Fiscal Research Program

THE ECONOMIC IMPACTS OF ENVIRONMENTALLY CONTAMINATED SITES ON COMMERCIAL AND INDUSTRIAL PROPERTY MARKETS IN ATLANTA, GEORGIA

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Executive Summary

Post-industrial migration of industry and light manufacturing from urban centers to suburban areas have left U.S. cities strewn with many environmentally contaminated properties. Investors are often reluctant to redevelop these sites because of cleanup costs and liability risks. Because of concerns over contaminant migration and associated liabilities, investor reluctance may extend to properties near a contaminated site that are not themselves contaminated. This reluctance would manifest itself as reduced sales prices for properties near contaminated sites.

We explore the impacts that contaminated sites have on nearby commercial and industrial property values. The study area is Fulton County, Georgia, which encompasses most of the City of Atlanta. Property value models, which account for the for factors that determine a property's market value, are employed to investigate the impacts that hazardous waste sites listed on the Georgia Hazardous Sites Inventory (HSI) and the U.S. Environmental Protection Agency's database of hazardous sites (CERCLIS) have on nearby commercial and industrial property values. Separate analyses are conducted for five different land-uses: apartments, offices, retail, industrial, and vacant land.

Environmentally contaminated sites are found to have significant negative impacts on surrounding commercial and industrial property values for all five land uses. The negative impacts are most severe for offices and apartments, and least severe for industrial properties. The models indicate that properties located within one-half mile of a hazardous waste site may be reduced in value by between 3 percent (for industrial properties) and 20 percent (for offices). Apartments, retail properties, and vacant land are estimated to be reduced in value by approximately 7 to 15 percent.

The property value models are used to estimate the total property value losses occurring in Fulton County as a result of the 44 HSI and CERCLIS sites located in the county. For each property located within a 1.5 mile radius of a CERCLIS or HSI site, the reduction in property value resulting from its proximity to a hazardous waste site is computed and summed across properties. The reduction in property values are estimated for *all* commercial and industrial properties that are one of the five land-uses we

consider and are within a 1.5 mile radius of an HSI or CERCLIS site, regardless of whether or not the property has actually sold during the study period.

The total losses across all five land-use types is estimated to be approximately $1 billion, or 10 percent of the total fair market value of the commercial and industrial properties located within 1.5 miles of the 44 hazardous waste sites. The estimated property value losses surrounding specific hazardous waste sites varies substantially. The largest losses are for a CERCLIS site located in the City of Atlanta for which it is estimated that the value of commercial and industrial properties within 1.5 miles of the site are decreased by over $150 million. The smallest losses are for a HSI site with estimated losses in property values surrounding the site of only $1.5 million.

The estimated reduction in property values surrounding contaminated sites can be viewed as potential property value *gains* that would occur should the sites be fully remediated. Large gains in property values associated with hazardous waste site clean-up would result in substantial increases in property-tax revenues for local authorities. Commercial and industrial properties are taxed on 40 percent of their assessed value at a tax rate of approximately 5 percent. Thus, if a hazardous waste site cleanup results in surrounding property value increasing by $10 million, then property-tax revenues would increase by $200,000. In Fulton County, there are five contaminated sites for which it is estimated that tax-revenues would increase by over $1 million per year should one of the sites be remediated. There are nineteen hazardous waste sites for which it is expected that remediation of the site would increase tax-revenues by between $250,000 to $1 million per year. If each site in Fulton County were remediated, property-tax revenues could increase by as much as $21 million annually.

The potential magnitude of the property value and tax revenue increases are particularly interesting from a policy perspective. Surveys for three years of 231 U.S. cities have ranked the lack of funding as the number one obstacle to hazardous waste site remediation and redevelopment.[A] The estimated gain in property values surrounding

[A]United States Conference of Mayors, Recycling America's Land: A National Report on Brownfields Redevelopment - Volume 3, www.usmayors.org/uscm/brownfields/, 2000.

contaminated sites after they are cleaned appear to be sufficiently large to justify creative financing of cleanup such as a tax-increment financing program.

Tax-increment financing (TIF) is a creative solution for financing public improvement projects by local governments. To finance a project with TIF, a local government would issue debt (bonds) to finance the project and then rely on increased property tax revenues to repay the debt. For instance, say the City of Atlanta uses tax increment financing (TIF) to finance the cleanup of a hazardous waste site. The City would then develop an "improvement district" surrounding the hazardous waste site wherein any increases in tax revenues resulting from increases in property values within the district would be directed to a fund to repay the bonds. It is important to note that the "baseline" tax revenue is not redirected from its current uses. Only the incremental tax revenues that arise from the incremental increases in property values post-completion of the project are targeted for repayment of the debt. Tax-increment financing has been used for projects as large as $150 million and has been used widely in Texas, California, and many mid-western states.

If the average cost of cleanup per hazardous waste site is $1 million or less, 86 percent of the 44 HSI and CERCLIS sites in Fulton county would be candidates for tax-increment financing of their cleanup. However, if the cost of cleanup averages $10 million, only six sites would have expected property value gains sufficient to cover the costs of cleanup through a tax-increment financing plan. The map below highlights the location of sites that are feasible for cleanup with a TIF plan if the costs of cleanup are assumed to be $5 million per site. Also indicated on the map are neighborhood racial and income distributions in Fulton County. As indicated in the map, over 50 percent of the sites eligible for a TIF program are located in majority African American neighborhoods and neighborhoods where median household incomes are less than $25,000 per year. The additional tax revenues of up to $13 million per year resulting from cleanup of the ten eligible sites is significant. After repayment of bonds that finance the cleanup of these ten sites, the additional revenue could help local governments provide services as well as increase general economic activity in the areas.

I. Introduction

Post-industrial migration of industry and light manufacturing from urban centers to suburban areas have left U.S. cities strewn with many environmentally contaminated properties. Investors are often reluctant to redevelop these sites because of high, and often uncertain, cleanup costs and liability risks such as third-party claims against current and past owners of the properties. This reluctance can reduce the economic opportunities of the properties and lead to their abandonment or under-utilization. Reductions in employment and local tax bases can then be expected, which can be especially burdensome in light of the fact that environmentally contaminated properties are often associated with older, often blighted urban centers where public resources for maintenance or improvement of existing services are often limited.

The effects of environmentally contaminated properties can extend beyond their own reduced economic potential. Proximity to a contaminated property may also decrease a non-contaminated property's economic opportunities for a number of possible reasons. Potential investors may have concerns that contamination has migrated, or that there may be increases in health risks of employees and visitors to the property as a result of being located near a contaminated site. Concerns over liability for damages and cleanup associated with migrated hazardous wastes, reluctance of lenders to provide capital for projects involving heightened liability risks, and lack of adequate insurance markets against such liabilities are all factors that may reduce the economic potential, and therefore the market values, of properties surrounding contaminated sites. Thus, even if there are relatively few contaminated sites in an urban area, the total economic impacts of these sites could be substantial when considering their effects on surrounding property values.

While there is evidence that badly contaminated properties, such as those appearing on the U.S. EPA's National Priority List (NPL), reduce the values of nearby

single family homes,[1] there is little evidence on the extent to which commercial and industrial property values are impacted by environmentally contaminated sites. Furthermore, we also know very little about the extent to which properties are impacted by sites less severely contaminated than NPL sites, even though only a very small percentage of sites warrant NPL status.

This report summarizes the research reported in Ihlanfeldt and Taylor[2] which assesses the extent to which contaminated sites reduce nearby commercial and industrial property values in Fulton County, Georgia. It is important to examine commercial and industrial property markets as these land-uses are more likely to be located close to contaminated sites than residential properties. Therefore, the property value changes may be substantial in magnitude. Indeed, if the changes in property values due to contaminated sites are large enough, tax-increment financing (TIF) may emerge as an option to facilitate cleanup. The possibilities of a TIF approach to fund cleanup of the contaminated sites located within Fulton County is directly examined. Also, because contaminated properties are often located in lower-income, minority neighborhoods, the potential equity effects of these contaminated sites are also examined.

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[1]For example, see K. Kiel, "Measuring the Impact of the Discovery and Cleaning of Identified Hazardous Waste Sites on House Values," *Land Economics*, 71(4), 1995, pp. 428-35 and J. Kohlhase, "The impact of toxic waste sites on housing values," *Journal of Urban Economics*, 30(1), 1991, pp. 1-26.

[2]"Assessing the Impacts of Environmental Contamination on Commercial and Industrial Properties," Environmental Policy Working Paper Series #2001-001, Environmental Policy Program, Andrew Young School of Policy Studies, Georgia State University, Atlanta, Georgia, 30307 and *Journal of Environmental Economics and Management,* forthcoming 2004.

II. Study Area and Data

Fulton County

The study area is Fulton county, Georgia, which contains almost all of the geographical area of the City of Atlanta and inner-suburban areas lying immediately north and south of the central city. Figure 1 shows the study area, highlighting Fulton County, the City of Atlanta, and the 13-county metropolitan area. As indicated in Figure 1, almost all of the city of Atlanta is contained in Fulton county. Fulton is a large county with a population of 816,000 and a land area of 529 square miles (Census, 2000, which can be found at www.census.gov). Figure 2 displays the census tracts within Fulton county. The City of Atlanta within Fulton County is highlighted in light grey, and the horizontal blue line delineates properties located in "northern Fulton" versus "southern Fulton." This line passes through the central business district of Atlanta at the Five-Points MARTA station (the central subway station of Atlanta's public rail system).

Environmentally Contaminated Properties

Information on contaminated sites were obtained from three publicly available environmental data bases: the Georgia Environmental Protection Division's Hazardous Site Inventory (HSI), the United States Environmental Protection Agency's (EPA) Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS), and EPA's No Further Remedial Action Planned (NFRAP) reports. We recognize that the sites listed on these databases are likely to only be a fraction of the properties that have hazardous waste issues. Nonetheless, we have no means by which to reliably classify properties as contaminated or not except to rely on instances where a governmental authority has investigated the site. Thus, our discussion focuses only on sites that have been identified and investigated by authorities.

FIGURE 1

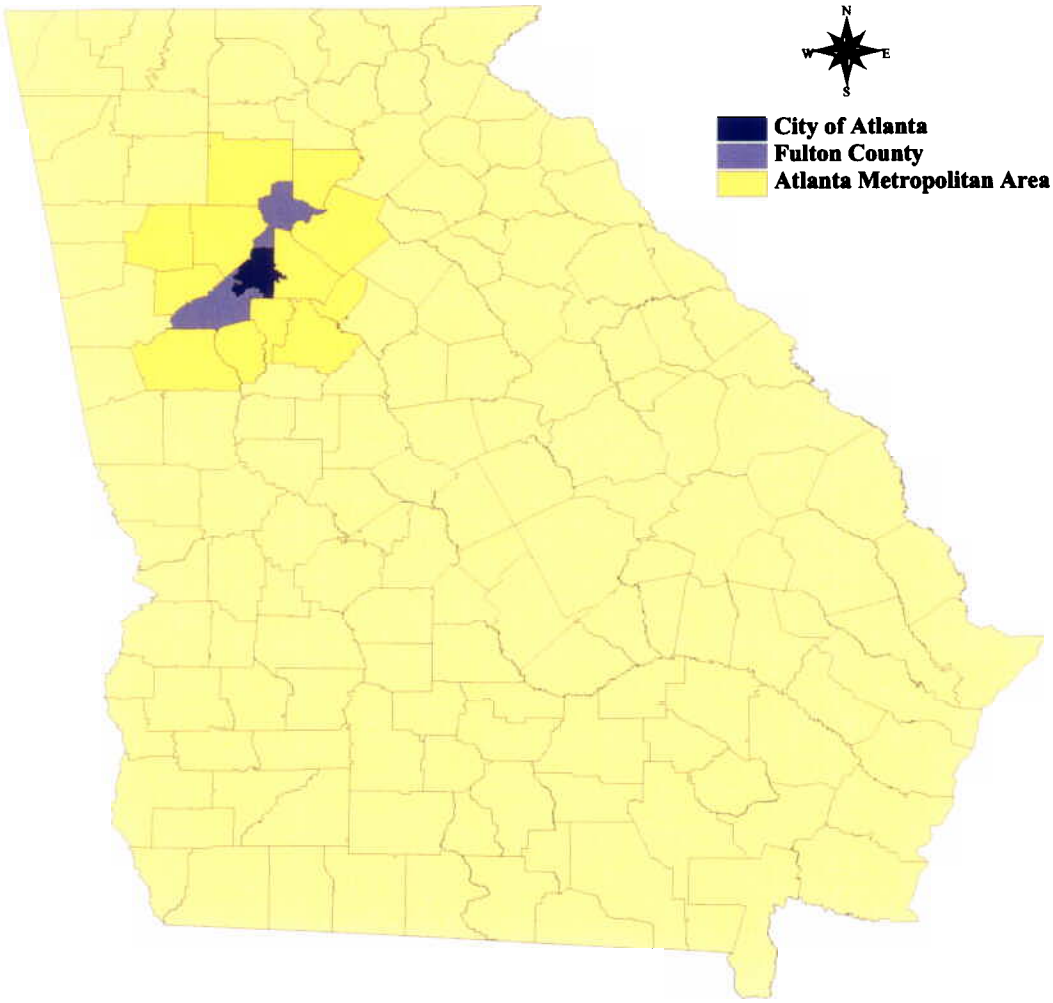

N
W
E
S
City of Atlanta
Fulton County
Atlanta Metropolitan Area

FIGURE 2

The sites listed on the Georgia HSI are a subset of suspected contaminated properties that have been screened by the Georgia Environmental Protection Division (EPD) of the Department of Natural Resources. When a release of a hazardous substance has occurred, a property owner is obligated to report the release to the EPD. The EPD then scores each property based upon the Reportable Quantities Screening Method (RQSM). The RQSM assigns numerical values to the following factors describing the released substance: toxicity, quantity, physical state, how close the site is to nearby residents and drinking wells, the degree to which the release is contained, the accessibility of the site, whether or not the release has resulted in exposure to nearby residents, and the presence of on-site sensitive environments. A mathematical equation combines these numerical values to calculate a single soil and a single groundwater score. If either of these scores is above their predetermined threshold levels, the site is then placed on the HSI. The EPD first published the HSI on July 1, 1994 and since then it has been updated annually. In 1998, there were 30 HSI sites within Fulton County.

CERCLIS is EPA's list of hazardous waste sites. These sites have either been investigated, or are currently under investigation by the EPA for the release, or threatened release of hazardous substances. If severe contamination is found, a CERCLIS site may ultimately be placed on the National Priority List. The U.S. EPA uses a different system for documenting and scoring the contamination at a site than what is used by Georgia authorities: the Hazard Ranking System. The Hazard Ranking System also assigns numerical scores to sites using the similar factors considered by the RQSM method used by Georgia authorities. In 1998, there were 21 CERCLIS sites in Fulton County, and none of these were listed as NPL sites. The majority of the CERCLIS sites were first listed in the early 1980s.

Because the Georgia EPD and the US EPA have different screening methods, different legal and regulatory jurisdictions, and different program mandates, it is possible to have a site listed on CERCLIS but not on the HSI, and vice-versa. In Fulton County, there were 7 sites that appeared on both CERCLIS and HSI in 1998.

The last list compiled contains NFRAP sites which are sites that were initially on CERCLIS but were subsequently "de-listed." De-listing occurs for one of three

reasons: 1) no contamination is found, 2) contamination is found but quickly removed, or 3) contamination is found, but is not judged serious enough to require federal superfund action or NPL consideration. For each NFRAP site the date it became a CERCLIS site and the date it became a NFRAP site (i.e., the de-listing date) are known. In 1998 there were 96 NFRAP sites in Fulton County.

Figure 3 presents the distribution of HSI, CERCLIS, and NFRAP sites in Fulton County. For ease of exposition, these sites are referred to as hazardous waste sites (HWS) even though NFRAP sites may have been fully remediated. Also indicated in the map are the census tract outlines for each county, the major interstates (in green), and the City of Atlanta. As indicated in Figure 3, the listed sites in Fulton county are concentrated within the City limits or close to the City limits. Figure 4 repeats the map in Figure 3, and adds the percent of the population within a census tract that is African American according to the 1990 Census. The HSI, CERCLIS, and NFRAP sites are concentrated in census tracts that are majority or near majority African American. In addition to being concentrated in areas with high percentages of African American residents, the sites are also located in areas where residents have relatively lower incomes as indicate in Figure 5. Indeed, approximately 75 percent of the HSI and CERCLIS sites are located in census tracts in which the median household income in 1990 was less than $25,000.

Figures 3, 4, and 5 highlight the need to understand the potential impacts of contaminated sites on property values. In addition to any health or environmental effects, if there is erosion in the tax-base due to erosions in property values surrounding these sites, the burden of this is likely to fall primarily on the City government as the sites are primarily concentrated within its jurisdiction. Any erosion in the tax base reduces the capabilities the local government to provide services to the lower income and African American neighborhoods which lie within its jurisdiction.

FIGURE 3

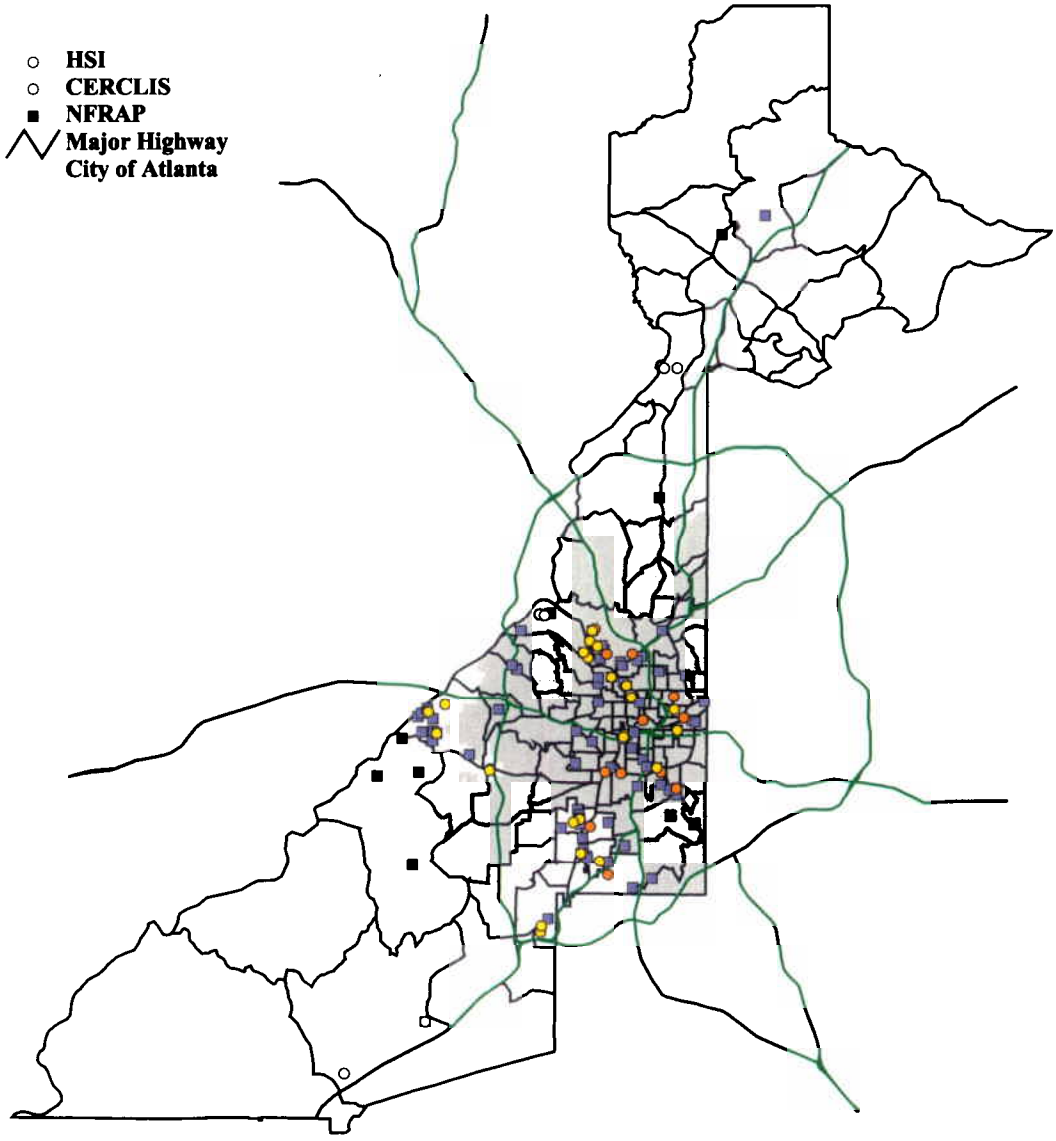


FIGURE 4

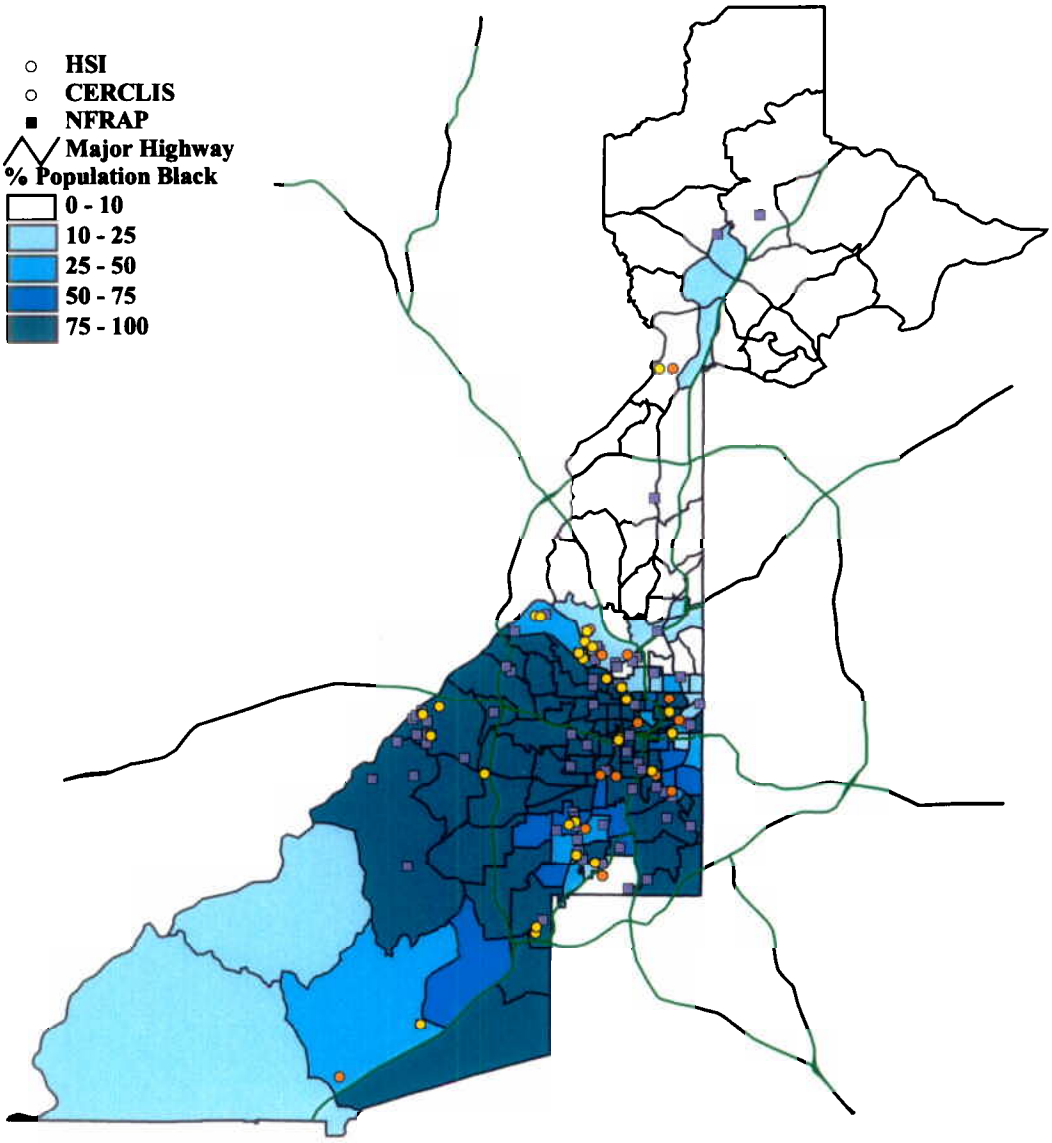
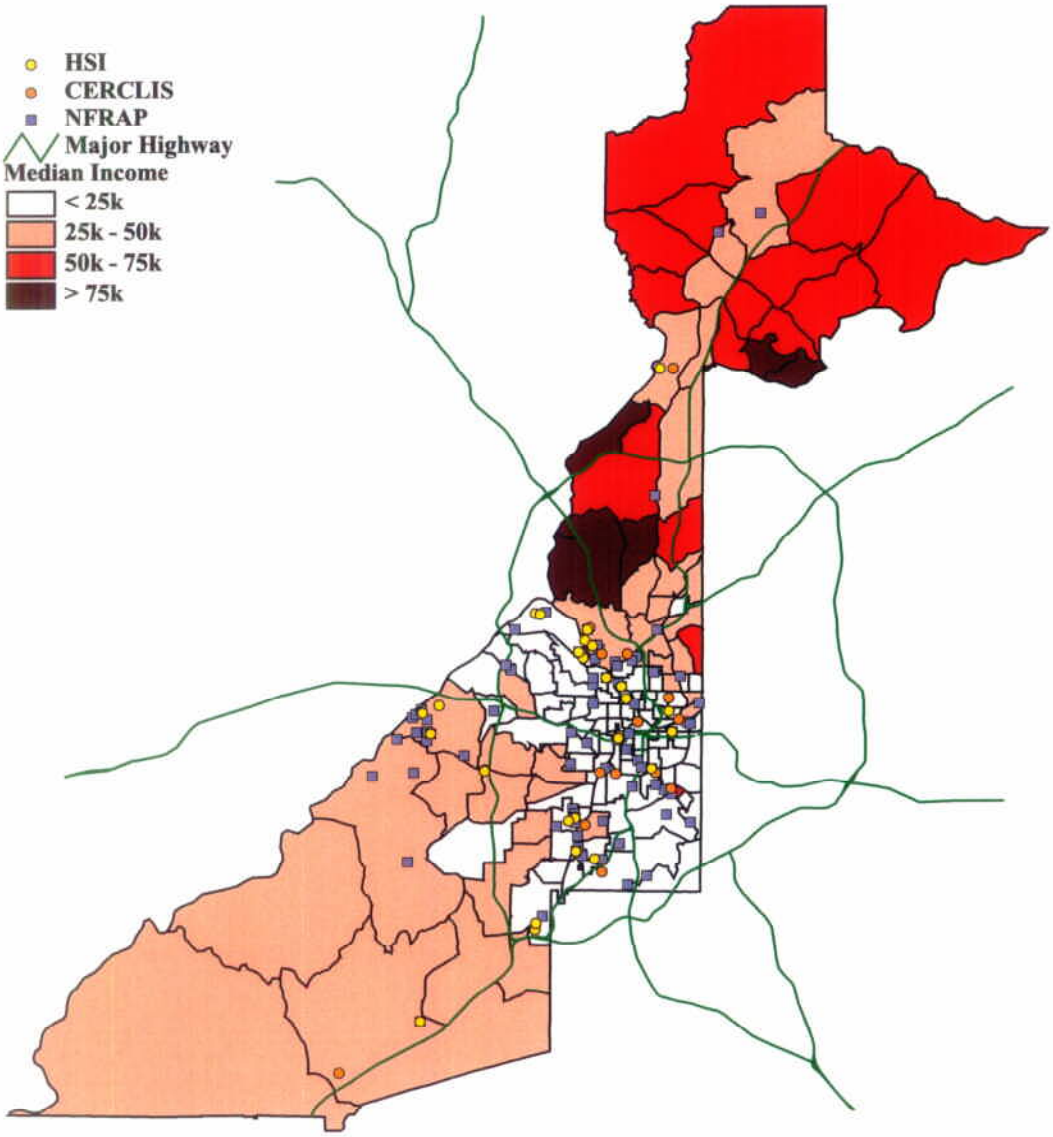

HSI
CERCLIS
NFRAP
Major Highway
% Population Black
0 - 10
10 - 25
25 - 50
50 - 75
75 - 100

FIGURE 5


HSI
CERCLIS
NFRAP
Major Highway
Median Income
< 25k
25k - 50k
50k - 75k
> 75k

Commercial and Industrial Property Sales

To estimate the impacts of contaminated sites on nearby commercial and industrial property values, information on commercial and industrial sales are needed. In addition to having the sales price of each property, it is important to understand the property's characteristics as fully as possible. For instance, information on the lot size, building size and quality, and locational characteristics of the property such as proximity to the nearest highway are needed. To develop this information, a database was obtained from a commercial vendor (Property Data Systems, Inc.) that purchased the complete tax roll from the county and researched deed transfer records to append to each property its most recent sales price.[3] In this database is a complete description and the most recent sales price for every commercial and industrial property appearing on the county tax rolls in 1998. Properties that sold between 1981 and 1998 are used in the analysis.

Table B1 in Appendix B contains a complete description of the property characteristics obtained from the tax rolls that are used in the analysis. Briefly, these descriptors were the acreage, square footage, and age of the building as well as a quality ranking of the building.[4] Also included are descriptions of the building's exterior wall type, the parking type and adequacy for the property, the type of street (e.g., primary or secondary artery) and neighborhood at which the property is located (e.g., business cluster or commercial/industrial park). The land-use codes of each property are also included and are key to the analysis.

In addition to the property characteristics provided by the tax-assessors roles, many spatially-related variables are developed to further characterize properties. To create the spatial variables, each property in the database had to be assigned its latitude/longitude coordinates. Fulton County's digitized tax-map was obtained and

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[3]Financial support for the purchase of this database by the Fiscal Research Center and the Environmental Policy Program, both in the Andrew Young School of Policy Studies at Georgia State University are gratefully acknowledged.

[4]Square footage is for all improvements on a property. Age is the age of the primary structure on the property.

used for these purposes. The tax map contains the county parcel-id (which could be matched to the parcel-id number in our database) and latitude/longitude coordinates of the centroids of all properties on the tax roll. The advantage of using this tax map over alternative spatial referencing methods such as address matching is its accuracy in assigning a property's coordinates. Address matching provides only estimates of a property's location along a street segment and can thus produce substantial errors.

The spatially-related variables were created with the use of ARCVIEW Geographic Information Systems (GIS). Location-oriented variables created included the linear distance between each property and the central business district, the nearest highway exit, Hartsfield International Airport, and the nearest subway station. Properties were also assigned to their respective census tracts so that neighborhood data could be appended to each property record. Census tract information for each property includes the population and employment densities of the census tract, percent of the population that is non-white (obtained from the Atlanta Regional Commission), and the real median household income in the track (obtained from Donnelly, Inc.). These variables, while based on 1980 and 1990 census information, are interpolated for each year between 1980 and 1998 by the original companies that provided the variables. Lastly, the tax jurisdiction of the property (there are 9 jurisdictions in Fulton County) is also recorded.

Overall, there are more than 60 variables describing a property that are available to describe each property. The impacts of contaminated sites on property values are estimated for each of five major land-use categories describing commercial and industrial properties: apartments (also including hotels and commercial/residential properties), offices, retail, industrial and vacant land. Vacant land-uses included are only those which are classified as non-residential. The analysis is conducted for each land-use separately because these are considered different markets. In other words, a potential investor looking for an industrial property to purchase does not consider apartments or offices as potential properties to purchase. The property sales in Fulton county that are classified under one of these five land-uses encompass approximately 85 percent of the total commercial and industrial property sales that occurred in the area during the study period (1981-1998). What are not included are automotive-related

properties, parking facilities and public buildings such as schools and utilities. There were 2,315 apartment and hotel sales occurring during our study period, 1,449 retail establishment sales, 894 office sales, 944 industrial property sales, and 805 vacant land sales. Of these sales, 1,229 apartment and hotels, 816 retail, 260 office, 644 industrial, and 582 vacant land sales could be included in the analysis because these sales records contained all the information on property characteristics necessary to conduct the analysis.

Figures 6 through 9 indicate the distribution of the sales used in the analysis for each of the developed land-use types relative to the distribution the HWS, not including vacant land. The commercial and industrial property sales are distributed as one would expect for Fulton county. There are concentrations of sales in the City limits, as well as following the major north-south and east-west highway corridors. The industrial sales most closely mimic the spatial distribution of the HWS, which is to be expected. The other three land-use sales are more spatially distributed across the county as compared to the hazardous waste sites.

FIGURE 6

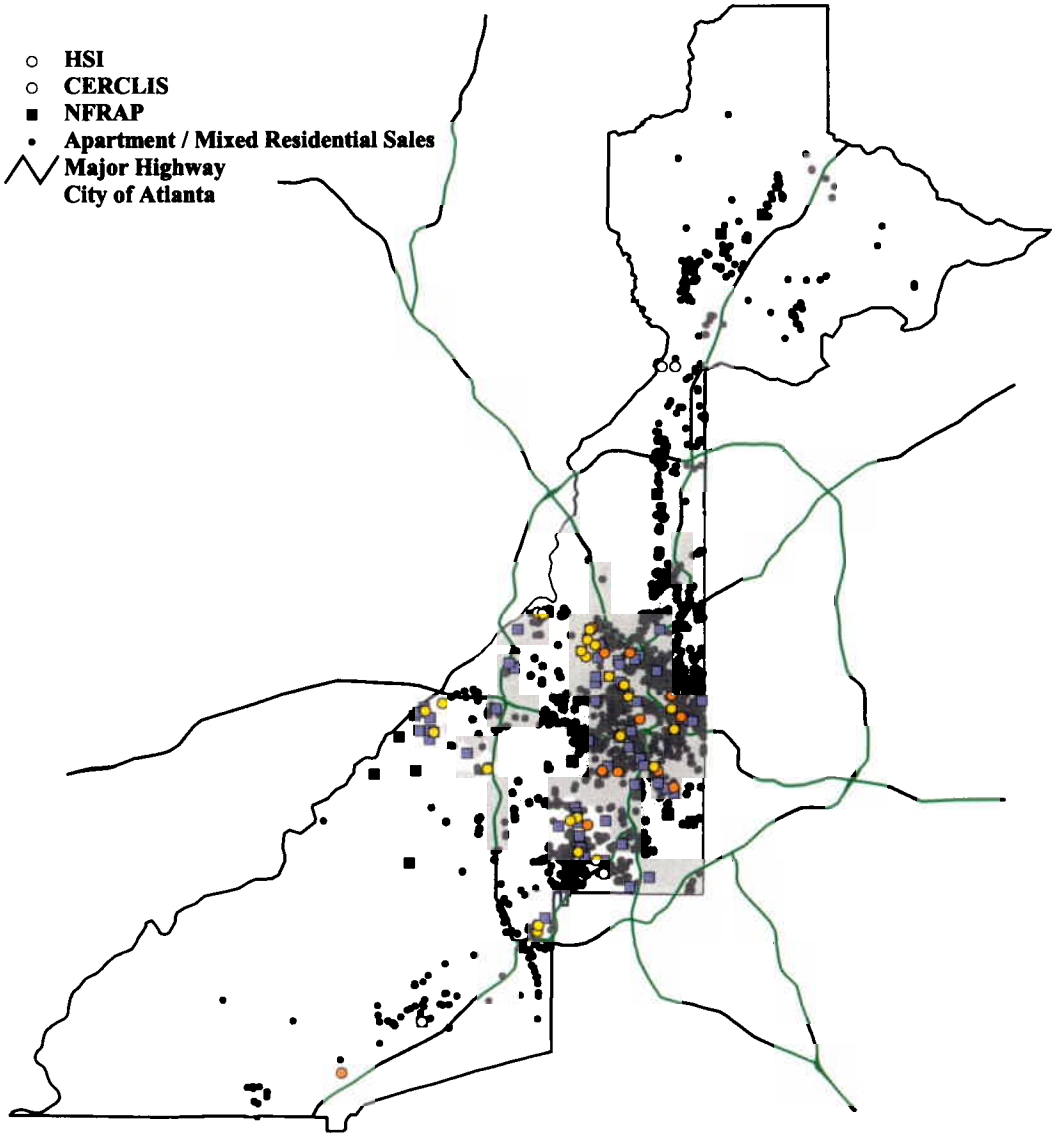

HSI
CERCLIS
NFRAP
Apartment / Mixed Residential Sales
Major Highway
City of Atlanta

FIGURE 7

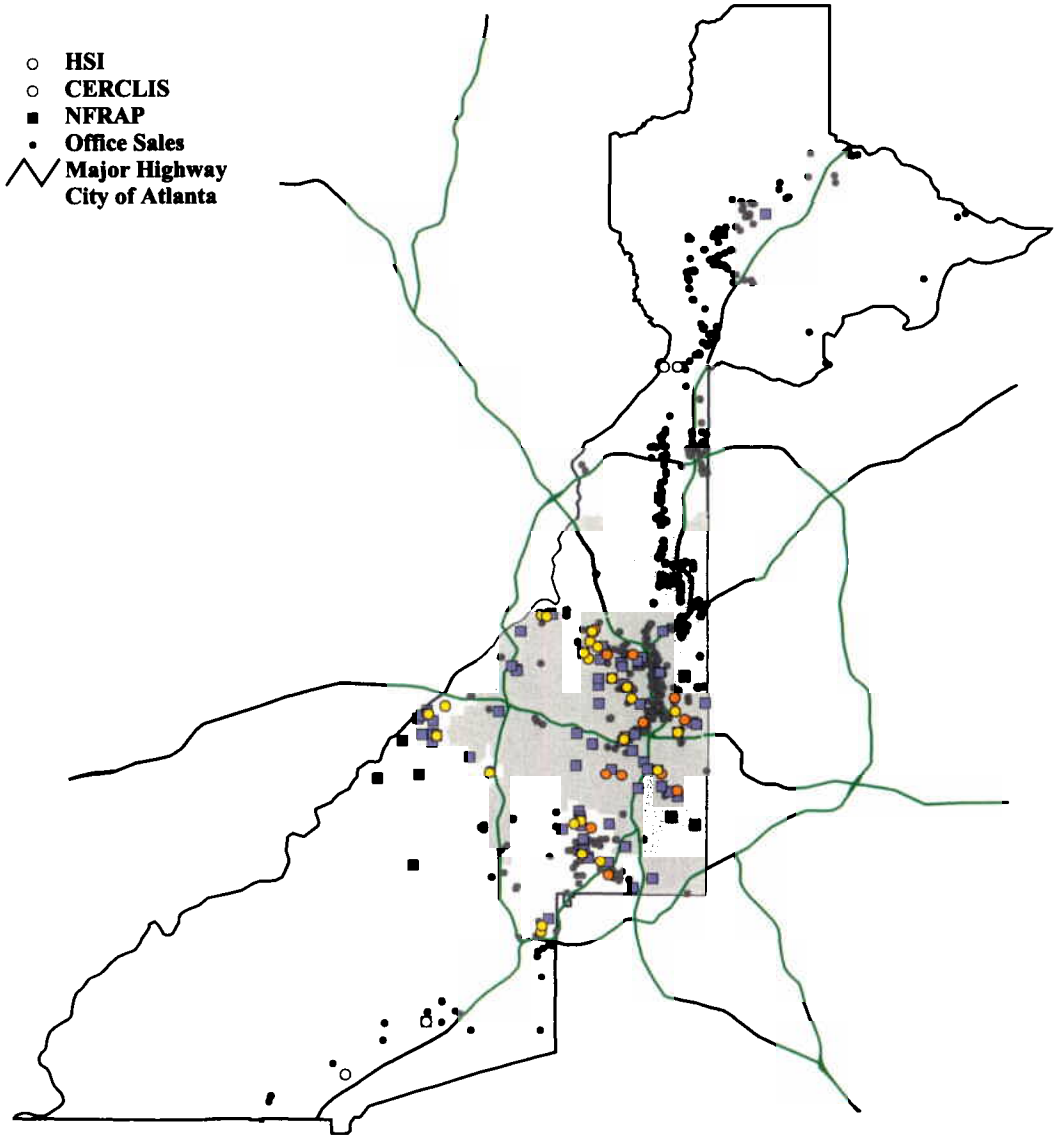

HSI
CERCLIS
NFRAP
Office Sales
Major Highway
City of Atlanta

FIGURE 8

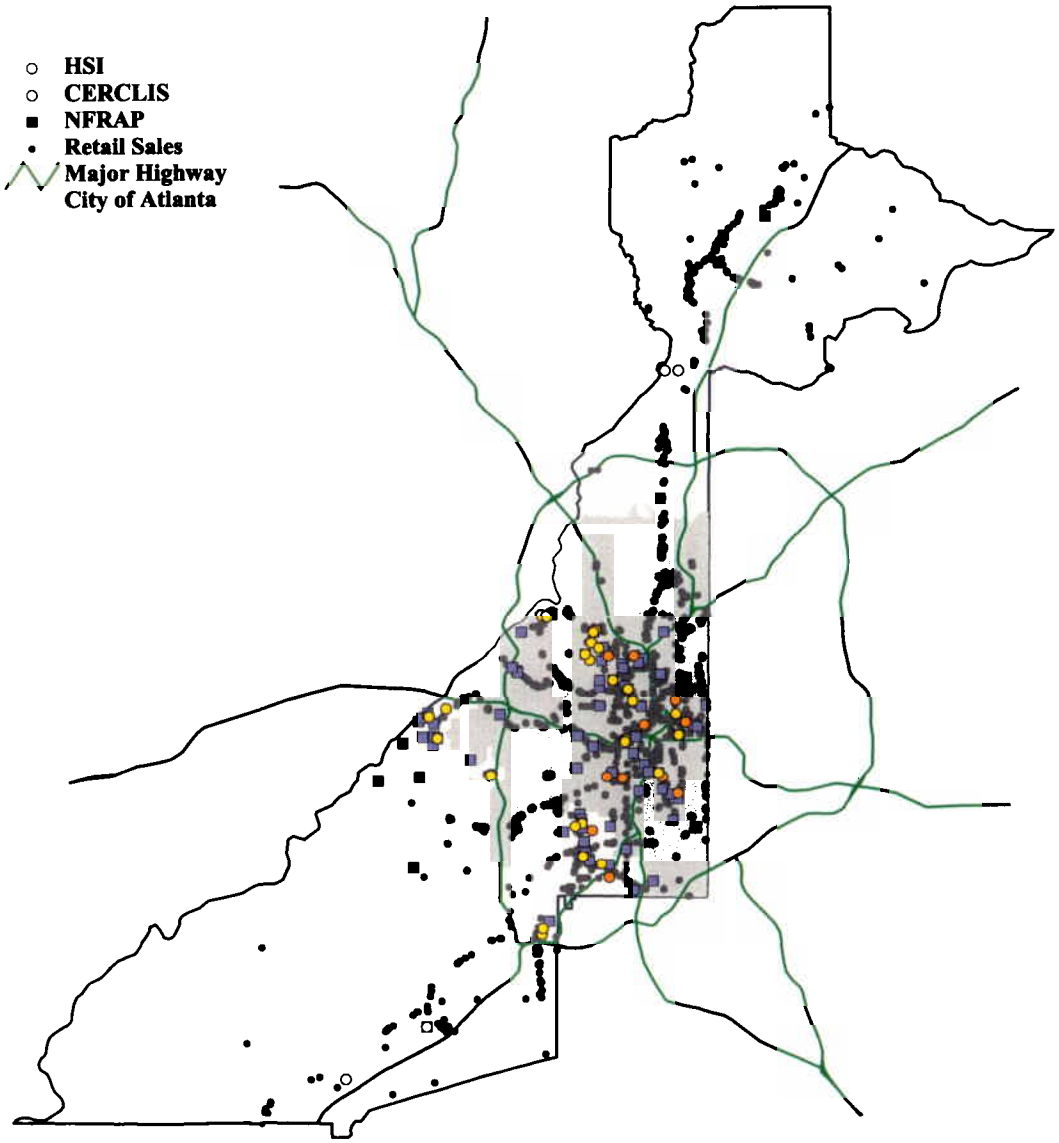
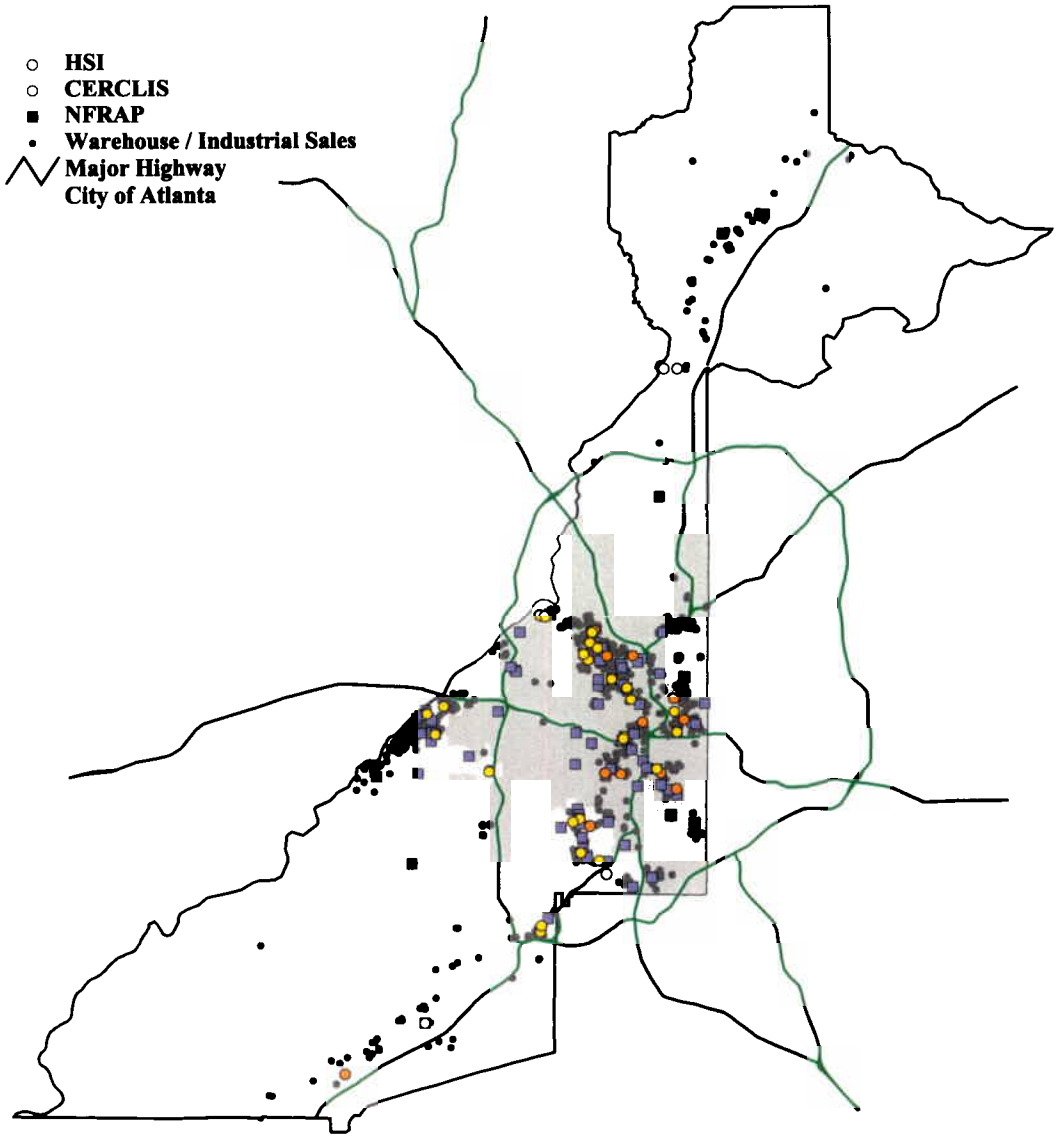

HSI
CERCLIS
NFRAP
Retail Sales
Major Highway
City of Atlanta

FIGURE 9


HSI
CERCLIS
NFRAP
Warehouse / Industrial Sales
Major Highway
City of Atlanta

III. Methods Summary

Our goal is to measure the impacts HWS may have on the property values of nearby commercial and industrial properties. These "spillover" effects are estimated using the hedonic method, which is commonly applied to real-estate markets. The hedonic method is based on the recognition that a property's price is determined by the property's many features. As such, it is possible to use information on sales prices and the characteristics of a property to determine the value purchasers place on each of the characteristics of the property. To illustrate how the hedonic model works, consider an example with two *identical* commercial properties: property-A and property-B. All improvements on the properties are identical (e.g., buildings and parking lots) as are the size, shape and characteristics of the lots. The accessibility conditions of the properties to roads and interstates are also identical, and so are the distribution of land uses around each property. In other words, both the properties and the neighborhoods in which they are located are identical. In a competitive market, these properties should sell for exactly the same amount. Say that we observe them each selling for $250,000.

Now, lets imagine that a highway exit ramp is built such that access to property-A is now twice as fast and easy as to property-B. If property-A were now placed on the market for sale, it would be preferred to property-B assuming a property with better highway access is more desirable to commercial and industrial property owners. As such, property-A's price should increase relative to property B. If we now observe property-A selling for $275,000, then we can attribute the $25,000 increase in property value to its increased accessibility (recall, all else about the two properties remains identical, only the access conditions at one of the properties has changed). The price differential that arises as a result of the change in access conditions at property-A is the "implicit price" that the purchaser has paid for the improved access conditions of property-A.

Of course, property markets are not so simple and a property's price depends on many factors. Yet, the fundamental intuition behind the hedonic method extends easily. By observing the choices buyers make over the properties they purchase, we can 'tease-out' the implicit prices of the component characteristics of the properties. To conduct

a hedonic analysis, each property's sales-price and a complete description of its characteristics are needed. With this information, regression analysis is used to "decompose" the sales price into the implicit prices for each of the property's component characteristics. Appendix A, Sections AI and AII contain a more technical discussion of the regression methods used to estimate the implicit prices for the characteristics of commercial and industrial properties in Fulton County.

The property characteristic of central importance to this study is each commercial and industrial property's proximity to a HWS. The statistical analysis will estimate the implicit price of proximity to a HWS and determine the magnitude of the price impacts if any are found. The estimated implicit price of proximity to a HWS is expected to be negative. In other words, it is expected that a property located closer to a HWS will sell for less than an otherwise identical property located far away from a HWS.

In addition, the analysis will allow us to determine how quickly the negative price impacts diminish as sales occur further from a HWS. For instance, we would expect a HWS to have little, if any, effect on sales prices of commercial and industrial properties that are located several miles from the site.

The first component of measuring how hazardous waste sites impact nearby commercial and industrial property values is to quantify how sales prices change as properties are located closer to a hazardous waste site. This "implicit price" of proximity to a hazardous waste site is estimated using the hedonic method. It is expected that the implicit price of proximity to a hazardous waste site will be negative, indicating that sales prices decrease as properties are located closer to a hazardous waste site.

The measure of proximity to a HWS that is used in the analysis is the linear distance between each commercial and industrial property and a HWS. Specifically, the linear distance between the center of a property that sold and the center of the nearest HSI, CERCLIS, and NFRAP site were computed using ARCVIEW GIS. Thus, a commercial property that is recorded in the data as being located 0.5 miles from a HWS is actually closer when considering the distance between the two property boundaries.

An issue that had to be addressed in the statistical analysis is the overlap between the HSI and CERCLIS sites. Recall that some CERCLIS sites are also listed on the HSI. Because of this overlap, it was not possible to conduct a statistical analysis that identifies the price impacts of the CERCLIS sites separately from the HSI sites. Thus, sites on either HSI or CERCLIS were combined to form a single list ("List1") of hazardous waste sites. Distance to the nearest List1 site is the measure of proximity to a HWS used in the analysis, and it measures the distance to the nearest HSI *or* CERCLIS site. It was possible to include the NFRAP sites separately in the analysis, and for ease of exposition, they are referred to as "List2" sites. Separating the impacts of HWS by List1 and List2 sites is important because the expectations regarding the impacts of List2 (NFRAP) sites on nearby property values are not as clear-cut as those for List1 sites. Recall, a site may be placed on CERCLIS and then given NFRAP status because either cleanup has occurred or site-investigation revealed that the site was not contaminated enough to warrant federal action. Depending on how potential investors view the information provided by NFRAP designation, it is not clear that these properties would have negative price impacts on surrounding property values.

The implicit price of proximity will be estimated for both List1 (HSI and CERCLIS) and List2 (NFRAP) sites. While it is expected that proximity to List1 sites will reduce commercial and industrial property values, the expectations regarding proximity to NFRAP sites are less clear, perhaps having no effect on sales prices.

A last feature of the hazardous waste sites that had to be considered in the analysis is the possibility of information effects associated with listing a property. Some property sales occur prior to the discovery and listing of a nearby HWS by authorities, and some sales occur after the government lists the HWS. If the primary source of information for potential buyers of a property are the government lists, then we would *not* expect the site to have negative impacts on nearby sales *prior* to its being listed by a government agency as contaminated. In other words, if a site is not contaminated or not known to be contaminated, sales prices should not be affected by being located close to the site. Indeed, in commercial real estate markets, there are often positive effects

associated with commercial properties being located near each other. For example, certain retail establishments might find it attractive to be located close to offices.

On the other hand, it is also possible that not all contaminated sites are "discovered" by authorities, but are nonetheless apparent to prospective purchasers who investigate properties surrounding the one they wish to purchase. If real estate markets respond to perceived contamination and only partially rely on governmental lists of contaminated sites when evaluating nearby properties, then we could see property values being impacted by nearby hazardous wastes sites both *prior* to their being listed and after they are discovered and listed on the HSI or CERCLIS.

To investigate the role of the information provided to the market by "listing" a site, the analysis separates the effects of proximity to a HWS according to whether or not the site actually appeared on the CERCLIS or HSI at the time a nearby commercial property sold. In other words, for List1 sites, there will be two price impacts measured. The first is the impact on sales price of being located near a List1 site when the sale occurs *prior* to the actual listing of the List1 site on the HSI or CERCLIS. The second is the impact on price of being located near a List1 site when the sale occurs *after* the site is listed on the HSI or CERCLIS. A reasonable prior expectation is that List1 sites will have no price impacts on nearby property values prior to their being listed on the HSI or CERCLIS, but would have negative effects after their listing. This expectation assumes the governmental lists provide the primary signal to potential investors of the hazardousness of nearby properties. If on the other hand, potential investors rely more on factors other than governmental listings, then we might expect price impacts occurring both prior to and after a site is listed. If we find this result in our analysis, it could indicate that the market knows about contamination before the authorities.

The effects of "listing" a site as NFRAP are also examined. The impacts of a List2 site on nearby sales prices are allowed to vary according to three time periods: 1) prior to the site being discovered by the US EPA, 2) after it has been discovered, but before it is de-listed, and 3) after the site is de-listed. Here, it is reasonable to expect that if List2 sites have any effect on sales prices, they will only affect them during the time period the site is listed on CERCLIS. If there are impacts found while a List2 site

is posted on CERCLIS, but not after the site is listed as NFRAP, this would indicate no residual stigma effects associated with the sites listing. There has been some concern by policy makers that sites might suffer significant stigma effects post-listing on CERCLIS, even if the site is later found to be not hazardous or if it is fully remediated.

The analysis that is undertaken is summarized in the following box. The details of the regression analysis used to test the hypotheses described below are presented in Appendix A, Section AI. A summary of the statistical results are presented next.

Five hypotheses regarding the potential impacts of hazardous waste sites on nearby commercial and industrial property values are investigated

I. Do List1 sites affect nearby property values *prior* to being "discovered" (i.e., prior to listing on either the HSI or CERCLIS)?

II. Do List1 sites affect nearby property values *after* being placed on either the HSI or CERCLIS?

III. Do List2 sites affect nearby property values *prior* to being discovered (i.e., prior to listing on CERCLIS)?

IV. Do List2 sites affect nearby property values *after* being discovered and placed on CERCLIS, but *prior* to being delisted?

V. Do List2 sites affect nearby property values *post* de-listing from CERCLIS?

IV. Spillover Effects from Hazardous Waste Sites

Table 1 summarizes the results for the five major land-use types we analyze. Reported in Table 1 are whether proximity to a List1 site was estimated to have a positive, negative, or no effect on sales price. These effects are distinguished according to whether the HWS was already listed on either the HSI or CERCLIS at the time the sale occurred. Also reported is a summary description of the precision of our estimated impact of HWS on sales prices. If the estimates are imprecise, and statistically not different from zero, we cannot say with reasonable confidence that price impacts exist.

TABLE 1. ESTIMATED IMPACTS OF PROXIMITY TO A LIST 1 SITE ON SALES PRICE[a]

	Apartments	Offices	Retail	Industrial	Vacant
	LIST 1 SITES Sale occurs *prior* to HWS being placed on HSI or CERCLIS				
Impact of Proximity on Sales Price	Negative Not Significant	Negative Not Significant	Negative Not Significant	Negative Not Significant	Negative Not Significant
	LIST 1 SITES Sale occurs *after* HWS is placed on HSI or CERCLIS				
Impact of Proximity on Sales Price	Negative Significant	Negative Significant	Negative Signaficant	Negative Significant	Negative Significant

[a] See Appendix A, Table A1 for the statistical results underlying the summary presented in this table.

Table 1 indicates that if a sale occurs *after* a List1 site is listed on either HSI or CERCLIS, sales prices decrease as properties are located closer to the site, holding all else constant. These relationships are all statistically significant. The opposite results are found when considering how proximity to a List1 site affects sales price when the sale occurs *prior* to the site being placed on either the HSI or CERCLIS. For all land-uses, proximity to a List1 site does *not* have a statistically significant relationship with sales price if the sale occurs prior to the site being listed on either the HSI or CERCLIS.

Table 2 reports the results for the List2 sites. As indicated in Table 2, List2 sites do not seem to have any systematic effects on nearby property values, regardless of the

TABLE 2. ESTIMATED IMPACTS OF PROXIMITY TO LIST 2 SITE ON SALES PRICE[a]

	Apartments	Offices	Retail	Industrial	Vacant Land
	Sale occurs *prior* to HWS being discovered				
Impact of Proximity on Sales Price	Positive Not Significant	Negative Not Significant	Positive Not Significant	Negative Not Significant	Negative Not Significant
	Sale occurs *after* HWS is discovered and placed on CERCLIS, but prior to delisting				
Impact of Proximity on Sales Price	Negative Significant	Negative Not Significant	Positive Not Significant	Negative Not Significant	Negative Not Significant
	Sale occurs *after* HWS is delisted				
Impact of Proximity on Sales Price	Positive Not Significant	Negative Not Significant	Positive Not Significant	Positive Not Significant	Negative Not Significant

[a] See Appendix A, Table A2 for the statistical results underlying the summary presented in this table.

time period (i.e., if the sale occurs prior to listing, after listing, or after delisting of the site), with the exception of apartments. The models indicate that if an apartment sale occurs while the List2 site actually appears on CERCLIS (i.e., after discovery, but prior to delisting), there is a significant negative impact on the sales price of the apartment. Importantly, results indicate this relationship is no longer statistically significant if the apartment sold after the site was delisted (i.e., listed as NFRAP sites by the EPA). This result is suggestive that the stigma effects associated with a site having once been listed on CERCLIS do not remain once it is delisted. Of course, the results overall are suggestive of very weak effects of the NFRAP sites, regardless of what "stage" they are at when a nearby property sells.

The question arises as to why List2 sites are treated differently by the market than List1 sites even though they appear on CERCLIS at some point in time. These results may be due to significant differences in the perceived hazardousness of List 1 and List 2 sites. If purchasers are aware that the property is listed, then it is reasonable to assume they also know the status of the EPA's investigation of the site since this is easily obtainable public information. While the NFRAP sites would have appeared on CERCLIS after initial "discovery" of the site, the EPA records would indicate, in most

cases, that no site assessments had taken place (the majority of NFRAP sites appeared to be de-listed at the time of their first assessment). Investors may place a low probability on a site's potential for causing future problems until assessments are completed. By contrast, the majority of List1 sites are HSI sites (70 percent) which the Georgia EPD does not place on the HSI until after they have been screened and found to be hazardous based on known releases. Of the remaining 13 List 1 sites (which are only on CERCLIS and not cross-listed with HSI), two-thirds of these sites were first listed in 1980 or 1981 and the EPA had assessed 70 percent of these sites by 1985. The fact that these sites had been assessed and remained listed for many years without being delisted may be a signal to investors that the site may have significant problems.

Result #1: There are negative impacts of List1 sites on nearby commercial and industrial property values *after* the sites are listed on the HSI or CERCLIS, but not prior to their listing.

Result #2: There are no systematic effects of List2 sites on nearby commercial and industrial property values.

Because we find no significant impacts of List2 sites on nearby property values, or of List1 sites prior to listing, the remaining discussion will focus on the impacts of the List1 sites post-listing.

The magnitude of the effects of HSI and CERCLIS sites on nearby property values are estimated to be quite large in some instances. Table 3 reports the expected decrease in sales prices for a property the closer it is located to a List1 site if it is already listed on either the HSI or CERCLIS at the time of the sale. The impacts are generally quite large for properties located very close to a site. For instance, an office building located 0.5 miles from a List1 site is expected to sell for approximately $387,400 less than it would have had it not been located near a site. Note, that because our proximity measure is the distance between the centers of each property, a 0.5 mile distance is actually closer than 0.5 miles when measuring between property-boundary lines.

TABLE 3. PRICE IMPACTS OF PROXIMITY TO A LIST1 SITE POST-LISTING[a]

Distance to HWS	Apartments	Offices	Retail	Industrial	Vacant
0.50 miles	-$82,900	-$258,300	-$20,100	-$10,700	-$42,000
0.75 miles	-$36,800	-$114,800	-$8,900	-$4,800	-$18,700
1.00 miles	-$20,700	-$64,600	-$5,200	-$2,700	-$10,500
1.25 miles	-$13,300	-$41,300	-$3,200	-$1,700	-$6,700
1.50 miles	-$9,200	-$28,700	-$2,200	-$1,200	-$4,700
1.75 miles	-$6,800	-$21,100	-$1,600	-$900	-$3,400
2.00 miles	-$5,200	-$16,100	-$1,300	-$700	-$2,600

[a]This table is computed by evaluating the marginal effect of distance to a List1 site at the various distances indicated in the Table. See the Appendix A, Section AI for a more detailed discussion.

The negative impacts decline quickly as distance from the sites increases, generally becoming quite small in magnitude beyond one mile.

It is important to consider the impacts reported in Table 3 in the context of the value of the commercial and industrial properties. Table 4 reports the impacts of proximity to a List1 site on sales price as a percentage of the mean sales price for the properties in each land-use code. As indicated in Table 4, the impacts of proximity are quite severe for properties located very close to a site, but decline quite quickly, generally becoming less than 5 percent of the mean property value between one and 1¼ miles. The analysis suggests the largest impacts are for apartments and offices as these properties, when located within 0.5 miles of a site, are estimated to sell for approximately 20 to 30 percent less than comparable properties without a site nearby. The impacts are much smaller for industrial properties. An industrial property located very close to a List1 site (0.5 miles centroid to centroid) is only expected to sell for 3 percent less than a comparable property without a site nearby.

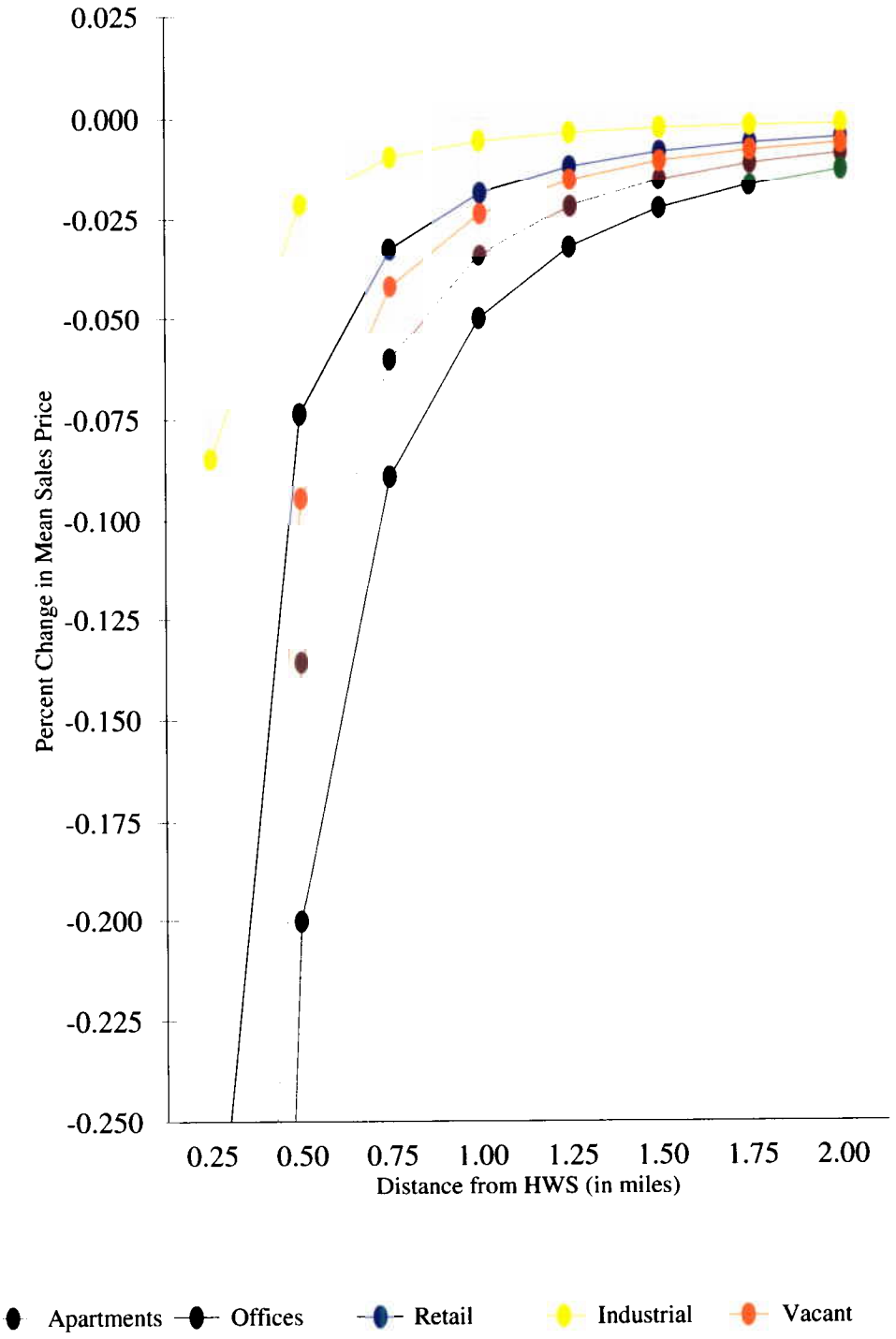
TABLE 4. IMPACTS OF PROXIMITY TO A HWS AS A PERCENTAGE OF MEAN SALES PRICE

Distance to HWS	Apartments ($610,286)[a]	Offfices ($1,288,484)	Retail ($272,619)	Industrial ($505,751)	Vacant ($444,936)
0.50 miles	-0.136	-0.200	-0.074	-0.021	-0.094
0.75 miles	-0.060	-0.089	-0.033	-0.009	-0.042
1.00 miles	-0.034	-0.050	-0.018	-0.005	-0.024
1.25 miles	-0.022	-0.032	-0.012	-0.003	-0.015
1.50 miles	-0.015	-0.022	-0.008	-0.002	-0.010
1.50 miles	-0.011	-0.016	-0.006	-0.002	-0.008
1.75 miles	-0.008	-0.013	-0.005	-0.001	-0.006

[a] Mean sales prices are shown in parenthesis under each land-use heading.

The relationship between the percentage change in sales-price and proximity to a List1 site is graphed for each land-use category in Figure 10. The change in sales price as distance to a site increases is referred to as the price gradient. The gradients shown in Figure 10 graphically demonstrate how prices are severely impacted when a property is approximately a half mile from an HSI or CERCLIS site, but that the negative impacts subside very quickly as distance is increased. The gradient is steepest for apartments and offices, and is least steep for industrial properties. Prices return to their baseline prices at approximately one-half mile from a site for industrial properties, while prices return to their approximate baseline at 1 to 1½ miles for the remaining land uses.

FIGURE 10


0.025
0.000
-0.025
-0.050
-0.075
-0.100
-0.125
-0.150
-0.175
-0.200
-0.225
-0.250
Percent Change in Mean Sales Price
0.25
0.50
0.75
1.00
1.25
1.50
1.75
2.00
Distance from HWS (in miles)
Apartments
Offices
Retail
Industrial
Vacant

V. Neighborhood Impacts of Hazardous Waste Sites

In this section, the total impacts HSI and CERCLIS sites have on commercial and industrial properties in Fulton county are computed. The results from the previous section (in particular, Table 3) are used to compute these total impacts. For each property within a 1.5 mile radius of a CERCLIS or HSI site, the reduction in property value resulting from its proximity to a HWS is computed and summed across properties (see Appendix A, Section AIII for more detail on this computation). A conservative distance of 1.5 miles is chosen as the impacts are estimated to be very small beyond that point. The impacts of NFRAP sites are not included as they are found to be insignificant. The reduction in property values are computed for *all* properties that are one of the five land-uses we consider within a 1.5 mile radius of an HSI or CERCLIS site, regardless of whether or not the property has actually sold during the study period. The property value losses are summed in two ways: by land-use type for the whole county, and by census tract (for all land-use types). The sum is calculated by census tract so the losses can be related to neighborhood characteristics of the census tract in which the sites are located.

Table 5 presents the total estimated property value losses associated with HSI and CERCLIS sites located within the county. The estimated losses are substantial, with a minimum of $54.3 million for industrial establishments and a maximum of $377 million for apartments. The total losses across all five land-use types is approximately $1 billion.

TABLE 5. TOTAL PROPERTY VALUE LOSSES DUE TO HSI AND CERCLIS SITES IN FULTON COUNTY[a]

	Apartments	Office	Retail	Industrial	Vacant	Total
# of Properties	2,823	703	2,167	1,868	2,709	10,270
Total Value Loss ($ millions)	377	347	63.5	54.3	231	1,073
Total Value Loss / Total Assessed Value	0.18	0.13	0.07	0.05	0.19	0.10

[a]See Appendix A, Section AIII for details on the methods used to compute total property value losses.

To put the losses in context, they are compared with the total value of all properties in these land-use categories within 1.5 miles of an HSI or CERCLIS site. The value of each property, regardless of whether or not they actually sold during the study period, is the 1997 Fair Market Value (FMV) of each of property as recorded by the Fulton Couty Tax Assessment Office. This information that was contained in the property value data purchased from PDS, Inc. Because tax-assessed values generally underestimate market value, our comparison will overstate the size of the property value losses relative to true value of the properties.

As Table 5 reports, the property value losses as a percentage of total property value varies from 5 percent for industrial properties to 18 percent for apartments. Overall, the total property value losses associated with proximity to HSI and CERCLIS sites are 10 percent of the total fair-market value of properties within 1.5 miles of these sites. The $1 billion in losses also represents 5 percent of the total fair-market value of all non-residential properties in Fulton County.

Figure 11 summarizes the property value losses by census tract. The losses vary substantially, as would be expected given the distribution of HSI and CERCLIS sites across the county. A number of northern Fulton County census tracts indicated no property value losses. The largest impacts is $60.6 million for a census tract located in Hapeville, an area just south of the City of Atlanta.[5] There are 47 census tracts with no losses associated with HSI or CERCLIS sites. The average loss per census tract is $5.4 million. The total property losses that are estimated to occur within the City of Atlanta are $641.7 million, or 75 percent of the total losses in the County.

In comparison to the total tax-assessed values for each census tract, the property value losses due to hazardous waste sites can be substantial. There are 14 census tracts in the City of Atlanta and 2 census tracts in East Point, an area to the south of the City of Atlanta, where the value losses of properties located within 1.5 miles of a HWS are greater than 25 percent of the total tax-assessed value of all commercial and industrial properties in the census tract. As Figure 12 indicates, many census tracts in the

[5]Hapeville lies on the east-west portion of the Fulton county line, that forms a right angle on the eastern edge of the north/south portion of the county line.

FIGURE 11

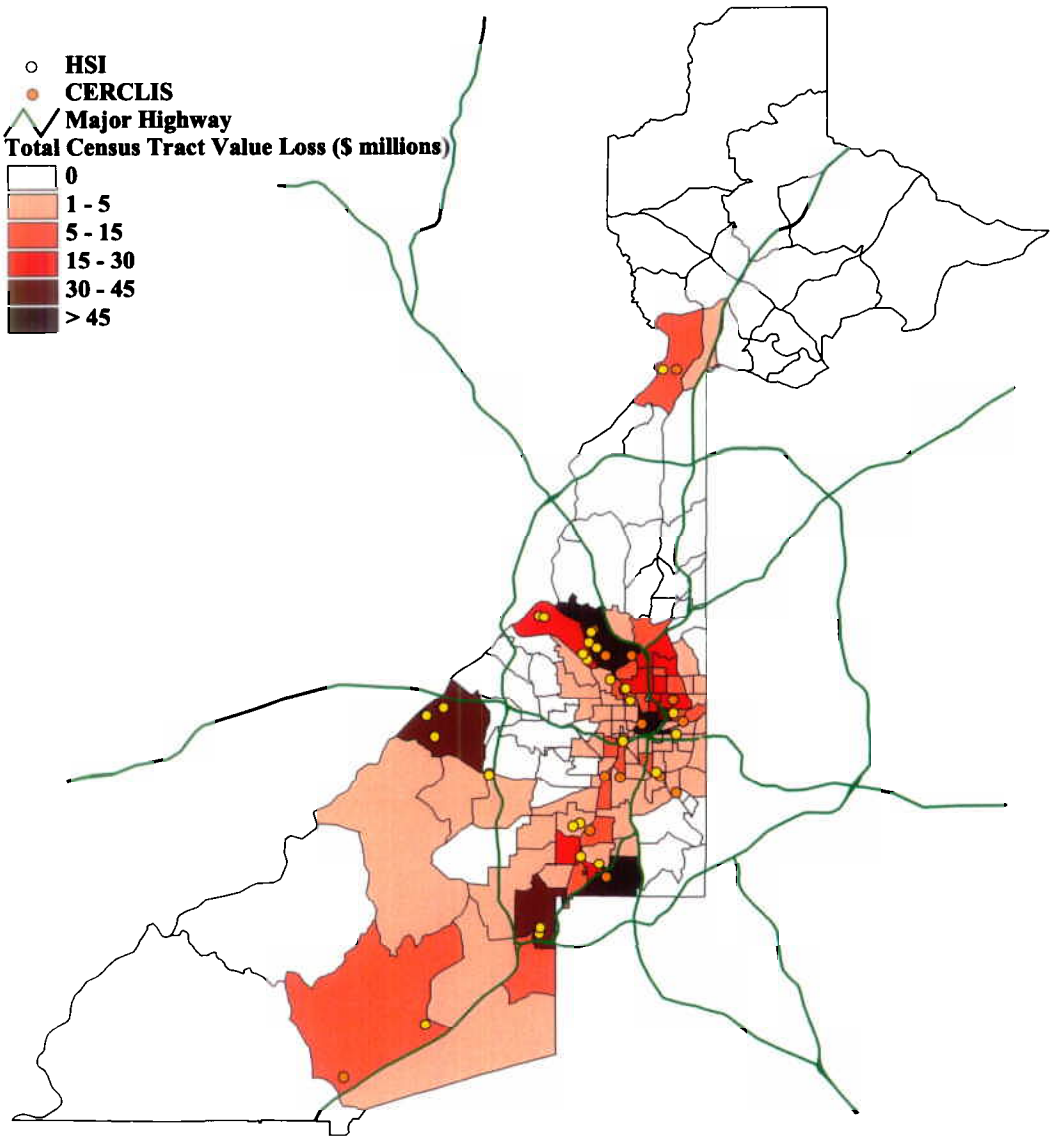
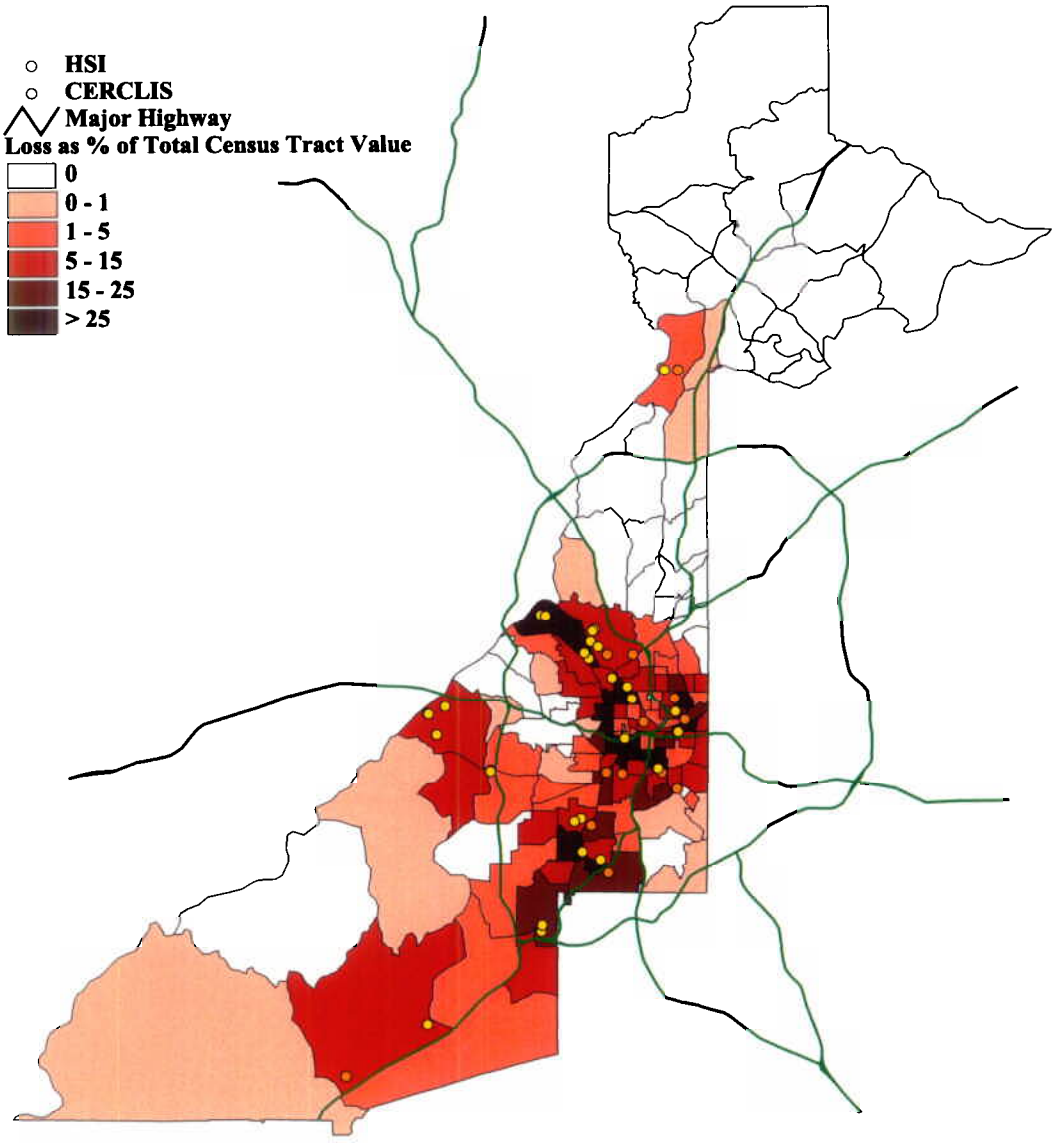

HSI
CERCLIS
Major Highway
Total Census Tract Value Loss ($ millions)
0
1 - 5
5 - 15
15 - 30
30 - 45
> 45

FIGURE 12


HSI
CERCLIS
Major Highway
Loss as % of Total Census Tract Value
0
0 - 1
1 - 5
5 - 15
15 - 25
> 25

City of Atlanta have property value losses that are greater than 5 percent of the total tax-assessed value of the commercial and industrial properties in the census tracts. There are substantial losses in other jurisdictions within the county as well. Both College Park and East Point, to the south of the City of Atlanta have more than one census tract with losses over 10 percent of total commercial and industrial tax assessed values.

The property value losses also occur primarily in areas with large African American communities. Figure 13 relates the proportion of African American residents in a census tract to the estimated property value losses as a percent of total commercial and industrial property values. If a census tract has property value losses greater than 5 percent of the total tax-assessed value of the commercial and industrial properties, the census tract is highlighted with cross-hatching on the map in Figure 13. The census tracts with the greatest percentage losses are primarily in majority, or near majority, African American neighborhoods. The larger property value losses are also occurring in relatively poor neighborhoods as Figure 14 indicates.

The results as presented in this section highlight that erosion in commercial and industrial property-tax bases due to hazardous waste sites (by as much as 25 percent and more in some census tracts) are predominantly occurring in low-income, majority African American neighborhoods that are located in or near the Atlanta city limits. As these areas have eroded tax-bases, the ability of local governments to provide services to these neighborhoods are diminished, thus highlighting the need for creative solutions to facilitate cleanup of these properties. In the next section, we discuss the possibility of one such solution: tax-increment financing of cleanup costs.

FIGURE 13

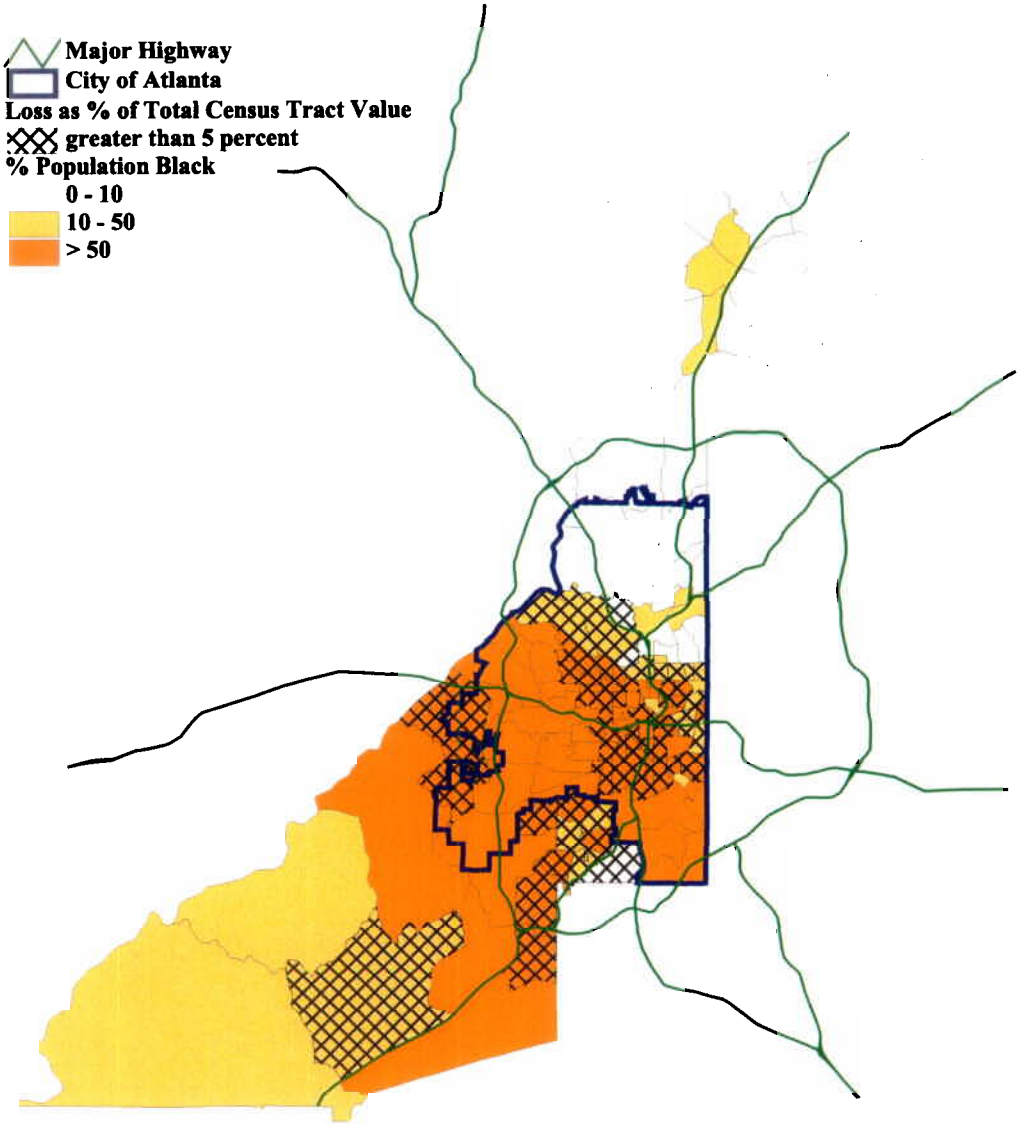
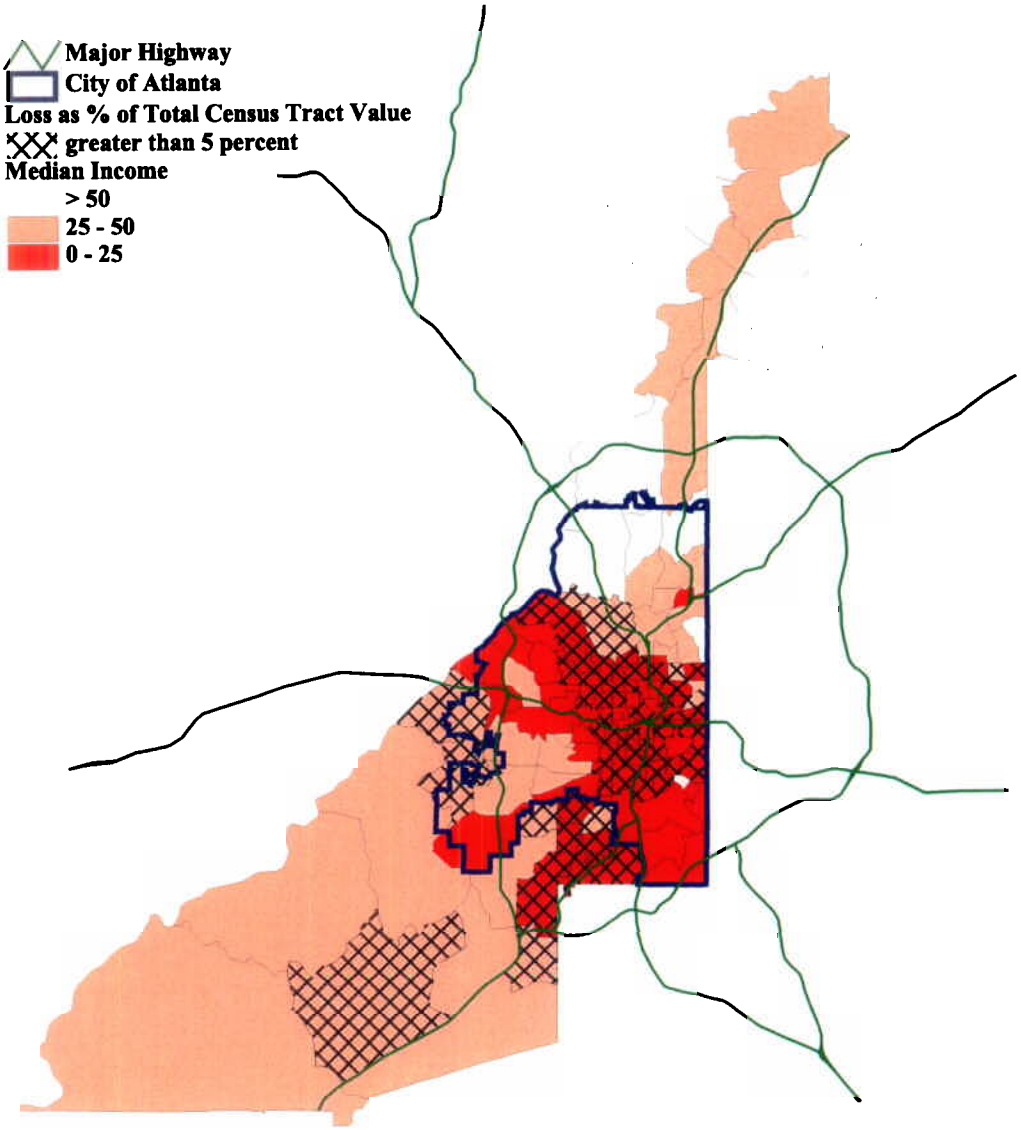

Major Highway
City of Atlanta
Loss as % of Total Census Tract Value
greater than 5 percent
% Population Black
0 - 10
10 - 50
> 50

FIGURE 14


Major Highway
City of Atlanta
Loss as % of Total Census Tract Value
greater than 5 percent
Median Income
> 50
25 - 50
0 - 25

VI. Public/Private Partnership Opportunities

Tax-increment financing (TIF) is a creative solution for financing public improvement projects by local governments. To finance a project with TIF, a local government would issue debt (bonds) to finance the project and then rely on increased property tax revenues to repay the debt. For instance, say the City of Atlanta uses tax increment financing (TIF) to finance the building of a new public park. The City would then develop an "improvement district" surrounding the park wherein any increases in tax revenues resulting in increases in property values within the district would be directed to a fund to repay the bonds. It is important to note that the "baseline" tax revenue is not redirected from its current uses. Only the incremental tax revenues that arise from the incremental increases in property values post-project completion are targeted for repayment of the debt. Tax-increment financing has been used for projects as large as $150 million (Indianapolis's expenditure on a large, enclosed downtown shopping mall) and has been used widely in Texas, California, and many mid-western states.[6]

In this section, the feasibility tax-increment financing for contaminated site cleanup is explored. If tax-increment financing is to be feasible, the expected increases in property values surrounding a site after it has been cleaned has to be of a magnitude sufficient to increase property tax revenues enough to payoff the bonds issued to finance the cleanup effort. To determine if this will be the case, the estimated increases in commercial and industrial property values are computed and summed across each of the five land-uses studied within 1.5 miles of a particular HSI or CERCLIS site.

The expected increase in property value associated with the cleanup of a nearby contaminated site is computed in the same manner as the losses were computed in the previous section. In Section 5, the change in property value was referred to as the "property value loss" associated with the contaminated site. This same value is referred to as the "expected value gain" associated with the clean-up of the site in this section.

[6]For an overview of TIF and its use across states, see C. Johnson and J. Man, *Tax Increment Financing and Economic Development: Uses, Structures, and Impact* (State University of New York Press: Albany, NY: 2001).

In other words, we expect the value loss associated with being near a contaminated site to be regained should the contaminates be fully removed. This expectation requires two assumptions: (1) there are no stigma effects associated with the former HSI or CERCLIS site post-cleanup and (2) the number of properties affected by cleanup are small relative to the whole market for these properties. The results reported in Section 4 for NFRAP sites suggest there may be little stigma effects post-clean up in commercial and industrial markets.

Table 6 lists the expected increases in property values surrounding all 44 unique HSI and CERCLIS sites in our database. Also indicated in the table is whether the site is an HSI site, a CERCLIS site, or if the site appears on both lists. The potential increases in property values vary substantially across sites. The largest potential gain is for a CERCLIS site and is $154 million and the smallest is for an HSI site with a potential gain of $1.57 million. There is one HSI site with no commercial and industrial properties of our five land-use types within 1.5 miles, and so there are no gains computed for this site. The measures reported in Table 6 are conservative to the extent that land-use types other than the five we consider will increase in value. The sum of the potential property value increases across sites equals $1.07 billion (the sum of the losses reported in the previous section).[7]

Table 6 also reports the expected additional annual tax revenue resulting from the cleanup of each site. Commercial and industrial properties are taxed on 40 percent of their assessed value at a millage rate of 5 percent. Thus, the expected increase in tax revenue is 2 percent of the total expected increase in property value given in column 1 of Table 6.

[7]If a property is within 1.5 miles of more than one HWS, the property is only included in the benefit measure associated with cleanup of the nearest site. This is consistent with the statistical models upon which the estimates are based. To the extent that properties may increase in value from cleanup of more than just the nearest site, these estimates will be conservative measures of the total benefits of cleanup.

TABLE 6. POTENTIAL TAX-INCREMENT FINANCING FOR HWS CLEANUP

Expected Value Gain	Site Type	Expected Additional Annual Tax Revenue	Years to Bond Repayment (Cost=$1m)	Years to Bond Repayment (Cost=$5m)	Years to Bond Repayment (Cost=$10m)
$154,000,000	CERCLIS	$3,080,000	0.3	1.8	4.0
$115,000,000	CERCLIS	$2,300,000	0.4	2.5	5.9
$74,400,000	CERCLIS	$1,488,000	0.7	4.2	11.3
$66,700,000	HSI	$1,334,000	0.8	4.8	13.6
$53,200,000	BOTH	$1,064,000	1.0	6.5	21.8
$47,900,000	HSI	$958,000	1.1	7.6	27.9
$44,000,000	CERCLIS	$880,000	1.2	8.6	**
$39,200,000	CERCLIS	$784,000	1.4	10.3	**
$36,700,000	HSI	$734,000	1.5	11.5	**
$32,300,000	BOTH	$646,000	1.7	14.5	**
$28,600,000	HSI	$572,000	2.0	18.4	**
$28,000,000	HSI	$560,000	2.0	19.2	**
$27,100,000	HSI	$542,000	2.1	20.7	**
$27,000,000	HSI	$540,000	2.1	20.8	**
$24,900,000	CERCLIS	$498,000	2.3	23.3	**
$21,600,000	CERCLIS	$432,000	2.7	**	**
$19,900,000	HSI	$398,000	3.0	**	**
$18,400,000	CERCLIS	$368,000	3.2	**	**
$17,100,000	BOTH	$342,000	3.5	**	**
$16,600,000	HSI	$332,000	3.7	**	**
$15,500,000	HSI	$310,000	4.0	**	**
$15,400,000	CERCLIS	$308,000	4.0	**	**
$14,800,000	CERCLIS	$296,000	4.2	**	**
$13,400,000	BOTH	$268,000	4.8	**	**
$11,900,000	CERCLIS	$238,000	5.6	**	**
$11,800,000	BOTH	$236,000	5.7	**	**
$10,700,000	CERCLIS	$214,000	6.5	**	**
$10,500,000	HSI	$210,000	6.7	**	**
$9,530,000	CERCLIS	$190,600	7.7	**	**
$8,250,000	HSI	$165,000	9.5	**	**
$6,770,000	HSI	$135,400	13.3	**	**
$6,370,000	HSI	$127,400	14.8	**	**
$6,240,000	HSI	$124,800	15.4	**	**
$6,130,000	HSI	$122,600	16.0	**	**
$5,790,000	HSI	$115,800	17.9	**	**

Table 6 continues next page...

TABLE 6 (CONTINUED). POTENTIAL TAX-INCREMENT FINANCING FOR HWS CLEANUP

Expected Value Gain	Site Type	Expected Additional Annual Tax Revenue	Years to Bond Repayment (Cost=$1m)	Years to Bond Repayment (Cost=$5m)	Years to Bond Repayment (Cost=$10m)
$5,080,000	HSI	$101,600	24.0	**	**
$4,920,000	HSI	$98,400	26.0	**	**
$4,890,000	HSI	$97,800	26.5	**	**
$3,770,000	HSI	$75,400	**	**	**
$3,150,000	BOTH	$63,000	**	**	**
$2,740,000	CERCLIS	$54,800	**	**	**
$1,630,000	BOTH	$32,600	**	**	**
$1,570,000	HSI	$31,400	**	**	**
$0	HSI	$0	**	**	**

To determine the possibility of tax-increment financing of any one of these sites, information on the costs of cleanup are needed. Unfortunately, information on costs of cleanup at specific sites are not available. The Georgia EPD has completed investigation and cleanup at 113 HSI sites in the state at a total cost of $73.6 million, or $651,327 per site, and estimates an average cleanup cost of less than $1 million per site for the remaining HSI sites in Georgia.[8] Yet, private parties have argued that average cleanup costs are likely to be much larger, on the order of $10 million per site. With such a large range in the expected cleanup costs, three possible cost-of-cleanup scenarios are considered: $1, $5, and $10 million.

If cleanup is costs are covered through tax-increment financing, a local governmental authority (either the County or the City of Atlanta) would issue bonds sufficient to cover the cost of cleanup and any transactions costs associated with issuing the bonds.[9] In our example, bond issuances of $1, $5 or $10 million total are considered, implying an annual debt service of either $60,000, $300,000 or $600,000, respectively

[8]"Cleaning Up Georgia's Hazardous Sites," Environmental Protection Division, Georgia Department of Natural Resources, Hazardous Sites Response Program, January 2001.

[9]Transactions costs can be substantial, as much as $200,000 for the issuance of $800,000 in bonds. It is assumed the $1, $5, and $10 million cleanup costs include these transactions costs.

(the municipal bond interest rate is generally 6 percent). These bond amounts are representative of the typical TIF bond issuances. The average issue size of TIF bonds across U.S. munipicalities is $6 million, which is considered small by financial markets (Johnson and Man, 2001, p.74-75).

The last three columns of Table 6 report the years it would take to pay-back the bonds, or the years to maturity on the bonds. The maturity times in Table 6 assume there is no lag time between the realized increase in property values and the issuance of the bonds. In this case, the number of years it would take to pay back the bonds is calculated by dividing the total value of the bonds by the yearly additional tax revenue net of the annual debt service cost (given in column 3). For instance, consider the HSI site for which it is estimated that property value surrounding the site would increase by $44 million should the site be cleaned, thus implying additional annual tax revenues of $880,000. If the cost of cleaning this site (plus transactions costs of issuing bonds) is $1 million, the annual debt service would be $60,000, and so the additional tax-revenue net of debt-service is $820,000. The additional $820,000 would be placed in a special fund designated for repayment of the bonds, and the fund would reach $1,000,000 (enough to repay the bonds) in 1.2 years. The assumption of a full recovery of property values at the end of a year is unrealistic and is relaxed later without changing the overall results qualitatively.

Cleanup of the sites highlighted in yellow in Table 6 could be financed with bonds that mature in five years or less. Sites highlighted in orange and brown can be financed with bonds that mature in 15 or 30 years, respectively. Table 6 highlights how sensitive the feasibility of tax-increment financing is to the cost of cleanup. If the cost of cleanup is $1 million or less, 86 percent of all HSI and CERCLIS sites in Fulton county would be candidates for tax-increment financing of their cleanup. However, if the cost of cleanup averages $10 million, only a few sites (6 of 44 sites) would have expected property value gains sufficient to cover the costs of cleanup through a tax-increment financing plan. The sites for which it is not feasible to use a tax-increment financing plan because either the bond-life would be longer than 30 years, or the

additional annual tax revenue is not enough to cover even the debt service are marked with a "**" in Table 6.

As stated earlier, the above assumes the increased property values are realized immediately. If instead, we assume it is up to 10 years before the full increase in property values are realized, 80 percent of the sites would still be candidates for tax-increment financing if cleanup costs are $1 million. If instead, cleanup costs are $5 million, 12 sites highlighted in Table 6 are still eligible for tax-increment financing, and if cleanup costs are $10 million, four of the highlighted sites in Table 6 are eligible for TIF.

Figures 15 through 17 highlight the location of each site that is feasible for cleanup with a TIF plan. Sites whose cleanup can be financed with 5, 10, or 30 year bonds are highlighted in yellow, orange, and red, respectively. Figure 15 illustrates how most sites within the City of Atlanta are good candidates for a TIF plan when cleanup costs average $1 million per site. However, if costs are $5 or $10 million per site, only a few sites are eligible for TIF within the City limits. Nonetheless, cleanup of just three of these sites could generate additional tax revenues for the City of over $6 million per year as the properties surrounding these sites increase in value.

In Figure 18, cleanup costs are assumed to be $5 million per site and the sites that are eligible for TIF are related to the income and racial distribution of the neighborhoods in which they are located. As indicated in the map, the cleanup of over 50 percent of the sites eligible for TIF would benefit primarily majority African American neighborhoods and neighborhoods where median household incomes are less than $25,000 per year. Additional tax revenues of up to $15 million for the local governments that would result from cleanup of the fifteen eligible sites are substantial and could significantly help with the provision of local services as well as increase general economic activity in the areas.

FIGURE 15

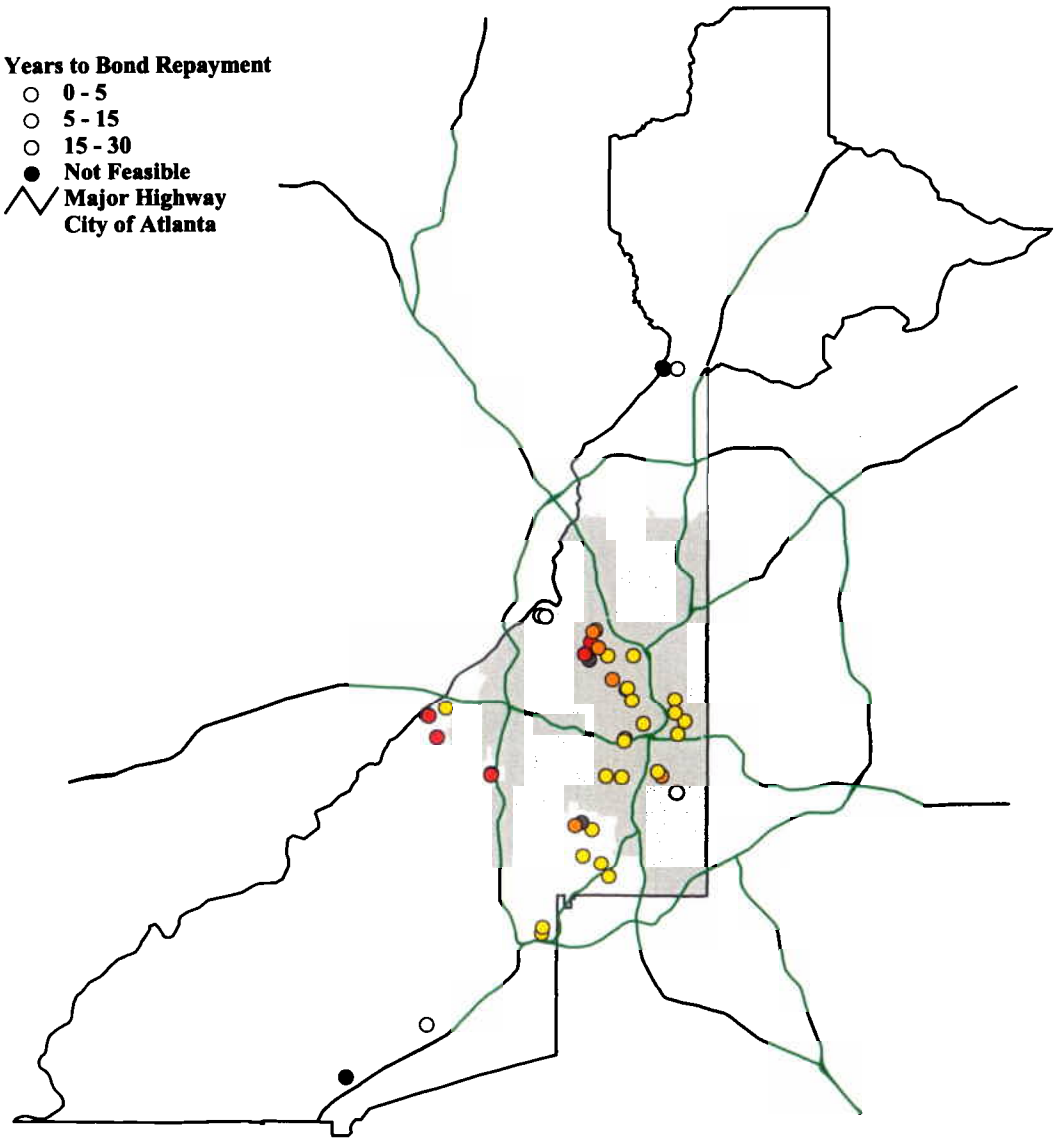

Years to Bond Repayment
0 - 5
5 - 15
15 - 30
Not Feasible
Major Highway
City of Atlanta

FIGURE 16

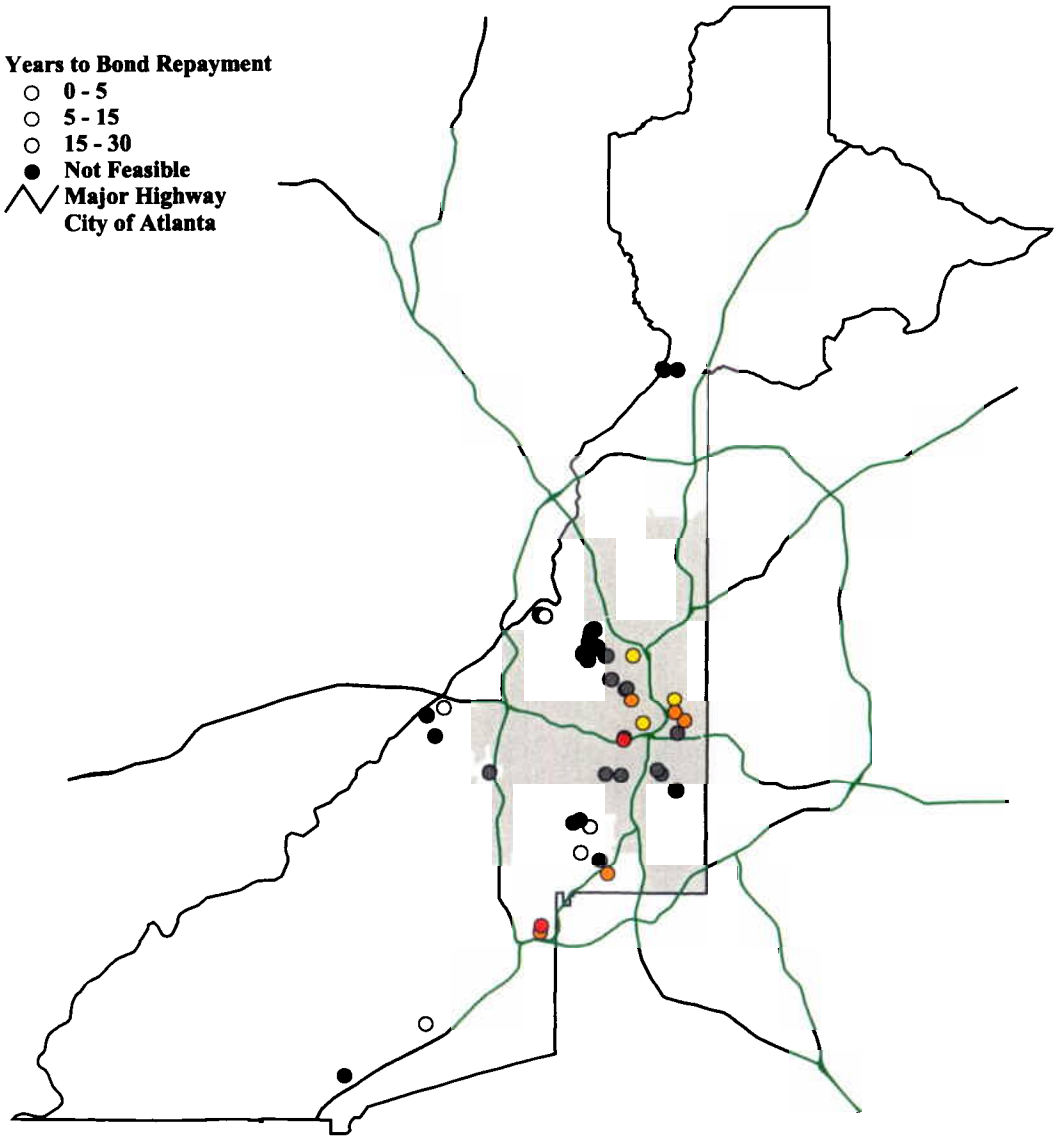

Years to Bond Repayment
0 - 5
5 - 15
15 - 30
Not Feasible
Major Highway
City of Atlanta

FIGURE 17

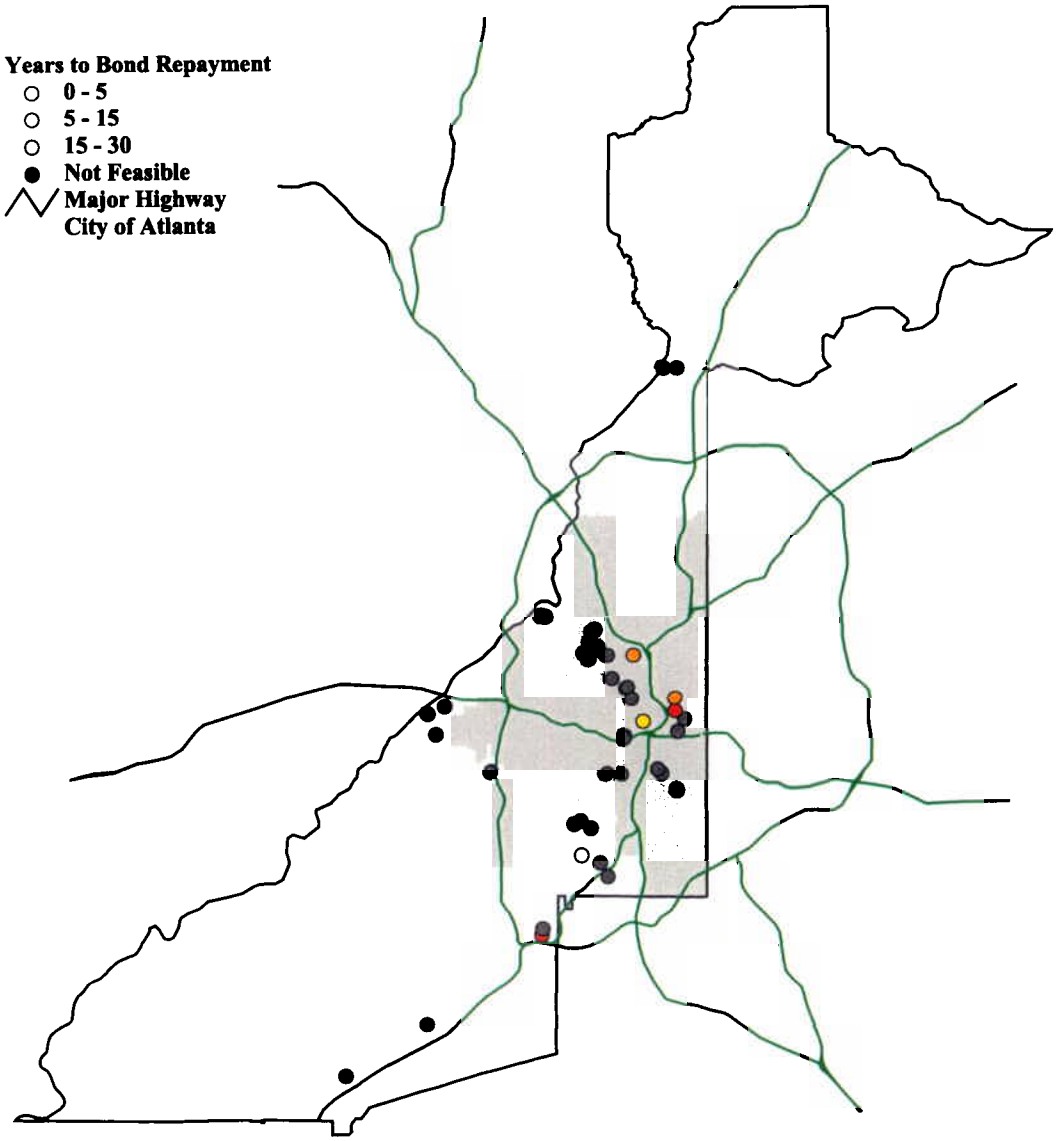
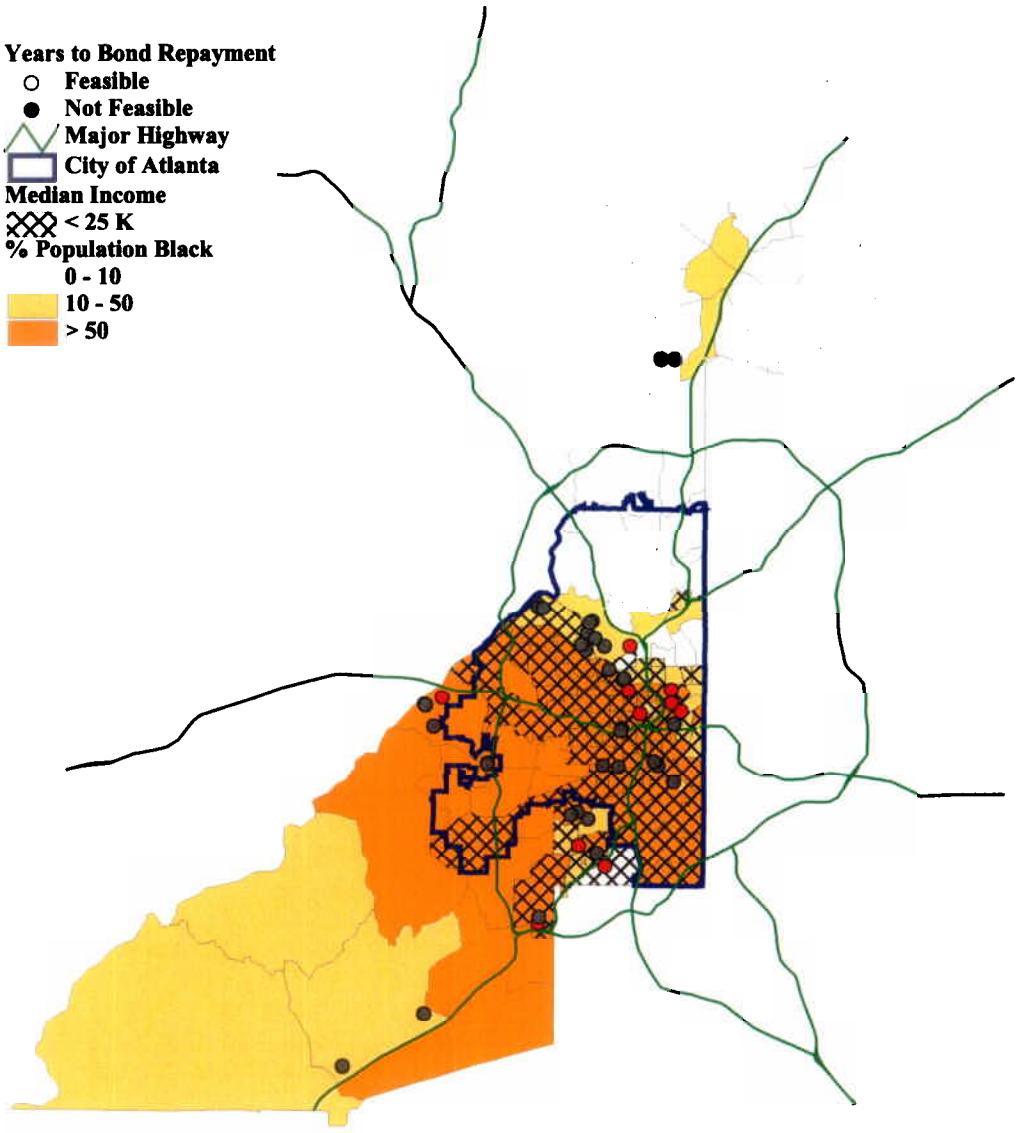

Years to Bond Repayment
0 - 5
5 - 15
15 - 30
Not Feasible
Major Highway
City of Atlanta

FIGURE 18


Years to Bond Repayment
Feasible
Not Feasible
Major Highway
City of Atlanta
Median Income
< 25 K
% Population Black
0 - 10
10 - 50
> 50

VII. Conclusions

The possible impacts that hazardous waste sites might have on nearby commercial and industrial property values is explored in this research. Hazardous waste sites listed on the Georgia Hazardous Sites Inventory (HSI) and the U.S. Environmental Protection Agency's databases of hazardous sites (CERCLIS) were found to have significant negative impacts on surrounding commercial and industrial property values. Property value losses in Fulton County, Georgia resulting from the 44 HSI and CERCLIS sites within the county are estimated to be approximately $1 billion or approximately 10 percent of the total fair market value of non-residential properties in Fulton County. Because many of these hazardous waste sites are located in majority African-American, low-income neighborhoods, the negative economic impacts associated with these sites fall primarily on these communities.

The magnitude of the property value losses are particularly interesting from a policy perspective. If each HSI and CERCLIS site within the county is cleaned and removed from the lists of hazardous sites, the resulting increase in property values could imply a $428 million increase in taxable value of properties in Fulton County and with a millage rate of 5 percent, this implies an additional $21 million in tax revenue per year that could potentially be gained by the City of Atlanta and Fulton County (approximately 75 percent of the property value gains are estimated to occur within the City limits).

The estimated gain in value of properties surrounding the sites after they are cleaned appear to be sufficiently large to justify tax-increment financing of cleanup. Local governments could issue bonds to pay for immediate clean-up of sites and then rely on increased future property-tax revenues (resulting from property values rising after the hazardous site has been fully remediated) to repay the bonds. The Environmental Protection Division (EPD) of the State of Georgia has estimated that cleanup costs per site could be as low as $1 million per site. If this is the case, approximately 80 percent of the hazardous waste sites in Fulton County could have cleanup financed by tax-increment financing. Even if cleanup costs are ten-fold higher than estimated by the EPD, approximately 14 percent of the sites in Fulton could be cleaned through a tax-increment financing scheme. Importantly, the sites that are good

candidates for a tax-increment financing of cleanup are also the sites that are located in low-income neighborhoods. Creative financing programs that help the public sector facilitate the cleanup of these sites, possibly resulting increased property-tax revenues of $5 to $10 million or more annually, could substantially improve local government's ability to enhance services and improve schools in these communities.

Appendix A

AI. Hedonic Price Model

The model and results presented here, as well as much of the discussion are from K. Ihlanfeldt and L. Taylor, "Assessing the Impacts of Environmental Contamination on Commercial and Industrial Properties," Environmental Policy Working Paper Series #2001-001, Environmental Policy Program, Andrew Young School of Policy Studies, Georgia State University, Atlanta, Georgia, 30307 and *Journal of Environmental Economics and Management,* forthcoming 2004.

The hedonic price model estimated to investigate the spillover effects of List1 and List2 sites can be expressed as follows:

$$P_{it} = a + \sum_{t=1}^{T} b_t D_t + \sum_{j=1}^{J} c_j X_{jit} + d_1 IDL1_i^B + d_2 IDL1_i^A + e_1 IDL2_i^B + e_2 IDL2_i^A + e_3 IDL2_i^D + w_{it} \quad (1)$$

where P_{it} = transaction price of property i at time t, t = 1981 to 1998;

D_t = dummy variables indicating the year the property was last sold;

X_{jit} = j property characteristics of property i in time t, including location-oriented variables;

$IDL1^B$ = inverse of distance from property to List1 site if sale occurred before the site was listed, otherwise 0;[10]

$IDL1^A$ = inverse of distance from property to List1 site if sale occurred after the site was listed, otherwise 0;

$IDL2^B$ = inverse of distance from property to List2 site if sale occurred before the site was listed, otherwise 0;

$IDL2^A$ = inverse of distance from property to List2 site if sale was after the site was placed on CERCLIS but before de-listing, otherwise 0;

[10]All distances are converted from meters to quarter-mile increments (thus, 500 meters = 1.24 quarter miles = 0.31 miles). Distances are converted because the distances involved are relatively small and quarter-mile increments yield marginal effects whose magnitudes are easy to understand. Reported coefficient estimates are thus scaled to reflect the change in price for a quarter-mile change in distance.

$IDL2^D$ = inverse of distance from property to List2 site if sale was after de-listing (i.e., after site was listed as NFRAP), otherwise 0;

w_{it} = random error.

Equation (1) is estimated separately for five different land uses: apartments, offices, industrial, retail, and vacant land. Equation (1) assumes the price-distance relationship (also called a price-distance "gradient") is described by the reciprocal transformation, 1/DL1, where DL1 is the linear distance to the nearest List1 site measured in quarter-mile increments (same applies for distance to list2 sites, DL2). Under this transformation, if the estimated coefficient on distance is negative, price will increase with distance at a decreasing rate approaching an asymptotically constant level. A priori, this is an attractive functional form because it is consistent with the general notion that spillover effects have a greater impact closer to their source but have no effect beyond a certain distance.

Equation (1) allows gradients and their intercepts to vary before and after listing in the case of List1 sites. In the case of List2 sites, the relationship is allowed to vary before CERCLIS listing, after CERCLIS listing but before delisting, and after delisting. The equation is estimated using sales over the period 1981 – 1998. The length of this period provided a reasonable number of sales before and after listing of the sites. The control variables (X_j) entering equation (1) are extensive and a complete listing of the variables, their definitions and sources are available in Appendix B, Table B1.

The implicit price of distance is the change in price associated with a change in proximity to the site. Note, "proximity" and "distance" are used interchangeably since they are measured identically. This price is computed as the derivative of the hedonic price equation with respect to distance. Given the specification of the hedonic model in equation (1), the implicit price of distance to a List1 site (DL1) prior to the site being listed is:

$$\frac{\partial P}{\partial D} = -\hat{d}_1 \frac{1}{DL1^2}, \qquad (2)$$

and the implicit price of proximity to the site after it is listed is:

$$\frac{\partial P}{\partial D} = -\hat{d}_2 \frac{1}{DL1^2}, \tag{3}$$

where $\hat{d}_1$ is the estimated coefficient for $IDL1^B$, $\hat{d}_2$ is the coefficient for $IDL1^A$, and DL1 is the distance from the property to the contaminated site. The implicit prices for List2 sites are computed analogously.

Several estimation issues arise related to the spatial nature of the data. The first issue is whether sales price observations should be restricted to some maximum distance from the listed sites. Preliminary estimation revealed that including observations that are beyond 2 miles of a listed site reduced the precision of the estimated coefficients for distance, but did not impact their magnitude. These observations are therefore excluded from the estimation of the hedonic price models.

Secondly, given the spatial nature of the data, and the hypotheses tested, the possibility of spatial dependence in the data must be considered. Robust Lagrange multiplier tests for spatial error autocorrelation were conducted. These tests, which are recommended by Anselin, et al., have good finite-sample properties and are robust to local mis-specification of the spatial dependence.[11] To conduct these tests, a spatial weight matrix has to be constructed which specifies the spatial structure of the data. The matrix constructed has elements equal to the inverse of distance between properties within two miles of a contaminated site and zero otherwise.

The null hypothesis of no spatial autocorrelation could *not* be rejected at the 95 percent level of confidence in the cases of office and vacant properties. However, we could reject the null hypotheses for the apartment and retail markets. Thus, spatial autoregressive (SAR) models were estimated. These models resulted in estimated gradients that did not differ appreciably from the OLS results using White's heteroskedasticity-consistent estimator of the variance-covariance matrix either in

[11]L. Anselin, A. Bera, R. Flora, and M. Yoon. "Simple diagnostic tests for spatial dependence," *Regional Science and Urban Economics*, 26, 1996, pp. 77-104.

magnitude or significance.[12] Thus, the OLS results are thus reported here. See Ihlanfeldt and Taylor for more detail on the SAR models.

[12]H. White, "A heteroskedasticity-consistent covariance matrix estimator and a direct test for heteroskedasticity," *Econometrica*, 48, 1980, pp. 817-838.

AII. Estimation Results

Complete results for all five hedonic price models are reported in Appendix B, Section BII. The apartment, office, and retail equations each explain over 49 percent of the variation in sales price within each of their respective categories. The industrial and vacant land equations performs less well, explaining approximately 25 percent of the variation in sales price. The lower R-square for these categories likely reflects differences in the value of machinery included with the property (in the case of industrial properties), and the topographic features of the land for vacant land that affects sales price, but which are not included in the property database. Because so few hedonic price equations for commercial and industrial property have been estimated, there is no benchmark that can be used to determine the explanatory success of the models estimated. Nevertheless, the R-squares of the models compare favorably to those obtained in the extensive literature that has estimated hedonic price models for single-family homes. Generally, the signs on the coefficients estimated for the X_j variables are as expected for each of the models estimated. A brief description of these results are included in Appendix B, Section BII.

The estimated coefficients for the distance variables related to List1 sites are reported in Table A1. For all land uses, the models indicate that proximity to a List1 site does not have an impact on price that is significantly different from zero prior to a site being listed on the HSI or CERCLIS. However, post-listing, all land-uses indicate that there is a significant, negative relationship between price and the inverse of distance to a List1 site.

TABLE A1. ESTIMATED DISTANCE COEFFICIENTS FOR LIST1 SITES.[a]

	Apartments	Offices	Retail	Industrial	Vacant Land
Pre-Listing	-63,518	-1,109	-29,976	-9,462	-36,382
	(110,190)	(81,890)	(19,652)	(26,512)	(83,113)
Post-Listing	-331,532**	-1,033,108**	-80,336*	-42,838*	-168,067*
	(122,952)	(404,692)	(44,901)	(24,028)	(95,922)
R-Squared	.569	.560	.491	.273	.252
Observations	1229	260	816	644	582

[a] Dependent Variable is sales price. Standard errors in parentheses.
* Significant at the 5 percent level in a two-tailed test.
** Significant at the 1 percent level in a two-tailed test.

Table A2 reports the coefficient estimates for List2 sites, and as indicated in the table, List2 sites do not seem to have a consistent impact on sales prices across land-uses. It is interesting to note that all coefficients are estimated to be negative during the time period a site is listed on CERCLIS, however, the relationship is only significantly different from zero for offices.

TABLE A2. ESTIMATED COEFFICIENTS FOR LIST2 SITES.[a]

	Apartments	Offices	Retail	Industrial	Vacant Land
Pre-Discovery	94,557	-563,838	4,331	-49,158	-148
	(115,702)	(941,449)	(10,148)	(39,215)	(82,001)
Post-Discovery	-197,345*	-287,726	1,195	-19,514	-13,528
	(107,124)	(188,534)	(11,282)	(26,895)	(43,654)
Post-Delisting	52,487	-126,480	4,136	38,100	40,918
	(66,954)	(238,554)	(11,053)	(25,592)	(76,722)
R-Squared	0.569	0.560	.491	.585	.252
Observations	1229	260	816	255	582

[a] Dependent variable is sales price. Standard errors in parentheses.
* Significant at the 10 percent level in a two-tailed test.

AIII. Computation of Price Changes

The estimated property value change associated with being close to a listed site is given by the difference in the predicted price of a property pre- and post-listing of a nearby contaminated site. More formally, the property value change, ΔP, for property i of land use type j is given by:

$$\Delta \hat{P}_i = \hat{P}_i^B - \hat{P}_i^A = (\hat{d}_{1j} - \hat{d}_{2j}) \frac{1}{DLI_i}. \quad (4)$$

In equation (4), the difference in the estimated price of the property before and after listing is equal to the difference in the estimated coefficients for $IDL1^B$ and $IDL1^A$ (defined in equation 1) weighted by the distance of site i to the nearest List1 site. This measure of value change captures the possibility that contaminated sites might have positive (or negative) effects on property values prior to their being discovered as being contaminated. The coefficients, d_1 and d_2, are specific to each of the j land-use types.

The other possibility is to compute the change in price as:

$$\Delta \hat{P}_i^{alt} = -\hat{d}_{2j} \frac{1}{DLI_i}, \quad (4)$$

in which the change in price is simply the reduction in property value associated with a certain distance to a List1 site after the site is listed. This approach ignores any price impacts of List1 sites prior to their listing and is a *less* conservative measure of the price changes for each of our land uses (because d_1 and d_2 are both estimated to be negative for all land uses).

To compute the total expected losses resulting from the listed sites, we compute ΔP_i for each property that is one of the j land-use types and is within a 1.5-mile radius of a List 1 site, regardless of whether or not it actually sold during the 18 year study period. The expected change in price for each property is them summed to compute the total losses for each land use type.

Appendix B

BI. Variable Names

Variable descriptions in Table B1. correspond to the variable names given in the regressions reported in Table B2. Both the variable names and the regression results are directly from Ihlanfeldt and Taylor. The variables names for a few key variables of interest were changed for ease of exposition in Appendix A.

TABLE B1. VARIABLE DESCRIPTIONS.

VARIABLE NAME	DESCRIPTION
Property Characteristics: Obtained from Property Data Systems, Inc.	
saleprice	Most recent sales price of the property.
yr5-22	Dummy variables indicating the year in which the property sold for the years 1981 to 1998.
sqft (sqft2)	Square feet, in thousands of feet, of all improvements on a property (square feet squared).
numimp	Number of improvements on a property.
acre (acre2)	Acreage of the property (acreage squared).
age (age2)	The age of the primary improvement (age squared).
gradeab, gradec	Dummy variable indicating the structures on the property were scored by the tax assessors with an A or B rating, the two best possible ratings on a scale of A through E. Gradec indicates the property received a quality scoring of C. Gradeab and gradec are compared to grades D or E, the two categories left out of the models. D and E are combined due to small numbers of observations receiving an E score.
concrete	Dummy variable indicating whether the exterior wall of the primary structure is concrete.
glass	Dummy variable indicating whether or not the exterior wall of the primary structure was glass.

Table B1 continues next page...

TABLE B1 (CONTINUED). VARIABLE DESCRIPTIONS.

VARIABLE NAME	DESCRIPTION
Property Characteristics: Obtained from Property Data Systems, Inc.	
frame	Dummy variable indicating whether or not the exterior wall of the primary structure was frame.
extmisc	Dummy variable indicating whether or not the exterior wall of the primary structure was combined wall types.
brick	Dummy variable indicating whether or not the exterior wall of the primary structure was brick (category left out of the models).
pkadeq	Dummy variable indicating whether or not the property has adequate parking.
front1- front3	Dummy variable indicating if the property fronts a major strip (front1), a secondary artery (front2), or secondary streets and frontage roads (front3). The category not included in the model varies across land uses.
loccod1-loccod8	Dummy variables indicating the type of location for the property. Categories are: CBD or permanent CBD (loccod1), business cluster (loccod2), major strip (loccod3), secondary strip (loccod4), neighborhood or spot (loccod5), commercial/industrial park (loccod6), industrial site (loccod7), apartment/condominium (loccod8). The category not included in the model varies across land uses.
ad1-ad3	Dummy variables indicating specific land-use codes within apartments and hotels. Categories are: non-high-rise apartments (ad1), hotels/motels (ad2), nursing/boarding homes (ad3).
rd1, rd2	Dummy variables indicating specific land-use codes within retail. Categories are eating and drinking establishments (rd1), and fast food (rd2).
od1	Dummy variable indicating land-use is a high-rise office.
manuf	Dummy variable indicating industrial land use is for manufacturing.

Table B1 continues next page...

TABLE B1 (CONTINUED). VARIABLE DESCRIPTIONS.

VARIABLE NAME	DESCRIPTION
Property Characteristics: Obtained from Property Data Systems, Inc.	
id1, id2	Dummy variables indicating specific land-use codes within industrial, other than manufacturing. Categories are: cold storage (id1) and mini warehouse (id2).
Location-Oriented Variables: Created with ARCVIEW Geographic Information Systems	
juris1-9	Dummy variables indicating the tax jurisdiction in which the property is located. Categories are: Alpharetta (juris1), Atlanta (juris2), College Park (juris3), East Point (juris4), Fairburn (juris5), Fulton County unincorporated (juris6), Hapeville (juris7), Palmetto (juris8), Roswell (juris9). Category not included in the model varies by land-use type. Sales included in our models did not occur in every jurisdiction for each land use.
north	Dummy variable equal to one of the property is located north of the central-point of the central business district.
cbd (ncbd)	Distance to the center-point of the central business district. The center is the central public rail transit station (5-points MARTA station) in downtown Atlanta (distance to the center-point of the central business district interacted with the dummy variable 'north').
marta1	Dummy variable equal to one if a property was within one mile of a MARTA station at the time of sale.
exit (nexit)	Distance to the nearest highway exit (distance to the nearest highway exit interacted with the dummy variable 'north').
harts (harts2)	Distance to Hartsfield International Airport (distance to the airport squared).

Table B1 continues next page...

TABLE B1 (CONTINUED). VARIABLE DESCRIPTIONS.

VARIABLE NAME	DESCRIPTION
	Census-Tract Variables: Obtained from the Atlanta Regional Commission (ARC) and Donnelly, Inc.
rmedinc [from Donnelly, Inc.]	Real median income, by year, of the census tract in which the property is located. Real median income for years 1981-1989 and 1991-1996 are estimated based on census data from 1980 and 1990. Estimates for 1997 were not available and so sales in 1997 are assigned values from 1996.
popden (npopden) [from ARC]	Population density (persons per acre of land), by year, of the census tract in which the property is located. Population densities in non-census years are assigned in the same manner as described for rmedinc (population density interacted with dummy variable 'north').
empden (from ARC)	Employment density (workers in all sectors per acre of land), by year, of the census tract in which the property is located. Employment densities in non-census years are assigned in the same manner as described for rmedinc.
minority (nminority) [from ARC]	Percent non-white in the census tract in which the property is located. Racial compositions in non-census years are estimated by ARC by conducting field surveys (minority interacted with the dummy variable 'north').
vacant (from ARC)	Percent of the land-area that is vacant in the census year closest to the sale date in the census tract in which the property is located.
	Proximity to Listed Sites Variables: Created with ARCVIEW Geographic Information Systems
IDL1[B]	Inverse of distance from property to List1 site (measured in quarter-mile increments) if sale occurred before the site was listed, otherwise 0. Measurements are not rounded. Thus, 500 meters = 1.24 quarter miles = 0.31 miles.

Table B1 continues next page...

TABLE B1 (CONTINUED). VARIABLE DESCRIPTIONS.

VARIABLE NAME	DESCRIPTION
	Proximity to Listed Sites Variables: Created with ARCVIEW Geographic Information Systems
IDL1[A]	Inverse of distance from property to List1 site (measured in quarter-mile increments) if sale occurred after the site was listed, otherwise 0.
IDL2[B]	Inverse of distance from property to List2 site (measured in quarter-mile increments) if sale occurred before the site was listed, otherwise 0.
IDL2[A]	Inverse of distance from property to List2 site (measured in quarter-mile increments) if sale was after the site was placed on CERCLIS but before de-listing, otherwise 0.
IDL2[B]	Inverse of distance from property to List2 site (measured in quarter-mile increments) if sale was after de-listing (i.e., after site was listed as NFRAP), otherwise 0.

BII. Regression Results

Complete regression results for each of the five landuses are reported in the following tables. Highlighted in bold are the estimates for the variables of interest related to the List1 and List2 sites. Table B2 and B3 report the coefficient estimates and p-values. P-values are based on robust standard errors. See Table B1 for variable definitions. Regression results are from Ihlandfeldt and Taylor.

Briefly, before presenting the tables, the results for the variables not related to risk are discussed. For non-vacant land, the models indicate that larger structures located on the parcel increase sales price (see coefficients for sqft and sqft2). Similarly, larger acreage increases sales prices for all land-uses. The age of a structure negatively impacts sales prices for retail prices, and apartment and retail properties that are assigned high grades by the tax assessors office (gradeab) sell for more than properties that are assigned low grades. The remaining location-oriented variables and miscellaneous characteristics vary in sign and significance across regressions.

TABLE B2. REGRESSION RESULTS FOR APARTMENTS, OFFICES AND RETAIL PROPERTIES

	Apartments		Offices		Retail	
	coefficient	p-value	coefficient	p-value	coefficient	p-value
constant	66.8	0.964	-2,116.3	0.025	373.9	0.044
yr6	-460.6	0.079			-145.9	0.003
yr7	-275.2	0.098	956.3	0.015		
yr8	286.6	0.053				
yr9			674.0	0.066		
yr10			876.2	0.005		
yr11	671.3	0.213	1,075.7	0.005		
yr12			1,035.5	0.011	94.5	0.024
yr13			1,720.2	<0.001	307.7	0.016
yr17	-60.2	0.627			53.5	0.373
yr18			1,596.5	<0.001		
yr19			504.2	0.293	327.7	0.029
yr20			1,127.1	0.077	77.6	0.077
yr21	191.3	0.129	1,653.7	<0.001	111.0	0.037
yr22	324.0	0.039				
sqft	48.4	0.006	28.7	0.013	10.7	0.245
sqft2	-0.0	0.010	-0.1	0.001	0.1	0.177
numimp	-214.4	0.240	469.0	0.117	-108.0	0.021
acre	406.4	0.067			246.5	0.046
acre2	-5.2	0.291	25.3	0.042		
age	24.9	0.346			-7.4	0.010
age2	-0.2	0.279			0.0	0.033
gradeab	1,414.7	0.013			290.7	0.065
gradec					-46.1	0.200
concrete	376.1	0.276	1,344.7	0.001		
glass	-2,826.7	0.011	1,177.0	0.210		
frame	-86.9	0.410				
extmisc			-259.0	0.348		
pkadeq	57.1	0.461	660.2	0.104		
loccod1	1,317.8	0.323				
loccod2	5,251.2	0.255			174.4	0.204
loccod3	666.5	0.566				
loccod4	948.4	0.409			40.1	0.355
loccod5	832.3	0.471			57.0	0.390
loccod6	-317.9	0.802				
loccod7					-68.6	0.666
loccod8	860.9	0.449			233.1	0.329
front1			858.3	0.008	161.7	0.053

Table B2 continues next page...

TABLE B2 (CONTINUED). REGRESSION RESULTS FOR APARTMENTS, OFFICES AND RETAIL PROPERTIES

	Apartments		Offices		Retail	
	coefficient	p-value	coefficient	p-value	coefficient	p-value
ad1	-126.5	0.261				
ad2	1,854.4	0.011				
ad3	-259.8	0.204				
od1			1,643.9	0.003		
rd1					123.6	0.306
rd2					-321.9	0.007
juris2					-148.6	0.065
juris3					270.8	0.001
juris4	181.3	0.459				
juris5	1,425.3	0.042				
juris7					235.4	0.012
north	104.5	0.825	144.8	0.634	182.0	0.109
cbd					-72.2	0.005
ncbd					42.5	0.034
marta1	-197.6	0.110			-107.4	0.018
exit			-220.4	0.402		
nexit	-737.4	0.002			-260.2	0.011
harts	-412.9	0.000	13.3	0.709	67.8	0.040
harts2	39.8	0.000			-3.4	0.047
rmedinc	-0.0	0.038	0.01	0.400	0.0	0.111
empden	5.4	0.327			2.6	0.002
popden					6.7	0.298
npopden	43.2	0.085				
minority						
vacant	-25.5	0.004			-219.0	<0.001
nmin	-32.2	0.922			6.3	0.097
empden	-14.8	0.040				
IDL1[B]	-63.5	0.564	-1.1	0.989	-30.0	0.128
IDL1[A]	-331.5	0.007	-1,033.1	0.011	-80.3	0.074
IDL2[B]	94.6	0.414	-563.8	0.550	4.3	0.670
IDL2[A]	-197.3	0.066	-287.7	0.128	1.2	0.916
IDL2[D]	52.5	0.433	-126.5	0.596	4.1	0.708
N Obs.	1229		260		816	
Prob>F	<0.001		<0.001		<0.001	
R^2	0.5691		0.5598		0.4911	

TABLE B3. REGRESSION RESULTS FOR INDUSTRIAL AND VACANT PROPERTIES

	Industry		Vacant	
	coefficient	p-value	coefficient	p-value
constant	2,426.8	<0.001	663.6	0.087
yr6	327.3	0.167	109.9	0.403
yr9	175.9	0.029		
yr10	225.2	0.096	67.8	0.417
yr11			155.5	0.446
yr12	144.8	0.109	271.0	0.178
yr13	216.1	0.023		
yr14	135.8	0.060		
yr15	169.9	0.095	-457.5	0.082
yr19	481.4	0.018	896.8	0.024
yr20	271.3	0.002	1,268.0	0.024
yr22	155.3	0.035		
sqft	8.6	<0.001		
numimp	-104.1	0.005		
acre	63.4	0.006	54.5	0.085
acre2	-2.7	<0.001	-0.8	0.024
age2	0.0	0.808		
gradeab	493.2	0.283		
gradec	152.5	0.067		
concrete	196.3	0.225		
glass	1,356.4	0.131		
loccod1	-1,874.9	<0.001	554.2	0.138
loccod3	-1,857.1	<0.001	199.6	0.396
loccod4	-1,957.9	<0.001	180.8	0.369
loccod5	-1,973.4	<0.001	274.7	0.209
loccod6	-2,057.7	<0.001	417.4	0.096
loccod7	-2,030.5	<0.001	6.4	0.981
loccod8			1,063.3	0.023
front2			-257.1	0.072
id1	1,363.5	0.108		
id2	791.6	0.003		
manuf	-88.9	0.200		
juris3			658.5	0.074
juris4	-472.4	0.106		
juris5	-2,075.4	<0.001	250.0	0.342
juris6	-1,162.5	0.004	1,943.6	0.016
juris7	-482.8	0.238		

Table B3 continues next page...

TABLE B3 (CONTINUED). REGRESSION RESULTS FOR INDUSTRIAL AND VACANT PROPERTIES.

	Industry		Vacant	
	coefficient	p-value	coefficient	p-value
north	-705.5	0.117		
cbd			-67.5	0.037
martal			-293.5	0.085
exit	171.7	0.052	13.1	0.894
popden	32.8	0.098	-5.6	0.704
npopden			-7.7	0.522
minority	-1,190.4	0.021	-1,019.8	0.000
vacant	14.9	0.001		
nmin	745.8	0.140		
empden			20.2	0.038
IDL1^{B}	-9.5	0.721	-36.4	0.662
IDL1^{A}	-42.8	0.075	-168.1	0.080
IDL2^{B}	-49.2	0.210	-0.1	0.999
IDL2^{A}	-19.5	0.468	-13.5	0.757
IDL2^{D}	38.1	0.137	-40.9	0.594
N Obs.	644		582	
Prob>F	<0.001		0.0130	
R^2	0.2728		0.2522	

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