Price Effects of Landfills on House Values

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ABSTRACT. *There is debate on the extent to which landfills impact on nearby single-family homes. This article applies an empirical model to estimate the price effects of one Minnesota landfill on the value of 708 nearby homes during the 1980s. Empirical results indicate that the landfill adversely affected home values in the range of 12 percent at the landfill boundary and 6 percent at about one mile. Beyond about 2–2.5 miles adverse effects are negligible. The findings have important implications for the siting of new landfills near residential areas and in areas within the path of future development.*

I. INTRODUCTION

The effects of certain land uses on residential property values has long been of interest in the public policy arena. Generally speaking, where neighboring or nearby land uses are such that they impose negative price effects on residential property value, nuisance claims are made and sometimes awards are given through the courts or other means. Forms of nuisance can include noise, flies and other insects, hours of operation, traffic, odors, debris located both on the nuisance property and drifting off the property, and appearance. The possibility that some land uses will have negative price effects on residential property drives the land use planning process to physically separate those land uses by such measures as distance, setbacks, and buffering. Sometimes some land uses that are perceived to have negative price effects are banned from the community altogether. In the real estate market people are willing to pay higher prices for sites that are not affected by nuisances than for sites affected by nuisances (Crecine, Davis, and Jackson 1967).

Landfills are commonly considered a form of nuisance. They are places of activity involving trucking, dumping, filling, sorting, spraying, operation of heavy equipment, and noise. In their search for sites for housing, families tend to equate landfill proximity with diminished environmental quality or quality of life. Given a choice between two sites offered for the same price and identical in every respect except that one is closer to a landfill, home buyers will choose the site that is farther away. Only when the closer site is offered for less money will families consider the closer site a suitable alternative. At some lower market price of the closer site, home buyers will become indifferent in choosing between that site and a higher priced one farther away from the landfill.

Literature indicates that environmental features can increase land and house value if they are viewed as attractive or desirable, or they can reduce values if they are viewed as nuisances or undesirable. Ambient noise levels increased by point-sources can reduce nearby urban residential property values (Li and Brown 1980). Air quality reductions associated with point source emissions can reduce nearby residential property value (Ridker and Henning 1967). Urban residential development can reduce nearby agricultural land value (Nelson 1986).

The effect of landfills on residential property values is a subject of debate. Some literature indicates negative effects while other literature indicates positive effects.

Using a sample size of 182 single-family

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homes near five landfills near Fort Wayne, Indiana, Havlicek (1985) found that a house located one mile closer to a landfill than a similar house would be valued about $3,640 less. House price rose about 5 percent per mile away from the landfill.

Adler et al. (1982) studied the price effects of proximity to a hazardous waste site in Pleasant Plains, New Jersey. That operation contaminated local water supplies, a condition which became evident after 1974. Their study evaluated house sales before 1974 (before contamination was known) and after 1974 (when contamination became evident). For homes within 1.5 miles of the landfill, there was no significant change in sales prices before or after 1974, indicating that the landfill impacted prices equally. Between 1.5 miles and 2.25 miles there was about a 10 percent difference in price change between homes sold before and after 1974. For sales after 1974, distance from the landfill was a significant predictor of price effects out to 2.25 miles from the landfill. The mean price effect was found to be $2,700 per mile.[1]

Gamble et al. (1982) evaluated the effects of the large Boyertown Landfill on nearby home values in Montgomery County, Pennsylvania, during the period 1977–79. They limited their investigation to a one mile radius around the landfill, theorizing that home prices farther away would not be substantially affected. While showing that the landfill had a negative effect on property values, the results were not statistically significant perhaps for a variety of reasons.[2] First, they did not include a large enough area away from the landfill to adequately measure variation in house prices that could be attributable to landfill proximity. Second, their sample size was only 137. Third, most cases were grouped near the outer edge of the one mile zone, which means there was only limited variation in the distance variable for this limited set of homes.

In a study done for Browning Ferris, Industries, one of the nation's largest operators of landfills, Research Planning Consultants, Inc. (1983) evaluated price and development effects of landfills on residential properties at four sites located in Houston, Texas, Baltimore, Maryland, Minneapolis, Minnesota, and Atlanta, Georgia. They did not find that landfills imposed negative price effects and, indeed, in some situations they found that landfills actually increased property values and were associated with greater residential development. However, they did not clarify at what stage of the life of the landfills the study was conducted. Near the latter stages of life of a landfill, after property values have already dropped, prices may rise because of future expectations of the positive benefits from closed and covered landfills.

Pettit and Johnson (1987) indicate that where a landfill is located in remote areas, the extension of infrastructure to accommodate the landfill actually attracts residential development towards it. Cartee (1989) concludes that there is little empirical evidence to suggest that landfills impose negative price effects, although he also admonishes that many studies including his own are limited because of a dearth of sales data.

There is, thus, debate on the extent to which landfills impact on nearby single-family homes. This article contributes to that debate. It develops and applies an empirical model to estimate the price effects of one landfill located in Minnesota on the value of more than 700 single-family homes, located within two miles of that landfill, sold during the 1980s. It is the most comprehensive study reported to date on price effects of landfill distance on single-family homes.

II. METHODOLOGY AND APPLICATION

As in any model estimating the price effects on single-family homes of distance to

[1] For sales after 1974, there was no statistical association between value of homes sold inside versus outside of the contamination zone.

[2] Interestingly, the price effect indicated a reduction in value of about $4,266 per mile, or about 5 to 7 percent. This is roughly equivalent to the other studies noted above.

an object causing nuisance or benefit, the model used in this analysis isolates the influence of landfill distance on house price after controlling for attributes of the house, lot, location, and other features:

$$V_i(t) = a_0(t) + \sum_{j=1}^{n} b_j(t)X_{ij}(t) + b_k LF_i = e_i \quad [1]$$

where:

$V_i(t)$ = value of house i at time t;
$X_{ij}(t)$ = contribution of individual attributes to value at time t;
LF_i = distance of the house i from the landfill; and
e_i = error term.

If landfill proximity influences house value negatively, the first-order relationship of house price with respect to distance from landfill is:

$$dLF_i/dV_i(t) > 0 \quad [2]$$

which means that house price rises with respect to distance away from the landfill.

The model is applied to analysis of the single-family house sales price effects of a landfill located in Ramsey, Minnesota. The Anoka Regional Landfill in Ramsey has been accepting solid waste since 1967. It has a permit to allow operations into the 1990s. It receives up to and sometimes more than 500 tons of waste per day. Minnesota state officials have allowed operations to continue and expand. While the area around the landfill was open country when operations commenced, development now comes near the boundary of the landfill.

The Ramsey landfill was selected for a variety of reasons. First, it is set amidst a suburbanizing landscape near a major urban area, Minneapolis–St. Paul. Second, the terrain is relatively flat and lightly wooded. Third, the landfill is operating under substantial regulatory constraints principally aimed at minimizing adverse effects on nearby property value (Genereux 1989). Fourth, the landfill has been operating since 1967 and will continue into the 1990s. The study period for this analysis extends from 1979 through 1989. Fifth, the landfill affects a reasonably homogeneous housing market. This affords reasonable estimation of purely distance effects on house prices where houses are roughly similar across the entire study area.

Data for the analysis come from the Anoka County Property Assessor, the Anoka County Board of Realtor's Multiple Listing Service (MLS), city and county plat maps, city and county highway maps, and site investigations (primarily to assess tree cover on house sites that may block landfill views).

The analysis proceeded in two phases. In the first, the price effect of landfill proximity was estimated by one-half mile increments of concentric zones. This was done to determine at what distance landfill price effects were statistically insignificant. This distance was found to be somewhere between 2.0 and 2.5 miles. The second phase, which is reported here, uses actual distance from the landfill center out two miles. The empirical model developed for this analysis is:

$$\begin{aligned} PRICE_i = a_0 &+ b_1 AGE + b_2 BDRMS \\ &+ b_3 BTHRMS + b_4 DI\text{-}694 \\ &+ b_5 FF + b_6 FIREPL \\ &+ b_7 SMALLLOT + b_8 SALEYR \\ &+ b_9 STYLE20 + b_{10} STYLE50 \\ &+ b_{11} TREES + b_{12} DFILL + w \end{aligned}$$

where

$PRICE_i$ = sales price of house i as reported in the MLS records;
AGE = age of the house in years as indicated in the MLS records;
$BDRMS$ = number of bedrooms as indicated in the MLS records;
$BTHRMS$ = number of bathrooms as indicated in the MLS records;
DI-694 = distance of the center of

property i to the nearest interchange with Interstate 694 to the nearest one-twentieth of a mile as measured from city and county maps;

FF = the square feet of the house foundation as measured by the exterior walls (in effect living square feet on the first floor) as indicated in the MLS records;

FIREPL = number of fireplaces (not woodstoves) as indicated in the MLS records;

SMALLLOT = whether the parcel is less than one acre, which is also a proxy for presence of public water and sewer, as indicated in the MLS records (1 if yes, 0 if no), where the lot sizes range between less than one-half acre to less than two acres (larger acreage lots are not evaluated to maintain reasonable homogeneity);

SALEYR = year of transaction as indicated in the MLS records;

*STYLE*20 = whether the house was of two full floors as indicated in the MLS records (1 if yes, 0 if no);

*STYLE*50 = whether the house was of three or more full floors as indicated in the MLS records (1 if yes, 0 if no);

TREES = categorical tree cover where 0 is no cover, 1 is very few, mostly young trees, 2 is several but mostly young trees, 3 is coverage of property by usually immature trees, and 4 is nearly complete tree canopy with mature trees, as determined from windshield surveys (admittedly more subjective than we would have liked);

DFILL = distance of the center of property i to the center of the landfill to the nearest one-twentieth of a mile as measured from city and county maps;

w = stochastic disturbance.

Of principal interest is whether $b_{12} > 0$, which would indicate that the mean property value rises with respect to distance from the landfill. The null hypothesis is that there is no significant association between house price and landfill proximity, all other factors considered.

Ordinary least squares regression is used. It is applied to all 708 sales of houses observed from 1979 through 1989 between 0.35 and 1.95 miles of the center of the landfill. Regression results are reported in Table 1. The descriptive statistics are reported in Table 2. The matrix of correlation coefficients (Pearson correlations) are reported in Table 3. The adjusted coefficient of determination (R^2) is 0.573 and the F-ratio is 80.188 ($p > 0.000$).

The sign on the landfill distance variable is in the expected direction, and the coefficient is significant beyond the 0.01 level of the one-tailed t-test. The magnitude clearly shows that mean house value rises the farther away from the landfill it is, all other factors considered. In particular, house value rises by nearly $5,000 for each mile it is located away from the landfill. On a percentage basis, house value rises by about 6.2 percent per mile from the landfill.

III. IMPLICATIONS

The empirical results indicate that the landfill adversely affects single-family house values in the Ramsey, Minnesota area to a distance of about two miles. Beyond about two miles, there is little if any adverse price effect. This has certain implications for the siting of new landfills. The results also indicated that landfill proximity is associated with a reduction in house value of perhaps more than 12 percent at

TABLE 1

RAMSEY, MINNESOTA, HOUSE SALE ANALYSIS: LINEAR REGRESSION RESULTS WITH RESPECT TO LANDFILL DISTANCE

Dependent Variable: *PRICE*

Variable	Coefficient	Standard Error	Standard Coefficient	Tolerance	*t*	*P*(1-tail)
CONSTANT	−166194.466	20003.448	0.000		−8.308	0.000
AGE	−204.745	92.066	−0.061	0.7896960	−2.224	0.013
BDRMS	−2499.788	707.367	−0.107	0.6594665	−3.534	0.000
BTHRMS	14239.881	1025.489	0.428	0.6347619	13.886	0.000
DFILL	4896.297	1160.251	0.115	0.8145561	4.220	0.000
DI-694	−635.387	325.504	−0.056	0.7429921	−1.952	0.026
FF	41.314	3.057	0.398	0.6970723	13.514	0.000
FIREPL	2290.754	909.205	0.074	0.7051258	2.520	0.006
SMALLLOT	807.899	1066.072	0.021	0.7932588	0.758	0.225
SALEYR	2121.608	210.664	0.263	0.8823538	10.071	0.000
*STYLE*20	4186.224	1028.881	0.113	0.7848099	4.069	0.000
*STYLE*50	3620.194	2198.845	0.043	0.8792989	1.646	0.050
TREES	340.109	473.184	0.020	0.7425526	0.719	0.237

Analysis of Variance

Source	Sum-of-Squares	DF	Mean-Square	*F*-Ratio	*P*
Regression	.139784E+12	12	.116487E+11	80.188	0.000
Residual	.100960E+12	695	.145266E+09		

N	708
Multiple *R*	0.762
Squared Multiple *R*	0.581
Adjusted Squared Multiple *R*	0.573
Standard Error of Estimate	12052.639

TABLE 2

RAMSEY, MINNESOTA, HOUSE SALES ANALYSIS: DESCRIPTIVE STATISTICS (Total Observations: 708)

	PRICE	*AGE*	*BDRMS*	*BTHRMS*	*DFILL*
N of Cases	708	708	708	708	708
Minimum	36000.000	0.100	1.000	1.000	0.350
Maximum	187400.000	49.000	9.000	4.000	1.950
Mean	74318.294	6.315	2.768	1.371	1.430
Standard Deviation	18453.037	5.540	0.789	0.555	0.433

	DI-694	*FF*	*FIREPL*	*SALEYR*	*SMALLLOT*
N of Cases	708	708	708	708	708
Minimum	6.000	704.000	0.000	80.000	0.000
Maximum	16.000	2358.000	2.000	89.000	1.000
Mean	13.705	1088.064	0.410	85.542	0.650
Standard Deviation	1.616	177.595	0.594	2.291	0.477

	*STYLE*20	*STYLE*50	*TREES*
N of Cases	708	708	708
Minimum	0.000	0.000	0.000
Maximum	1.000	1.000	4.000
Mean	0.555	0.051	1.458
Standard Deviation	0.497	0.220	1.112

TABLE 3

RAMSEY, MINNESOTA, HOUSE SALES ANALYSIS: PEARSON CORRELATION MATRIX
(Number of Observations: 708)

	PRICE	*AGE*	*BDRMS*	*BTHRMS*	*DFILL*
PRICE	1.000				
AGE	−0.078	1.000			
BDRMS	0.127	0.171	1.000		
BTHRMS	0.566	0.025	0.429	1.000	
DFILL	0.217	−0.194	−0.046	0.037	1.000
DI-694	−0.229	0.171	0.170	−0.047	−0.389
FF	0.511	0.094	0.324	0.395	−0.001
FIREPL	0.302	0.194	0.371	0.372	0.059
SALEYR	0.225	−0.079	−0.253	−0.107	0.114
SMALLLOT	−0.010	−0.327	−0.082	−0.067	0.165
*STYLE*20	0.134	−0.042	−0.183	0.109	0.073
*STYLE*50	0.110	−0.056	0.068	0.114	0.040
TREES	0.249	0.278	0.229	0.296	0.040

	DI-694	*FF*	*FIREPL*	*SALEYR*	*SMALLLOT*
DI-694	1.000				
FF	−0.025	1.000			
FIREPL	−0.009	0.369	1.000		
SALEYR	−0.167	−0.110	−0.163	1.000	
SMALLLOT	−0.257	−0.138	−0.062	−0.034	1.000
*STYLE*20	−0.139	−0.215	0.010	0.115	0.087
*STYLE*50	−0.109	0.148	0.046	−0.080	−0.005
TREES	0.006	0.293	0.337	0.022	−0.260

	*STYLE*20	*STYLE*50	*TREES*
*STYLE*20	1.000		
*STYLE*50	−0.259	1.000	
TREES	−0.015	−0.026	1.000

the landfill boundary and about 6 percent at a distance of about one mile from the landfill boundary.

The analysis is consistent with theoretical expectations and is consistent with many previous empirical studies. Two interesting and important implications emerge. First, this paper demonstrates that at perhaps less than 2.5 miles from the center of a landfill, residential property value will likely be adversely affected. Beyond this distance those effects may not be observed. This has implications for landfill siting around the nation since it confirms reports of other researchers.

Second, within at least two miles, the price effects of landfill proximity on middle income, relatively homogeneous housing markets are such that house value rises about 6 percent per mile from the landfill to about two miles. Work reported here combined with other studies seems to demonstrate this reasonably constant relationship. This reduction in house value is not trivial. A $100,000 home built within one mile of the proposed landfill the day before landfill operations commence would lose $6,000 the day after.

The price effects of landfills on single-family house values estimated from the case studies presented here are common to many other landfills as shown in the literature review. In some instances, landfill operators have realized that nearby property values will suffer because of landfill proximity. For example, Genereux (1989) observed that managers of the Flying Cloud Sanitary Landfill in Eden Prairie, Minnesota, the Anoka Regional Sanitary Landfill in Ramsey, Minnesota, and the Metro

Landfill near Franklin, Wisconsin, have all purchased land and homes surrounding those facilities in order to avoid, contain, or resolve disputes with private landowners. Browning Ferris Industries included a *compensation in advance* proposal in a 1990 application for a permit to expand capacity at the Flying Cloud Landfill in Eden Prairie, Minnesota.

Caution is made that the analysis does not specifically address the price effects of the latest landfills built and operated pursuant to the most modern standards. Nonetheless, it seems from the analysis reasonable to assume that unless new landfills achieve a state of operations such that the urban housing markets view them as essentially benign, one should expect that landfills will have negative price effects.

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