05$). The data show that these findings cannot be explained by newer residents (< 2 years) not knowing that a hazardous waste site exists in their neighborhood.

The availability of inexpensive housing seems to have played a central role in attracting newcomers. Seventy-seven percent (41 of 53) of new residents (< 2 years) indicated that housing was an important consideration in attracting them to the area, compared to 61% (90 of 148) long-term residents (>10 years) ($p < 0.05$). About 50 of the 377 respondents appended state-ments to their questionnaires to explain why they moved to the area. The availability of inexpensive housing was mentioned more often than all the other factors combined: 12 who moved to the GEMS area, 9 near the Helen Kramer site, and 10 to the vicinity of Lipari. A newcomer to the GEMS area noted the role of inexpensive housing: "I was only able to buy a house and property because it's adjacent to the landfill."

Our findings that these neighborhoods are not viewed as tainted by middle-class Americans is supported by other sources. For example, in 1980 the median sales price of a home in Mantua Township was 99% of the county value (*11*). In 1985, after the Lipari and Helen Kramer sites were declared Superfund sites, the median sales price slipped to 96% of the county's; that is, prices initially dropped after the sites were officially declared Superfund sites. Housing bargains were clearly available during the early 1980s. But by 1988, Mantua's housing prices were back up to 99% of the county's. In other words, once remediation had begun, records of decision had been signed, and the major problems of odors, fires, and appearance had been addressed, property values increased. Furthermore, these two sites have not permanently disrupted sales. For example, the number of homes sold in Mantua decreased from 85 in 1980 to 77 in 1985, but jumped to 111 in 1988. The township tax assessor confirmed our data and added that he knew of only one housing development that was abandoned because of the sites. Furthermore, he added that Mantua had 36% of the new county (Gloucester) housing construction in 1992. In other words, this township with the number 1 and number 4 NPL sites in the United States was once again seen as a good place to live by middle-class Americans.

Multiple Attributes of Neighborhood Quality

The hazardous waste site was the most bothersome characteristic at each site (Table 3). It distressed 46% of all respondents. Hazardous waste sites were more than twice as likely to bother respondents than polluted water and dogs, cats, and other uncontrolled animals. Eighteen percent of respondents wanted to leave as a result of the hazardous waste site. Polluted water (6%), odors or smoke (5%), and factories, businesses, and other nonresidential activities (5%) were the most important reasons for wanting to leave the area. Respondents living near the seven sites in the previous study were more distressed by 16 of the 18 characteristics listed in Table 3. Even though the three sites in the present study have much higher NPL scores than the seven sites, 33% of respondents living near one of the seven sites wanted to leave as a result of the hazardous waste site compared to 18% living near the three sites in the present study.

Table 2. Length of residence, neighborhood quality, and hazardous waste site[a]

Characteristic	% Residing		
	<2 years	2–10 years	>10 years
Neighborhood rating			
Excellent	56.6	33.5	26.4
	(42.3–69.9)	(26.5–40.3)	(19.3–33.5)
Good	37.7	54.0	55.4
	(24.6–50.7)	(46.6–61.4)	(47.4–63.4)
Fair	5.7	10.8	14.2
	(-0.05–11.9)	(6.2–15.4)	(8.6–19.8)
Poor	0	1.7	4.1
		(-0.2–3.6)	(0.9–7.3)
Want to leave as a result of the hazardous waste site	5.7	14.2	27.0
	(0.1–11.9)	(9.0–19.4)	(19.8–34.2)

[a]Based on 377 valid responses; 95% confidence limits in parentheses.

Table 3. Bothersome characteristics of three and seven neighborhoods (percent of reporting respondents)

Characteristic	Characteristic is bothersome		Wants to move because of characteristic	
	Three	Seven	Three	Seven
Sites with hazardous wastes	45.6	49.5	18.0	33.2
Polluted water	18.6	20.2	6.1	13.3
Dogs, cats, or other uncontrolled animals	17.0	21.6	1.9	7.9
Inadequate street lighting	15.1	13.7	1.6	3.3
Motor vehicle noise and heavy traffic	14.1	25.3	3.7	14.7
Odors or smoke	11.9	36.3	5.3	22.0
Litter or trash in streets, empty lots, or properties	11.7	22.5	2.7	8.8
Abandoned or boarded-up buildings	11.1	5.9	1.9	1.6
Traffic congestion	10.3	17.9	3.2	10.7
Streets, roads, and sidewalks in disrepair, or open ditches	9.8	16.0	2.7	4.9
Factories, businesses, electrical power, sewage treatment, or other nonresidential uses	8.2	23.2	5.3	15.6
Unfriendly neighbors	7.4	12.7	4.2	9.5
Occupied buildings in poor or dangerous condition	4.8	14.7	1.3	6.5
Crime	3.2	5.2	1.9	3.9
Noise from airplanes or trains	3.2	22.8	0.8	9.8
Flooding	2.9	5.9	0.2	2.9
Right-of-way for a utility	2.7	3.4	1.6	2.5
Recreational facilities that attract noisy/rowdy people	2.4	8.5	0.8	3.7

Discriminant analysis is a systematic way of capturing the association among multiple neighborhood characteristics. The 17 variables listed in Table 4 were all statistically significant discriminators at $p < 0.01$. They were ordered by their F-value. A high value of F means that the among-group variance is greater than the within-group variance, which means that the independent variable significantly discriminates among one or more groups. Correlations between the two discriminant functions and the 17 variables help us understand respondents' aggregate evaluation of the quality of their neighborhoods. Variables with a correlation of >0.25 with at least one of the two discriminant functions are reported.

The first discriminant function contrasts respondents who rated their neighborhood as poor with those who rated their neighborhood as excellent. It describes people who judge their new neighborhood to be worse than their previous one ($r = 0.460$). These respondents were distressed by the hazardous waste site ($r = 0.293$), especially odors ($r = 0.322$) and health impacts ($r = 0.273$). Yet they were also concerned about nine other local conditions, such as factories and nonresidential activity ($r = 0.522$), streets and roads in need of repair ($r = 0.410$), and traffic and noise associated with motor vehicles ($r = 0.389$). In other words, respondents who rated their neighborhood as poor or fair were likely to be distressed by the hazardous waste site and by nine other neighborhood characteristics. One resident of the Helen Kramer area summarized the distress felt by many of those who rated their neighborhoods as poor or fair: "We moved from Philadelphia. We loved the fresh air and single-family homes. The landfill, noisy neighbors, motorcycles and souped-up cars destroyed our tranquil neighborhood."

On the other hand, many respondents who rated their neighborhood as excellent reported few, if any, of these as disturbing characteristics. Many of these people commented that they liked the small-town atmosphere, the low crime rate, good schools, and nearby friends and neighbors. Overall, the first discriminant function epitomizes the way Americans consider a variety of factors, not just one, when they evaluate their neighborhoods.

The second discriminant function focuses on the distress felt by residents of the GEMS area. These people have continued to focus on the impact of the hazardous waste site on their quality of life. The function contrasts residents of the GEMS area ($r = 0.488$), many of whom were long-term residents ($r = 0.280$), who were disturbed by reduced property value

Table 4. Factors associated with respondents' views of present neighborhood: results of discriminant analysis[a]

Factor	F-value	Function names and correlations	
		Poor/excellent	GEMS/Lipari
Present neighborhood is worse	41.6	0.460	
Hazardous waste site	41.2	0.293	0.341
Factories, businesses, etc.	38.1	0.522	
Motor vehicle noise and heavy traffic	38.1	0.389	
Lipari site	34.4		−0.568
Traffic congestion	31.0	0.363	
Hazardous waste site and odors	30.8	0.322	
Hazardous waste site and property value	27.8		0.402
GEMS site	22.5		0.488
Odors or smoke	21.5	0.314	
Unfriendly neighbors	21.3	0.286	
Streets/roads need repair	19.5	0.410	
Hazardous waste site and health	19.0	0.273	
Occupied buildings in poor condition	18.0	0.303	
Inadequate street lighting	12.8	0.356	
Airplane and train noise	10.3	0.284	
Longer-term resident	8.7		0.280

[a]All variables shown have a p-value of <0.001 and a correlation of r>0.25 with at least one function.

caused by the hazardous waste site ($r = 0.402$), with residents of the Lipari area ($r = -0.568$) who were newer residents and not disturbed by reduced property values. We quote two residents of the GEMS area who illustrate the frustration felt by many residents of the area: "I moved from Philadelphia to escape a bad neighborhood 10 years ago. I am extremely disturbed by the site. We did not know about the landfill." The second resident stated, "I was advised that the landfill was a ski mountain being built by public officials."

Discussion

More than a decade has passed since the initial Superfund legislation was passed. We expected that hazardous waste sites would no longer be horrifying blemishes in neighborhoods where a legitimate effort has been made to remediate, where there are not many other distressing neighborhood characteristics, and where sufficient time has passed for many of the angry people to leave and be replaced by newcomers untainted by the past and attracted by relatively inexpensive housing. In other words, neighborhoods with hazardous waste sites, even formerly highly controversial sites, might be considered attractive places to live.

We found that the residents living within one-half mile of three of the most prominent NPL sites in the United States rated their neighborhood about the same as residents of northern New Jersey and the United States as a whole. A disproportionate number of recent residents rated the neighborhoods as high quality. In strong contrast, long-term residents disproportionately rated their neighborhood as fair or poor quality. These results are consistent with our hypotheses that newer residents often

got land and housing at bargain prices and saw a Superfund site that was covered, looked green, smelled less, if at all, and in other ways was less of an eyesore than it had been a decade earlier. Again, in sharp contrast, the low neighborhood quality ratings of long-term residents are consistent with our hypothesis that they cannot dismiss the anger caused by lower property values, fears of health effects, odors, and community disruption caused by the site.

The hazardous waste site was mentioned as bothersome much more often than any other neighborhood characteristic, as expected. In particular, long-term residents of the GEMS site who were concerned about declining property values rated their neighborhoods as fair or poor. Yet, as expected, neighborhood quality was not determined solely by the presence of a hazardous waste site. Those distressed by the hazardous waste site were often distressed by other neighborhood characteristics. Those not distressed by the hazardous waste site tended not to be distressed by other characteristics.

This pilot study has implications for research. First, this study was designed for highly ranked NPL sites without other major locally unwanted land uses nearby. The design should be replicated in other states with major isolated NPL sites. Researchers with more funding than was available for this project should do multiple mailings to increase the response rate. They should also consider open-ended surveys to capture the images of residents of neighborhoods with hazardous waste sites. For example, we recently conducted 54 open-ended interviews at the GEMS and Helen Kramer sites. Respondents were asked to share their feelings about "terrible" and "great" neighborhoods, the char-

acteristics of a terrible neighborhood, and the characteristics of their own neighborhood.

Second, the hypotheses should be tested for other kinds of controversial facilities, such as active hazardous waste sites that have been remediated, and active and abandoned refineries, manufacturing facilities, power stations, and other land uses that are widely assumed to distress residents. We recommend focus panels of community residents to enable researchers and policy-makers to gain insights about community psychology, social networks, support groups, and other factors that are not possible to obtain from a survey instrument.

Third, we do not know the impact of choosing all New Jersey sites on the applicability of the results to other states. New Jersey's hazardous waste management program is rated among the best in the United States (*33*). The strength of the state's program should mean more rapid control of sites. Yet in the short run, an aggressive remediation program increases public awareness and sensitivity to the problem. We suggest caution about generalizing the results to other situations. Replications are needed in other states.

This research has implications for those charged with remediating hazardous waste sites. The U.S. EPA and U.S. Departments of Defense and Energy have developed complex procedures to prioritize hazardous waste sites for remedial action. They conduct preliminary risk analyses at every site and may spend considerable time and resources on quantitative risk assessments at the potentially most dangerous sites (*34,35*). EPA is charged with monitoring welfare, as well as health and environment. The Agency for Toxic Substances and Disease Registry is charged with examining the impact of hazardous waste sites on quality of life (*36*). However, the federal agencies have not attempted to measure quality of life, welfare impacts, and benefits of remediation at each site. This study provides initial support for the conclusion that remediating sites in neighborhoods without other major LULUs will lead to benefits in the form of improved neighborhood quality. We urge the federal agencies to consider a method such as the one demonstrated here to gather data in support of their hazardous waste remediation mission.

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