

# **Modeling the Brownfield Relationship to Property Values and Community Revitalization**

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## **Abstract**

The predominant brownfield redevelopment focus is on the most marketable properties typically found in the healthiest urban neighborhoods. While this approach is helping to return brownfields to productive use, as evidenced by the rapid redevelopment that many urban communities are now experiencing, certain neighborhoods are being left behind. This research examines the impacts of brownfield redevelopment on urban communities and their housing stock, paying particular attention to distressed, inner-city neighborhoods.

Through regression analysis, this article addresses the question of whether economic efficiency is the most appropriate and/or only criterion by which to make public investment decisions for brownfield remediation. Analysis of the results suggests that we can expect widening urban inequality if the predominantly market-based approach to public brownfield redevelopment efforts continues unabated. Significant public brownfield redevelopment efforts redirected towards poverty neighborhoods and low market value brownfields, however, can help to lessen urban inequality and poverty conditions.

## Introduction

Exactly how many brownfields exist nationwide, and how many have been cleaned-up and remediated is unknown. Consequently, we also cannot know the extent to which economic development potential stemming from the redevelopment of brownfields is not being met in communities across the nation. A comprehensive study of the effects of brownfields for 231 major U.S. cities estimated that these cities had more than 21,000 brownfield properties encompassing more than 81,000 acres.<sup>1</sup> If redeveloped to their full potential, the study estimated the 231 cities would realize cumulative gains in tax revenues of \$878 million (US Conference of Mayors, 2000).

The year 1995 marks the point at which the public sector, at all levels of government, became proactive in seeking to solve the brownfield problems found in communities across the nation. In January of 1995, the US Environmental Protection Agency (EPA) published its Brownfield Action Agenda which included brownfield pilot grants to communities, clarification of liability issues for brownfield property owners, partnerships between federal, state, and local agencies to promote brownfield redevelopment, and job development and training for brownfield remediation. The Brownfield Action Agenda was to encourage a cooperative approach by EPA, lenders, and prospective purchasers to ease fears of financial liability and regulatory burdens associated with redeveloping brownfields. Subsequently, a number of EPA and other federal initiatives have been taken to further increase brownfield redevelopment activity.

This public sector response to brownfields, however, is predominantly characterized by a focus on the economic efficiency of cleanup and redevelopment of individual properties, as opposed to how remediation and redevelopment can contribute to the overall economic revitalization of neighborhoods (Iannone, 1996; Black, 1995; Simons, 1996). To elaborate, brownfields can be large or small properties. They can be found in depressed as well as healthy areas of our cities and states. But given the public sector emphasis on allocating scarce brownfield redevelopment resources to those properties that will realize the greatest market returns (Simons and Iannone, 1997; US EPA, 1996; Argonne National Laboratories, 1998), properties that are small and/or located in depressed neighborhoods are more than likely to be overlooked. We call the first category of properties marketable brownfields and the second category of properties low market value brownfields.<sup>2</sup> As a result of the public sector's brownfield redevelopment strategy, the low market value brownfields found in the most distressed neighborhoods may well be the most difficult properties to develop for reasons extending beyond their contamination. That is, their remediation costs may be relatively minor, but their poorer locations and the lack of incentives to target brownfields in weaker market

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<sup>1</sup> This study follows the initial study on brownfields generated by the US Conference of Mayors in 1996. The 1996 study only surveyed 39 cities and the results revealed similar but less comprehensive results.

<sup>2</sup> In reality, some brownfield properties may have no, or even negative, market value because of the cleanup costs of contamination that must be incurred before the property can be redeveloped. Sometimes the costs of remediation can exceed the current value, or even the future value, of the property once it has been cleaned up.

areas means that they are ignored. This, in turn, further dims the prospects for improving the economic conditions of poor neighborhoods. This is because brownfield status not only impacts the property labeled as such, it stigmatizes and de-values surrounding non-brownfield properties. For example, the work of Patchin (1988, 1991), Mundy (1992a, 1992b), and Chalmers and Roehr (1993) has shown that contamination stigma can negatively affect housing prices.

Thus, the current market-driven focus of brownfield public policy suggests that healthier neighborhoods are the greatest beneficiaries of public expenditures for remediation and redevelopment to the detriment of the depressed neighborhoods. Continuation of this focus may contribute to growing urban inequality, where healthy neighborhoods are aided in redeveloping their brownfields and realize the economic gains from doing so, while brownfields in distressed neighborhoods are ignored. This runs counter to the principles of market failure being the rationale for public sector intervention into the property development process.

In this paper, we report findings from a research project that analyzes the incidence and redevelopment pattern of brownfields for two cities' neighborhoods to explore the implications for widening urban inequality and current public sector brownfield strategies. We do so with a series of regression models and a unique database we have created that takes a comprehensive approach to systematically identifying known and potential brownfields. Our research supports the argument that low market value brownfields place an additional strain on central city revitalization efforts, thereby calling for a focused brownfield redevelopment effort in order to strengthen and more equitably distribute the outcomes of existing revitalization efforts.

## **Research Approach**

Our research considers the effects of brownfields and their redevelopment on distressed neighborhoods, paying attention to the impacts federal brownfield policies had on these low-income brownfield communities during the second half of the 1990s<sup>3</sup>. Utilizing a pre-test/post-test research design to model the property value effects of brownfields and their redevelopment, we have sought to understand the effects of federal brownfields policies on neighborhoods via their housing markets. In doing so, we identify the difference in property value effects both before and after 1995, the year when the EPA established its brownfields pilot program.

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<sup>3</sup>The Brownfields Reform and Small Business Liability Relief Act (HR 2869) passed both the House and the Senate on December 21, 2001 and was signed into law on January 13, 2002. This legislation significantly changes the liability aspects of brownfield cleanup by providing solid liability relief for prospective redevelopers. The liability changes are expected to help revitalize aging urban areas by removing previous litigious barriers to brownfield redevelopment (US EPA, 2002).

### *Hypothesis and Research Questions*

To measure brownfield impacts, we isolate the effect of brownfield cleanup and redevelopment through a cross-sectional analysis of neighborhoods with redeveloped and un-redeveloped brownfields. A unique feature of our research is that we have built a brownfield database of what we label “known” and “potential” brownfields. Known brownfields are those that appear on an official list of contaminated properties. Potential brownfields are those properties that have had a previous use history giving them a high probability of being contaminated but are not on an official list (see Leigh and Coffin, 2000). An underlying hypothesis of our research is that since 1995, market redevelopment activity reflects awareness and stigmatization of potential brownfield properties. Further, this awareness and stigmatization may disproportionately affect the lowest income neighborhoods if they have a higher incidence of such properties. (See Figures 1 and 2.) Thus, the pattern of distribution of these potential brownfields between depressed and healthy neighborhoods needs to be examined in order to understand the full impacts of brownfields and the effectiveness of current brownfield public policy in fostering inner city neighborhood revitalization where it is most needed.

Our research objective is to explore the relationship between brownfield redevelopment and property values. Specifically, we seek to determine whether brownfields have a negative impact on property values. We distinguish this impact in several ways such as by low and high poverty neighborhoods, pre and post pivotal brownfield policy year, known and potential brownfields, and strong and weak economies.

Figures 1 and 2 about here.

### *Selection of Case Study Cities*

While similar in population size, our two case study cities, Atlanta and Cleveland, differ on a number of fundamental economic development characteristics, as described in Table 1 below. We deliberately chose these two cities for their dissimilarities and the insights that might be gained from studying the brownfield redevelopment process in two such different geographies and urban economies.

Atlanta is a fast-growing, sunbelt metropolitan area. While the city began in 1847, its primary growth era has been in the second half of the twentieth century with particular acceleration during the last decade of the twentieth century. In the last decade, its population increased 5.7%. Its landmass in 2000 was more than 30,000 acres -- or 60% -- greater than Cleveland's, despite Cleveland having 15% more population.

In contrast to Atlanta, Cleveland's major growth era was coincident with the age of industrialization, occurring over the first three decades of the 20<sup>th</sup> century. Consequently, the mean age of Cleveland's housing stock is 25 years older than Atlanta's. Between 1950 and 1990, the city of Cleveland lost close to 45% of its population while the population in the region remained fairly stable (Krumholz, 1999). The latest 2000 US Census figures reveal that depopulation in the central city continues,

with a population loss of 5.4% in the decade of the 1990s (US Census of Population and Housing, 2000). Its November 2001 unemployment rate was 1.2% higher than Atlanta's.

Cleveland has a higher elderly population than Atlanta and a lower poverty population. This, combined with a lower unemployment rate for Atlanta, may suggest that Cleveland's elderly have higher retirement incomes associated with larger proportions of unionized industrial workers.

#### TABLE 1 ABOUT HERE

Cleveland's major growth era coincided with precisely the kinds of economic activities that left behind brownfield contamination. As a consequence, Cleveland's total incidence of brownfields is more than two and a half times greater than Atlanta's (Tables 2 and 3). For the US Conference of Mayors report on brownfields in 231 cities (2000), Cleveland officials estimated there were approximately 350 brownfield sites scattered throughout the city, totaling around 6,000 acres land. Further, if these properties were developed to their fullest potential, they would generate between \$225 million to \$500 million in tax revenue as well as an additional 100,000 jobs.

Cleveland's Urban Renewal activities in the 1960's and 1970's, compounded by the economic woes of the energy crisis in the early 1970's and significant inner city population loss due to white flight, left behind entire neighborhoods of abandoned, vacant lots and substandard housing where only the poorest residents remain. Following the restructuring of the auto and steel industries in the 1970's and 1980's, Cleveland experienced severe deindustrialization that left an even larger landscape of abandoned and underutilized properties.

Cleveland was early to recognize the need to redevelop the vacant and abandoned brownfields stemming from its history of urban "renewal" and deindustrialization. Consequently, brownfield redevelopment was a high priority for Cleveland even before the national brownfields program was established in 1994 (Cuyahoga County Planning Commission, 1993). Further, the State of Ohio has been proactive in improving the climate for brownfield redevelopment inside and outside of its cities. Ohio has developed Risk-Based Corrective Action (RBCA) or cleanup standards and a voluntary cleanup program that has been accepted by the US EPA through a memorandum of agreement (MOA) under Superfund. These standards allow for more flexible approaches to cleanup that can contain costs and reduce liability fears associated with potential future US EPA regulatory actions (Ohio EPA, 2001).

In contrast, the brownfield problem is under appreciated in Atlanta. In the same US Conference of Mayors report, Atlanta officials estimated the city had 147 acres of 1 brownfield property. This estimate was made even though officially listed brownfields already totaled 308 acres (Table 3), and over 306 square miles of land in Atlanta is classified as industrial -- the land use most associated with brownfield contamination (ARC, 1990).

Our own count of brownfields in the Tables 2 and 3 suggests that instead of Atlanta having only 2% of the amount of brownfield acreage of Cleveland (147 acres/6000 acres) per the U.S. Conference of Mayor's city official derived estimates, it

actually has 3,244 acres of known and potential brownfields while Cleveland has 3,701 acres. Thus, Cleveland has significantly overestimated its brownfield problem while Atlanta has significantly underestimated its problem.

With an economy that boomed throughout the 1990s, Atlanta's brownfields simply did not draw the attention or action from policy makers, public officials, and legislators that they should have. Underutilized urban land has not been problematic since, unlike Cleveland, the region was not facing the effects of economic decline.<sup>4</sup> A recent attempt to pass state legislation designed to encourage brownfield redevelopment failed as law makers stated they did not see brownfields as a serious problem in Georgia (Atlanta Chamber of Commerce, 1997). In contrast to Ohio, Georgia does not have a formally legislated Voluntary Cleanup Program (VCP), Memorandum of Agreement (MOA), or formal Risk-Based Cleanup (RCBA) process in place. (Bartsch and Dorfman, May 2000).

TABLES 2 AND 3 ABOUT HERE

## **Data Development and Model Design**

We explore the dual relationship between brownfield redevelopment, property values, and brownfield policies through a series of models employing a combination of regression equations. We first model the effects of several brownfield measures on property values before 1995 (our identified pivotal policy year) and after, to estimate the effect that brownfields and their redevelopment have on property values. Next we model the effects the presence of brownfields have in neighborhoods where there are poverty households (i.e., households receiving food stamps, AFDC and Section 8 housing assistance). Widespread awareness of brownfields, and of the difficulty and liability associated with their redevelopment did not exist before 1995. Further, since 1995, there has been a continuing growth of federal, state and local programs to promote brownfield re-use. Over \$250 million has been spent in federal funds for brownfield programs during this period. (<http://www.epa.gov/brownfields>, accessed 9/16/02) Most recently, President Bush signed the bipartisan legislation, Public Law 107-118 (HR 2869), titled the *Small Business Liability Relief and Brownfields Revitalization Act of 2002*.

Prior to 1995, it was much more likely that brownfield property transactions occurred without the knowledge of their brownfield status. We suggest this is particularly the case for the group of properties we have labeled "potential brownfields." From 1995 on, however, we hypothesize that property transactions reflect their known or potential brownfield status. This is because the lending community does lend on properties without due diligence undertaken on contamination status (meeting the requirement of a Phase One Environmental Assessment). Property developers factor this requirement into their purchase and development decisions.

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<sup>4</sup> Atlanta has been the recipient of an US HUD Empowerment Zone grant as well as a US EPA Brownfield Redevelopment Pilot grant. However, its performance on the Brownfield pilot was found insufficient at one point in time and the City was in danger of losing the funding.

## *Data sources*

Our research model incorporates data variables created and/or obtained from local government agencies, public records, published secondary data, as well as through GIS calculations. We use data that identifies environmental, neighborhood, and economic characteristics to measure the effects of brownfield cleanup and redevelopment on neighborhood property values. The database of property and brownfield characteristics we employ is a unique feature of our research. It incorporates historical tax assessed values, tax delinquencies, physical property characteristics such as land and building amenities, concentrations of and distances to known and potential brownfields, and socioeconomic characteristics at the census tract level. Additionally, it includes variables we have constructed that measure the effects on properties of having a nearby brownfield, and market activity on property values in brownfield neighborhoods. The specific data generated from these sources can be aggregated into three distinct categories; (1) real property characteristics, (2) suspected and confirmed property contamination and remediation characteristics, and (3) neighborhood characteristics.

*Real Property Characteristics.* The real property characteristics are generated from county property tax assessor's records generated in Cuyahoga County, Ohio (the county in which the city of Cleveland is located) and Fulton County in Georgia (the primary county in which the city of Atlanta is located).<sup>5</sup> We recognize that there can be reliability issues associated with property tax assessment data, however the alternative data resource, sales data, would inherently bias our study. We are interested in comparing areas with active real estate markets to those areas with depressed market activity. If we use property sales data, we will obtain results that exclude the very neighborhoods we are interested in studying. That is, using sales data as an indicator of market conditions would likely provide little data on depressed neighborhoods due to lack of sales. Our data would also not reflect consistent time intervals across neighborhoods. Although property tax assessment data may be biased downwards for low-income neighborhoods due to the lack of sales activities triggering updates in comparable property assessments, we believe this bias is less problematic for the time series component of our modeling.

Given that we are using tax assessment data, we are faced with limited time series data. Property tax assessment strategies are not uniform across localities within the US. Further, few locales conduct them on an annual basis. In the years between assessments, tax bills are generated based on predictions of property value changes. Thus, we must rely exclusively on the information generated in property tax reassessment years, as these years will reflect most closely actual changes in property values, rather than predicted change. In Cleveland, these years are 1988, 1994, and 2000, as county-wide reassessments are mandated every six years in Ohio. In the Fulton County portion of

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<sup>5</sup> The City of Atlanta is located in parts of two counties, DeKalb and Fulton. Our reason for excluding the portion of Atlanta that is located in DeKalb county is explained in footnote 6.

Atlanta<sup>6</sup>, the years are 1992, 1995, and 1998, as county-wide reassessments occur every 3 years.

*Suspected and Confirmed Property Contamination and Remediation Characteristics.* Information on suspected and confirmed contamination was collected from three sources: the US EPA, state environmental agencies, and local business directories. The US EPA provides a list of properties where investigations have been conducted to determine the existence of health threatening contamination. The EPA lists are categorized by degree of concern, with the National Priorities List (NPL) identifying those properties posing the most immediate and serious threat to public health. The Active Sites list identifies properties where investigations and/or remediations are currently being conducted, and the No Further Action list identifies properties where investigations and/or remediation activities are complete and the property has been declared to present little or no threat to the health of a community. Currently, there are no properties in either city listed on the NPL, thus we utilized only the active and no-further-action lists of sites.<sup>7</sup>

The state environmental agencies in Ohio and Georgia also maintain lists of leaking underground storage tanks (LUSTs), which we also utilize in our analysis. While we recognize that underground storage tank cleanups are not governed under the same laws as other contaminated sites, prior research indicates that leaking underground storage tanks negatively impact property values (Bowen, et. al., , 1997). Further, leaking underground storage tanks are generally included in brownfield discussions.

Our final source of information on suspected contamination is generated from local business directories. We have developed a list of historical land uses for both Cleveland and Atlanta using the local business directories from 1910, 1930, 1950, and 1970. The methodology for the list of the locations of known and suspected contamination follows the logic of the propensity for contamination based on prior land uses. In 1992, researchers Frank Noonan and Charles Vidich conducted a survey of environmental professionals asking about the various aspects of environmental remediation of brownfields including the probability for contamination based on land using activity. Through this survey the researchers developed a probability table that considered the likelihood of contamination based on land use. In developing the database of locations of known and suspected brownfields, we utilized the Noonan and Vidich (1992) probabilities to determine those properties that had a 50 percent or greater likelihood for contamination based on the land using activity listed in the directory. We will use the information assembled in our database to generate the total acreage of potential contamination by census tract.

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<sup>6</sup> Note that approximately 7% of the city of Atlanta falls within the DeKalb County boundary. We have elected not to analyze the properties that fall within this portion of the city as tax assessment is conducted yearly in DeKalb County and is based on a different percentage of property market value. A comprehensive dataset combining the property values for the two counties is not possible without significantly distorting the study results.

<sup>7</sup> Given the historical stigma associated with even the threat of contamination, we are including those properties that appear on the No Further Action list.

Additionally, we have developed a brownfield remediation variable based on the three environmental lists and real estate market activity. We use the assumption that if a property has been sold after 1995, the Federal brownfields policy year, some form of environmental investigation has occurred and resulted in either remediation or discovery of little or no contamination. This assumption is based on the practice of due diligence in real estate finance: that is, when a financial institution provides funding for a real estate investment, it requires environmental audits and provisions for required remediation before it will loan money. Thus, if we identify a property in our database as being either a potential or officially recognized brownfield *and* the property has had a real estate transaction any time after 1995, we assume that this property is a remediated brownfield.<sup>8</sup>

*Neighborhood Characteristics.* To measure the effects of brownfields on communities we incorporated socioeconomic data from both the 1990 and 2000 Census of Population and housing into our database.<sup>9</sup> Given that 2000 Census data on persons living below poverty is not yet available, we had to rely on an alternative measure, persons receiving assistance through the Federal TANF (Temporary Assistance for Needy Families) program. We incorporated information from both the food stamps and the Aid to Families with Dependent Children programs to develop our proxy for poverty.

### *Model Development*

We test our hypothesis that low market value brownfields act as a deterrent to redevelopment in low-income neighborhoods through a series of regression models, which examine the effects of brownfield characteristics on property values. We also examine the distribution of brownfield properties relative to concentrations of persons receiving food stamps and/or AFDC. We follow a method employed by Galster, et. al. (1999), that statistically measures threshold effects, estimating impacts on neighborhoods, as defined by these threshold effects. We utilize the threshold effect in two ways. First, we measure the concentrations of brownfields within 500 feet, between 501 feet and 1,000 feet, and between 1,001 and 1,500 feet of a brownfield. Next, we measure the effect dichotomously with a variable indicating where there is a brownfield within 500 feet, between 501 and 1,000 feet, and between 1,001 and 1,500 feet of the property.

The threshold effects measure is another unique feature of our work as this methodology has yet to be applied to measures of brownfield impacts on residential property values in the US. While Simons, et. al. (1997) measured the effects of leaking

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<sup>8</sup> We acknowledge this may result in an overcount of remediated brownfields due to the small (and impossible to quantify) number of real estate transactions that may take place through entirely private financing and land trades where the parties involved are either unknowledgeable or unconcerned about brownfield contamination.

<sup>9</sup> In making our comparisons between the decades, we have acknowledged the changes in census tract boundaries that occurred in Atlanta and have accommodated for these shifts in our database.

underground storage tanks on property values, employing a variable that indicated whether a tank was located within one block, their static measure does not capture the variation within a city block. Further, it assumes uniformity in size and distribution of city blocks across space.

We incorporate these threshold-effects variables into a series of model specifications that measure the various brownfields while controlling for structural characteristics of the building improvements, real estate market activity, and socioeconomic characteristics of the community. We test our hypothesis in the following sequence where the variable acronyms are defined in Table 4.

**Model 1:** Base Model (with property values measured pre 1995)

$$\text{LnP}_{\text{pre1995}} = c + [\text{Struct}] + [\text{Size}] + [\text{Invstmt}] + [\text{SES90}] + [\text{BFCON}_{500}] + [\text{BFCON}_{1,000}] + [\text{BFCON}_{1,500}] + [\text{BFADJ}_{500}] + [\text{BFADJ}_{1,000}] + [\text{BFADJ}_{1,500}] + [\text{BFDIST}]$$

**Model 2:** Property Effects Model (with property values measured post 1995)

$$\text{LnP}_{\text{Post1995}} = c + [\text{Struct}] + [\text{Size}] + [\text{Invstmt}] + [\text{SES00}] + [\text{BFCON}_{500}] + [\text{BFCON}_{1,000}] + [\text{BFCON}_{1,500}] + [\text{BFADJ}_{500}] + [\text{BFADJ}_{1,000}] + [\text{BFADJ}_{1,500}] + [\text{BFREADJ}_{500}] + [\text{BFREADJ}_{1,000}] + [\text{BFREADJ}_{1,500}] + [\text{BFDIST}] + [\text{BFREDIST}]$$

**Model 3:** Food Stamps and AFDC Assistance Concentration Effects Model

$$\text{LnAID} = c + [\text{Size}] + [\text{SES00}] + [\text{BFADJ}_{500}] + [\text{BFADJ}_{1,000}] + [\text{BFADJ}_{1,500}] + [\text{BFREADJ}_{500}] + [\text{BFREADJ}_{1,000}] + [\text{BFREADJ}_{1,500}] + [\text{BFDIST}] + [\text{BFREDIST}]$$

TABLE 4 ABOUT HERE

**Discussion of results**

*Property Effects Models*

The following discusses the results of our series of property effects models. These models estimate the effects of brownfields on property values, distinguishing these effects before and after the 1995 shift in brownfield policy focus. They also distinguish the effects on property values of remediated versus nonremediated brownfields.

To address our policy focus on the effects of brownfields in poverty versus non-poverty neighborhoods, the post 1995 models were run separately on aggregations of poverty and non-poverty neighborhoods in Atlanta and Cleveland. Table 5 presents the results for the post 1995 period for poverty neighborhoods, defined as census tracts with

greater than 20% poverty, while Table 6 shows the results for non-poverty neighborhoods defined as tracts with 20% or less poverty.

*Pre 1995 Property Models.* The base models for Atlanta and Cleveland tested the effect of brownfields on neighborhoods before heightened public and private awareness of the negative impacts brownfields began to develop. Due to different property tax assessment years, as previously noted, the Atlanta base model reflects values in 1995, while the Cleveland base model reflects values in 1994. The results from these base models show distinct differences between the two cities. The strength of the relationship between potential brownfields and property values is considerably stronger in Cleveland while the relationship between listed brownfields and property values is slightly stronger in Atlanta. This initial finding from the base models demonstrates that the stigma surrounding environmental impairment appeared to be more readily understood in the Cleveland real estate market prior to official recognition of brownfields. In contrast, the real estate markets in Atlanta appeared to only slightly acknowledge officially recognized environmental impairments. The table of pre-1995 results is presented in the appendices. (See Appendix C.)

*Post 1995 Property Models.* The post 1995 property models examine the effects of both brownfield concentration and adjacency on property values, comparing the differences between the poverty and non-poverty neighborhoods.<sup>10</sup> Three distance intervals to a property were used: within 500 feet, between 501 and 1,000 feet, and between 1,001 and 1,500 feet. Brownfields were divided into four categories: remediated listed sites, remediated potential sites, non-remediated potential sites, and non-remediated listed sites. The concentration effect measured the impact of overall numbers of brownfields in proximity to the property, and the adjacency effect measured the impact of being next to a brownfield site, as measured in the three 500 ft. intervals. That is, the concentration measure determines the neighborhood or externality effects of brownfields on surrounding property values, and the adjacency measure determines the threshold effect of distance to a brownfield.

### *High Poverty Neighborhoods*

In poverty neighborhoods (Table 5), the brownfield concentration effect was evident when there were listed brownfields in the neighborhoods as well as when there were potential brownfields. It was much stronger for listed than potential sites in Cleveland; that is, property values were lowered by almost 11% for each additional listed brownfield site located within 500 feet, and by more than 8% for each additional listed brownfield site between 501 and 1,000 feet. In contrast, Atlanta's effects, while significant, were less than 3% for the same categories.

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<sup>10</sup> We were unable to make a pre and post 1995 comparison of the impacts of the policy regime change on poverty because we could not get consistent poverty-proxy (food stamps and AFDC) data before and after 1995. The official poverty statistics for the census tract level are only gathered during the decennial census.

In the high poverty neighborhoods in Atlanta, adjacency effects of the non-remediated brownfields (both listed and potential) had a negative impact on property values, with a larger effect happening from the potential sites. Interestingly, the largest effect (-18.7%) involved remediated, listed brownfields between 1,001 and 1,500 feet from the property. Yet remediated, listed brownfields within 500 feet had an effect of a 16.3% increase on property values. Thus, it appears that immediately adjacent remediated, listed brownfields generate a positive impact on property values that quickly dissipates with distance. In contrast, the high poverty model in Cleveland was less than robust, with only one adjacency variable having any statistically significant effect (measured at .01 level of significance). Remediated, listed brownfields had a -22.5% effect on property values, a result parallel to that of Atlanta.

### *Low Poverty Neighborhoods*

In the neighborhoods with less than 20% poverty (Table 6), the concentration effect of potential brownfields had a slightly larger overall negative effect on property values in Atlanta at all three measured intervals than in Cleveland, with the effect being greatest at 500 feet. For every additional listed brownfield found within 500 feet of a property, values decreased by almost 2.5% in Atlanta and 1.1% in Cleveland. Conversely, however, the concentrations of listed brownfields had a negative (and larger) impact in Atlanta and a positive impact in Cleveland. For example, brownfield concentrations of listed sites within 500 feet decreased property values by 6.9% in Atlanta and increased them by 1.3% in Cleveland. This finding is another illustration of the different character of industrial (re)development in Atlanta compared to Cleveland.

In contrast to the high poverty neighborhoods in Atlanta, the adjacency effect in low poverty neighborhoods appeared to have little negative effect. Listed, remediated sites found between 501 and 1,000 feet decreased property values by 3.2%, the largest negative effect. Conversely, the adjacency effects of non-remediated potential sites measured at all three intervals had an increasing effect on property values, with the 501 to 1,000 foot interval showing the largest effect at 10%. Remediated, potential sites found between 1,001 and 1,500 feet of a property had an increasing effect of 8.7%. In Cleveland, non-remediated sites, both listed and potential, had a considerable negative effect on property values with the listed sites decreasing in magnitude, ranging from 15.2% at the 500 foot interval to 12.3% for the 1,001 to 1,500 foot interval. Of note for the non-remediated potential sites, the standard error for the coefficients was extremely high, ranging from 25 % to 43%. While the results appear skewed, they still indicate a strong negative effect on property values.

### *Proximity to Brownfields*

The effect on property value of how close a property was to a brownfield was examined by the four categories of brownfields. For high poverty neighborhoods (Table 5), there were significant results in three out of the four categories for Atlanta and only one category for Cleveland. Of particular note is that for every foot closer to a non-remediated potential brownfield, property value decreases by over 1/100 of a percent in Atlanta poverty neighborhoods and by over 3/100 of a percent in Cleveland (see section

“Distance, in feet, to the nearest Brownfield). That is, all things being equal, a property in a Cleveland poverty neighborhood that is one hundred feet closer to a potential non-remediated brownfield will have a 3% lower property value, while one in Atlanta will have a 1% lower property value.

#### TABLES 5 & 6 ABOUT HERE

*Concentrations of poor households model.* Following the property effects models, the impacts of brownfields on the concentrations of poor households in Atlanta and Cleveland were examined. Of interest was the extent to which brownfields impacted the concentrations of poor households to see if adjacency to a brownfield was a factor<sup>11</sup>. To aid in understanding the effects of the adjacent brownfield variables listed in Table 7, it was assumed that a census tract had a population of 1,000 and an average size of 21,000,000 square feet. Further, the average block within each city was assumed to be approximately 197,000 square feet<sup>12</sup>. Thus, interpreting the percentage effects listed in Table 7, the relationship of adjacent brownfields to poor residents is as follows: There are 7 additional poor residents in Atlanta and 11 additional in Cleveland (.00694 x 1,000 and .0106 x 1,000) living within 500 feet of a property, if there is also a remediated, listed brownfield within 500 feet of that same property. That is, remediated listed brownfields are concentrated in poorer neighborhoods when measured by the interval of 500 feet. The concentration effect strengthens at the next interval (20 more poor residents in Atlanta and 10 more in Cleveland when there is a listed, remediated brownfield within 1,000 feet of a property), and then reverses (at 1,500 feet there are 7 more poor residents in Atlanta and 5 more in Cleveland if a listed, remediated brownfield is also located within that same distance.)

Listed, non-remediated brownfields had similar concentrating effects with similar spatial inconsistencies, as well. The inconsistent results suggest that factors other than brownfield influence begin to dominate spatial effects beyond 500 feet of a property.

Alternatively, potential brownfields, both remediated and non-remediated, have an overall deconcentrating effect on poor residents, though, again, the results are spatially inconsistent. For example, 12 fewer poor households in Atlanta and 26 fewer in Cleveland would live within 1,000 of a property for every one unit increase in the number of remediated, potential brownfields within 1,000 feet of that same property. An exception involved potential, remediated brownfield sites within 500 feet of a property in Atlanta, which had a concentrating effect of 1.8%. This finding suggests that the type of brownfield (listed versus potential) has more of an impact on poor residents than the distance to the brownfield for Atlanta.

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<sup>11</sup> Due to data limitations with the brownfield concentrations variables, this element of the research focused on the brownfield adjacency and overall distance variables only.

<sup>12</sup> These averages are based on actual GIS calculations of the combined average size of a census tract and block for Atlanta and Cleveland.

In considering the impact on concentrations of poor households of the distance to nearest brownfield variables, it is important to understand that the variable measure is in feet. Thus, Table 8 describes the impact of overall distance to brownfields on poor households when translated to the previously assumed census tract with 1,000 people and an average square footage of 21,000,000. Notice that an increased distance to remediated, potential brownfields has a strong deconcentrating effect in Atlanta while in Cleveland distance to non-remediated, potential brownfields has a strong deconcentrating effect. This finding suggest that the negative externality from low market brownfields – whether or not they are remediated -- is less in Atlanta than in Cleveland.

TABLE 8 ABOUT HERE

## Conclusion

As we stated at the outset of this paper, the public sector response to brownfields has been characterized by a focus on the economic efficiency of cleanup and redevelopment of individual properties instead of on how remediation and redevelopment can contribute to the overall economic revitalization of neighborhoods. As a result of the public sector's brownfield redevelopment strategy, the low market value brownfields found in the most distressed neighborhoods may well be the most difficult properties to develop for reasons extending beyond their contamination. This, in turn, further dims the prospects for improving the economic conditions of poor neighborhoods. That is, brownfield status not only impacts the property labeled as such, it stigmatizes and de-values surrounding non-brownfield properties.

Our research has confirmed our hypothesis that brownfields, both listed and potential, lower property values in poverty neighborhoods in the two case study cities of Atlanta and Cleveland. The effect is strongest in Cleveland for officially recognized (listed) sites, suggesting that the overheated Atlanta real estate market of the 1990s was able to counter some of the negative externalities associated with brownfields. At the same time, however, the adjacency effects of brownfields in poverty neighborhoods were significant and as predicted in the stronger Atlanta economy while largely insignificant in the weaker Cleveland economy. The positive impacts from remediating and redeveloping brownfields in Atlanta's poverty neighborhoods were confirmed. Yet, our research shows that redevelopment rates in the poverty neighborhoods are significantly lower than those in the non-poverty neighborhoods.<sup>13</sup> This points to the need for increasing the level of redevelopment activity in the poverty neighborhoods of a strong urban economy in order to counter a trend towards widening inequality. In addition, the negative impacts on property values from not remediating are confirmed for both cities, and are strongest in the weaker economy of Cleveland.

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<sup>13</sup> As previously discussed in the body of the paper, we use property turnover as our proxy for redevelopment. The average percentage of property turnovers per census tract in poverty census tracts in Atlanta was 9.5% and in Cleveland, 8.7%. The average percentage of property turnovers per census tract in non- poverty census tracts in Atlanta was 13% and in Cleveland, 15.2%.

This research has sought to shed light on whether the current market-driven focus of brownfield public policy may contribute to growing urban inequality, as well as affect the outcome of other federal programs seeking to aid low-income households. The results suggest that location matters and raises the classic “people versus place” development question. That is, should the status of poverty households be raised through increasing their ability to leave the most impoverished neighborhoods, or, should the economic conditions of impoverished neighborhoods be improved such that resident poverty households experience greater positive economic benefits? As our analysis shows, the latter strategy, when focused on brownfields, can improve property values, which also increases their associated tax revenues. This in turn can provide the public means with which to fund further revitalization efforts. Thus, we can expect widening urban inequality if the predominantly market-based approach to public brownfield redevelopment efforts continues unabated. Significant public brownfield redevelopment efforts redirected towards poverty neighborhoods and low market value brownfields, however, can help to lessen urban inequality and poverty conditions.

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