The Impact of Brownfield Reclamation on Surrounding Land Values and Crime

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Abstract

How have land values and crime patterns changed near brownfields post reclamation? This paper used geographic information systems analysis tools and statistical analysis to measure the change in land values and crime occurrences over time. Land value and crime data from 2002 were compared to the same geographic areas in 2005 using paired t-test analyses. Both land value and crime statistics were analyzed on a micro-level and macro-level level for purpose of comparisons. The goal was to demonstrate whether or not brownfield sites have a measurable difference compared to control sites that did not receive brownfield reclamation investment. Steps were taken to select control and brownfield sites with similar qualities. Three different selection processes determined the control sites. Land value tests had control sites selected based upon attributes such as land use type, percent low-income residents, school district, and proximity to each other. Crime analysis tests had control sites selected based upon proximity alone. A bivariate correlation analysis was performed to determine if there was a relationship between dollars spent on cleanup and impact on total crime, property crime, and violent crime in 2005. Post brownfield reclamation shows two of three brown parcel groups near brownfields increased land values at the same rate as comparable control sites. The analysis of all former brownfields in Central Minneapolis revealed parcel land values within 1500 ft of brownfield sites showed a statistically significant decline in land value. However, post brownfield reclamation, the Central Minneapolis control neighborhoods showed significant increases in total value and property crime, but the neighborhoods with brownfield reclamation did not.

Introduction

Governmental agencies and the public have become increasingly aware of advantages of cleaning up polluted or derelict sites known as brownfields. A George Washington University study (Deason, Sherk, and Carroll, 2001) reported, "Every brownfield acre redeveloped would have required a minimum of 4.5 acres had the same project been located in a greenfield area." As neighborhoods go through a lifecycle and into decay, renewed interest in brownfield reclamation often follows. In fortunate neighborhoods, high property demand in heavy urban areas helps drive private re-investment into developing and cleaning up brownfield sites. In areas where private investment is too risky for property and business investors, deed tax is levied to financially support the cleanup of

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brownfields and encourage private investment.

Federal, state, and local government agencies grant funds to remediate areas of perceived contaminants or toxic areas. The Environmental Protection Agency (EPA) (2009) at the federal level in 2009 funded 2,127 sites across the fifty states and U.S. Territories (Figure 1).

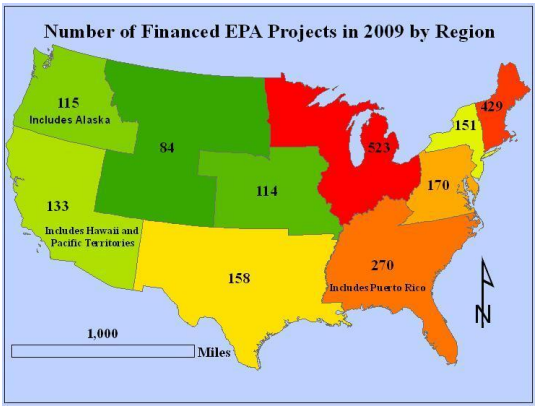

Figure 1. Number of EPA funded brownfields by region.

Figure 1 represents only the funded EPA sites. An even larger number of sites exist which either received funding from other sources or went unfunded.

In many counties in the United States, county commissioners approve raising the deed tax for the purpose of brownfield cleanup. With deed tax collections, financial grants are awarded to non-profit housing agencies, private developers, and individuals with property for the purpose of pollution investigation and/or removal of the hazardous materials.

This project explores measurable impact on land values, total crime, violent crime, and property crime near brownfield reclamation areas before and after investment of public dollars for cleanup. The financial public investment spent on brownfield reclamation is considered highly significant to a wide variety of stakeholders (Wedding and Crawford-Brown, 2007). The stakeholders in brownfield reclamation processes include taxpayers, legislators, non-profit organizations, private industry, academia, multiple government agencies, and others. Because brownfield reclamation influences countless aspects of redevelopment and improvements to a community, everyone is ultimately considered a stakeholder in the reclamation of brownfields.

The stakeholders in this project were the Hennepin County Environmental Services (HCES), Aeon – a non-profit housing organization, the Minneapolis Police Department, and the Metropolitan Council. HCES funds the Environmental Response Fund (ERF) with levied and appropriated deed tax. The ERF fund was first awarded in 2001. HCES's criterion for selection of brownfield sites weights environment as the highest priority. The goal of the HCES is to identify the most threatening brownfield sites to the environment, water-table, and sewage systems and assist only with assessment and clean up cost. In 2001, HCES awarded $1,539,605 to recipients. The ERF sites that received reclamation funds ranged in award value from $25,000 to $90,000. Some of the money awarded goes to investigation or the approximation of quantity, quality, and dollars necessary to perform cleanup. The sites chosen for this research received dollars to remove quantified pollution.

Aeon provides affordable housing for 3,000 low-income residents in the Minneapolis and Saint Paul, Minnesota area. Aeon was awarded a total of $410,200 in reclamation grants for 2001 and 2002 combined from HCES. Aeon targets sites that are accessible to their clientele financially and geographically. In some

circumstances, the sites Aeon chose contain known contaminants, making these sites eligible for Hennepin County financial assistance.

The Minneapolis Police Department has a stake in the successful reclamation of brownfields. According to De Sousa (2006), homelessness, gangs, and crime are associated with brownfield sites. In De Sousa's research at Mill Ruins Park in Minneapolis, an 11.3% decrease in crime post reclamation of the brownfield site would seem to indicate that the police department would be an interested stakeholder and would support brownfield reclamation.

The Metropolitan Council, sanctioned by the Minnesota Legislature, controls the seven counties comprising Minneapolis, Saint Paul, and surrounding suburbs. Each year all seven counties of the metropolitan region assess parcel land value data for the Metropolitan Council. Compilation of tax assessor's data by the Metropolitan Council and inventory of brownfield distributions and qualities help the council achieve and track the comprehensive plan's financial and environmental goals.

Many qualities of a neighborhood are improved post reclamation. Environmental, financial, socio-economic, and livability issues are all negatively influenced by the presence of brownfield sites. Each of these negative aspects draws different interest groups, corporations, and the public making brownfield reclamation and research a major planning and re-development issue.

Brownfields and Control Sites

Saint Barnabas Apartments, owned by Aeon, houses young adults between the ages of 16 and 21 years of age whose families are unable or unwilling to provide for them. In the fall of 2001, a $25,000 investigation to quantify contaminants revealed asbestos and lead paint. In spring of 2002, a $65,000 ERF grant funded the asbestos and lead paint abatement. Saint Barnabas apartments have received $7.43 million dollars from numerous local and state governments and non-profit agencies for renovations.

Alliance Apartments, the selected control site to accompany Saint Barnabas is also owned by Aeon housing. Alliance Apartments is a housing development for people recovering from substance abuse problems. Both sites are zoned multifamily residential and are located in the Minneapolis school district with 100% low-income residents. In 2001, the parcels of land that currently contain the Stone Arch Apartments were vacant but contained artifacts from previous industrial use. In the fall of 2001, a $90,000 grant from the ERF was awarded to Wall Development Company for the purpose of general cleanup of former industrial activity. Although no contaminants were recorded on the site, decades of industrial activity had littered the site and caused it to be classified as a brownfield. This classification made the site eligible for the ERF award. The accompanying control site to Stone Arch Apartments was the East West Apartments. This multifamily apartment complex is three blocks northeast of the Stone Arch apartments.

Pine Cliff Apartments owned and operated by Aeon, houses low-income residents. Pine Cliff apartments was built in 1970 and contained asbestos. The Pine Cliff Apartments (Aeon) received $80,000 for the abatement of contaminants. Pine Cliff Apartments today is a modern residential facility providing housing for many residents.

The accompanying control site to Pine Cliff Apartments was the Portland

Commons Apartments. This multifamily apartment is south of Pine Cliff Apartments and also has at least 25% low-income residents.

Path to Brownfields and Beyond

Central Minneapolis, like many turn of the century American cities, has a history of large scale industrial production and the associated financial rewards and environmental consequences. The cycle of increased industrial output due to new technology, increased commercial demand, and resulting pollutants have left numerous brownfield sites in Central Minneapolis. Materials such as lead and asbestos, once thought to be harmless by American consumers, were found in the 1970's to be a threat to public health.

The main objective of this study was to examine the impact brownfield reclamation had on parcel land values that surround brownfields and to assess changes in crime rates. In this project, the surrounding brownfield parcel group, including adjacent or contiguous groups, will be referred to as a BPG. The control parcel group, created to make comparisons to the BPG, will be referred to as a CPG.

Methods

The three main sets of data for this study are the HCES brownfield data from fall of 2001 and spring of 2002, the Hennepin County parcel data containing assessed land value, and a crime dataset with quantities of total, violent, and property crimes by Minneapolis neighborhoods. The majority of the data sources supplied the data in ArcGIS shapefile format.

The resolution of the brownfield data provided was detailed to the parcel level. Each brownfield parcel had information about the parcel pin number, name of site applicant, amount of dollars awarded, address, type of contaminant, past use, and future use. Most important to this study, the parcel dataset included tax assessed land values for approximately 43,000 parcels in Hennepin County in the years 2002 and 2005. In research completed by Bacot and O'Dell (2006), property value and brownfield relationships were studied using data from the county tax assessment office instead of Multiple Listing Services, a real-estate data source, because the assessor's dataset was more complete. The Minneapolis Police Department provided spreadsheets of crime types and quantities at the neighborhood level available to the public from their website (Minneapolis Police Department, 2010). According to the downloaded Adobe ".pdf" files provided by the Police Department, the neighborhood crime data is accurate +- 2.5%.

Rational for Site Selection, Temporal Comparison Scale, Paired t-test Analysis, and the 1,500 Feet Sample Radius for Selection of the Statistical Testing Sample.

One task of this project involved using ArcGIS for spatial selection, categorizing, joining tables, and cartography. The statistical analysis tools in IBM's SPSS statistical software were used to measure the financial impact of brownfield reclamation on the BPGs and CPGs (SPSS, 2010). SPSS offers the paired two-sample t-test, a comparison of sample means testing. This test compares two samples collected from populations with similar means making this test ideal for showing significant change in land value over the years. Microsoft's spreadsheet application Excel and

Adobe's PDF Suite 2010 were used to clean, parse, and transcribe crime data. Microsoft Excel was also employed to provide descriptive statistics, charts, and graphs for this project.

Although the parcel data and brownfield data extend throughout Hennepin County, sites for paired t-test analysis were chosen only in Central Minneapolis. The Minneapolis sites shared similar attributes that have an effect on property value, such as proximity to parks, a single school district, similar tax policy, and a range of 25% -100% of the residents classified as 'low-income.' Four of the six sites are also owned and operated by the non-profit housing agency, Aeon. Six Minneapolis sites, including three brownfield sites and three control sites were chosen for statistical analysis of land value. The control sites were also selected based on their similarity to the brownfield sites. By choosing attributes of the same quality in the control and brownfield sites, variables were standardized which allowed for a more accurate comparison of change in property values.

From interviewing employees at HCES and Aeon it was revealed that all projects started in 2001 and 2002 were completed in 2005. This time frame was the rationale for choosing years 2002 and 2005 for sample inputs.

Paired sample t-tests are ideal for comparing observations from two samples. A paired sample t-test compares the means before and after an intervention or experiment to find if a statistically significant change occurred in the samples over time. Each test was performed on two identical sets of parcels for each site. Quality measures were taken by having an ID number tied to each record in the samples together for a one to one ratio of comparison.

Other researchers have studied the gradient effect of brownfield reclamation over geographic area. De Sousa, Wu, and Westphal (2009) performed research measuring the impact brownfields had on surrounding property values in Minneapolis between 1997 through 2003. They concluded the optimal geographic footprint of influence from brownfield reclamation was a 1500 ft radius with a gain of 4.2% on land value prices. Another test concluded by De Sousa et al. (2009) found a geographic footprint of 2,500 ft radius only had a 1.8% gain. Considering these findings, this project used the 1,500 ft selection radius to geographically collect samples and statistically test for changes in property value means adjacent and contiguous to former brownfields.

Brownfields and Land Value Testing

Three broad groups of paired t-tests were conducted to examine the impact brownfield reclamation had on land values of surrounding parcels in 2002 and 2005. The first group of paired t-tests includes an examination of three BPG's and three CPG's. The second group of t-tests includes the same six sites but the geographic footprint of selected parcels was expanded to a 1500 ft radius around the brownfield and control sites. The third group of paired t-tests examines all HCES brownfield sites in Central Minneapolis for 2001 and 2002 at the same 1500 ft radius sample area. It should be noted all samples selected for paired t-test comparisons had the brownfield parcels removed from the analysis. Removal of brownfield parcels from the samples focused the study on the effect of parcels around brownfields.

All sample selections collected from the parcel data included records of

a $0 value for the parcel. According to the Hennepin County Tax Assessors office, parcels that have a value of $0 are exempt by the county and may include federal, state, county, or municipal property, cemeteries, highway right-of-ways, and emergency shelters. These parcels were excluded from statistical analysis. All control sites were at least 1500 ft from the nearest brownfield site and shared similar attributes previously discussed.

Group 1: A Comparison of Adjacent Parcels of Three Brownfields and Three Control Sites in 2002 and 2005

The six sites each underwent a spatial selection in ArcGIS by manually selecting only the parcels adjacent to the brownfield site for both 2002 and 2005. Manual selection was necessary because adjacent parcels ranged in size significantly from site to site making it impossible to use a radial buffer selection or any other available "select by location" process. An example of the selected adjacent parcels is shown in Figure 2.

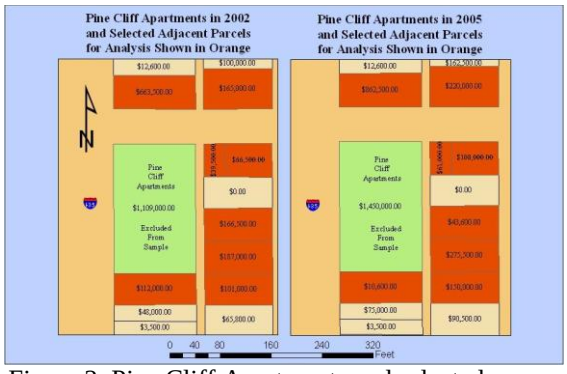

Figure 2. Pine Cliff Apartments and selected adjacent parcels in orange.

Group 2: A Comparison of 1500 ft of Contiguous Parcels for Three Selected Brownfields and Three Selected Control Sites in 2002 and 2005

The process of geographically selecting relevant parcels in Minneapolis within 1500 ft involved several steps in ArcGIS. The joining of attributes, based on parcel ID numbers, kept only matching records between multiple tables which ensured a one-to-one ratio for comparison over time. In ArcGIS, joins performed had less than 1% of the parcels removed by using the "keep only matching records" option. The 2005 land value data was joined to the 2002 land value data so as to retain chronological sequence of attributes for easier identification of appropriate years for analysis. The resultant joined attributes table underwent a spatial selection that intersected the brownfield layer and applied a1500 ft buffer to expand the selection sample. The selection sets table was exported to dBase table for cleaning in Excel and analysis in SPSS.

Group 3: A Comparison of 1500 ft of Contiguous Parcels to All Brownfields in Central Minneapolis in 2002 and 2005 and all Other Parcels as Control

Selection of samples for the third group was the same for group two except the selection was applied to all nine Central Minneapolis brownfields instead of the three sites for the previous two test groups (Figure 3). The BPG selection for this test was inverted or "switched" within the attributes table in ArcGIS to capture all parcels farther than 1,500 feet from a brownfield in Minneapolis. The switching of the BPG selection created the CPG selection and excluded all parcels within 1500 ft of brownfields.

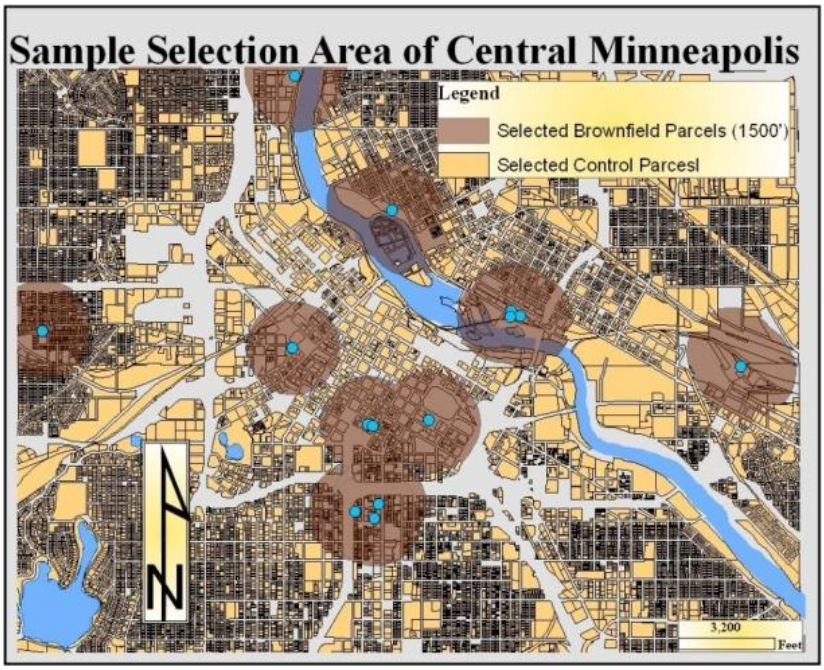

Figure 3. Selection areas for group 3.

Crime Analysis

The Minneapolis Police Department crime data provided the base inputs for the crime analysis. Two different statistical tests showed the change and relationships between brownfields and crime quantity and type. The crime data was prepared in Excel, collected in ArcGIS, and statistically analyzed in SPSS. The Minneapolis Police Department's crime data came in an Adobe "pdf" file format from their website for the year 2002. Considering the limitation and scope of this project, two categories, property and violent crime, were used to classify the different types of crime as shown in Table 1.

Table 1. Groupings of police crime data into two categories for paired t-test analysis.

Violent Crime	Homicide, rape, robbery, assault
Property Crime	Burglary, theft, motor vehicle theft, and arson

The Adobe ".pdf" file format cannot be imported into spreadsheet format in Excel or table format in Microsoft Word. The data from the Adobe files were entered for all relevant neighborhoods in Central Minneapolis. This parsing and filtering of crime data into spreadsheets in Excel prior to the ArcGIS join focused data to five brownfield composite control areas. Paired t-tests were conducted for years 2002 and 2005. A bivariate correlation analysis showed the relationship between award amount from HCES and the change in quantity and quality of crimes between years 2002 and 2005. Because the crime data published by the Minneapolis Police Department is at the neighborhood level and not at the parcel level, a new method of sample collection was implemented. The neighborhoods' crime data spreadsheet was joined to the neighborhood data layer in ArcGIS. The procedure for sample collection of the control sites involved selecting neighborhoods from multiple adjacent neighborhoods that did not possesses any HCES brownfields. By selecting all

surrounding neighborhoods as controls, an average was created to closely resemble the neighborhood containing the brownfield. Figure 4 shows two different samples represented by the color brown for the brownfield group and light yellow for the control group.

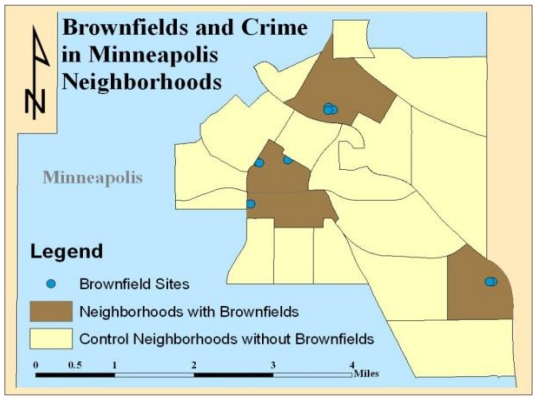

Figure 4. Neighborhoods used for crime analysis.

Results

In Central Minneapolis eleven brownfields sites were awarded funds for brownfield reclamation in 2001 and 2002. Evaluation of the percent change in land value of these brownfield parcels compared to non-brownfield parcels in Central Minneapolis demonstrates the value of investing in brownfield reclamation. Table 2 lists the difference in percent change of brownfield and control site means. The major difference between the brownfield parcels and the control parcels is the substantial private financial investment into the brownfields in addition to ERF awards. The descriptive statistics for the "Brownfields," in Table 2 include the brownfield parcels only and do not include the surrounding parcels. A look at the change in land values of the brownfields provides an interesting comparison of results to the other analysis of the BPGs.

Standard deviation is a statistic

Table 2. Descriptive statistics of brownfields and control sites.

	Mean Land Value 2002	Mean Land Value 2005	% Change Of Means	S.D. 2002 / S.D. 2005
Brownfields (N = 11)	441K	2.5M	82.37	320K / 3.87M
Control Sites (N = 7,696)	628K	619K	-0.01	4.6M / 3.84M

of a sample relative to the mean. In standard deviation a larger number represents a heterogeneous sample while a smaller number represents a more homogenous sample group. The standard deviation (S.D.), shown in Table 2 for the "Brownfields," shows a large increase from 2002 to 2005. This can be explained by the fact some sites received multimillion dollar improvements while other sites received smaller awards for only cleaning or the removal of contaminants and thus larger differences developed between the lower and high value properties.

Results of Group 1: A Comparison of Adjacent Parcels to Three Brownfields and Three Control Sites in 2002 and 2005

Figures 5 and 6 show the change in land value of the BPGs and the CPGs. Saint Barnabas Apartments in Figure 5 is the only site to show a decrease in its BPG value. The other two sites showed gains in their BPG value. In Figure 6 representing the control sites, all three CPGs had an increase in their land value.

The statistical look at changes in land values from 2002 and 2005 in the adjacent properties showed surprising results. Of the three brownfield groups

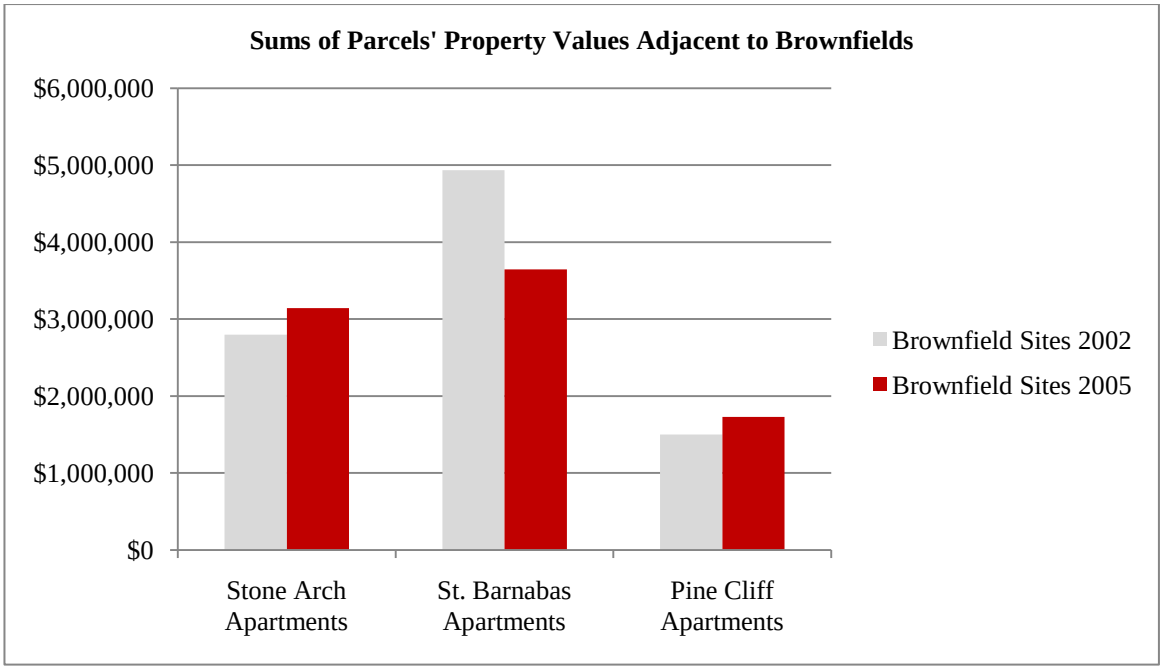

Figure 5. Total value of all adjacent parcels to brownfield sites.

only one site, Stone Arch Apartments, showed a statistically significant gain in mean value (Table 3). While only one BPG showed a statistically significant increase in mean value, two of the three control groups showed a statistically significant increase in their mean values, the East West Apartments and the Portland Apartments. In interviews performed by De Sousa et al. (2009) many people stated the most apparent influence on land value would be on the adjacent parcels to the brownfield. Contrary to the opinions of the people

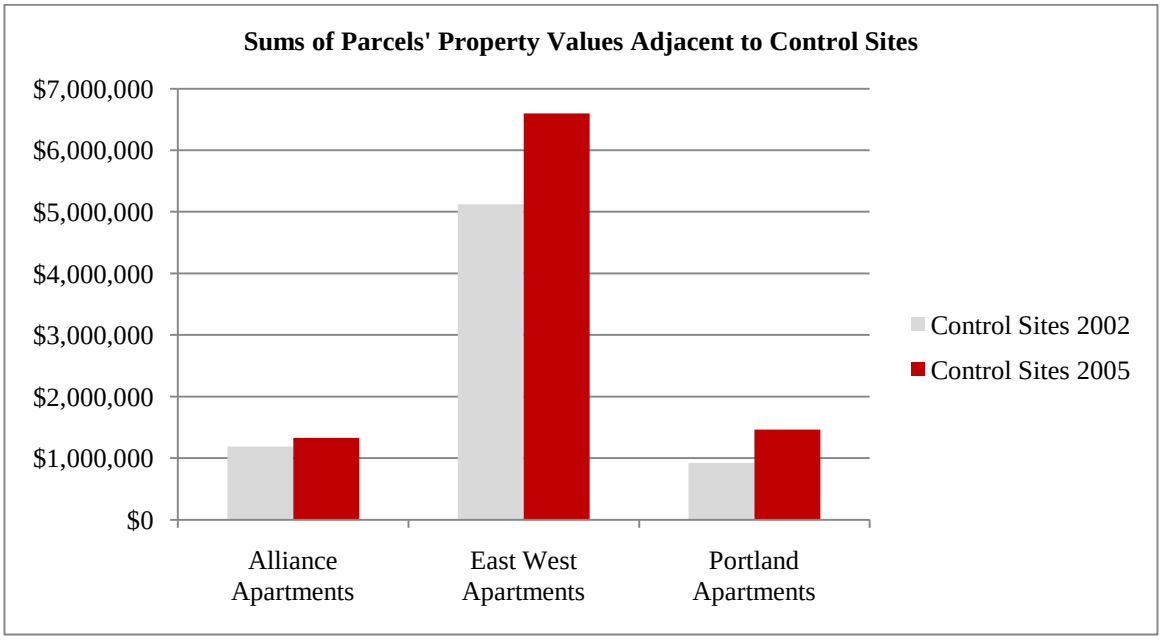

Figure 6. Total value of all adjacent parcels to control site.

Table 3. Descriptive and paired t-test results from analysis of adjacent parcel selection.

	Sample Size	Mean Land Value 2002 ($)	Mean Land Value 2005 ($)	% Change Of Means	S.D. 2002 ($)	S.D. 2005 ($)	Sig. (1-tailed) p-value
Stone Arch Apartments (Brownfield)	5	559,780	628,900	10.99%	749,455	816,941	0.04
St. Barnabas Apartments (Brownfield)	5	986,480	729,080	-35.30%	133,4941	808,985	0.17
Pine Cliff Apartments (Brownfield)	8	187,625	216,400	13.30%	199,015	276,062	0.23
East West Apartments (Control Site)	9	569,388	732,777	22.30%	468,231	618,394	0.00
Alliance Apartments (Control Site)	7	169,700	190,171	10.76%	137,007	159,662	0.20
Portland Apartments (Control Site)	8	115587	183025	36.85%	71082	103,412	0.00

interviewed in the De Sousa et al. study (2009), the results from this project showed no significant change to land values on adjacent BPG's. Additional tests were conducted with larger sample sizes to search for significance.

Results of Group 2: A Comparison of 1500 ft of Contiguous Parcels of Three Selected Brownfields and Three Selected Control Sites in 2002 and 2005

Figures 7 and 8 show change in land value sums of BPGs and CPGs. The Saint Barnabas Apartments (Figure 7) is the only site to show a decrease in its BPG land value sum, despite the much larger sample size of 173 parcels instead of five parcels. The other two sites showed gains in their BPG land value sums. In Figure 8, representing the control sites, all three CPGs had an increase in their land value sums between the years 2002 and 2005. When

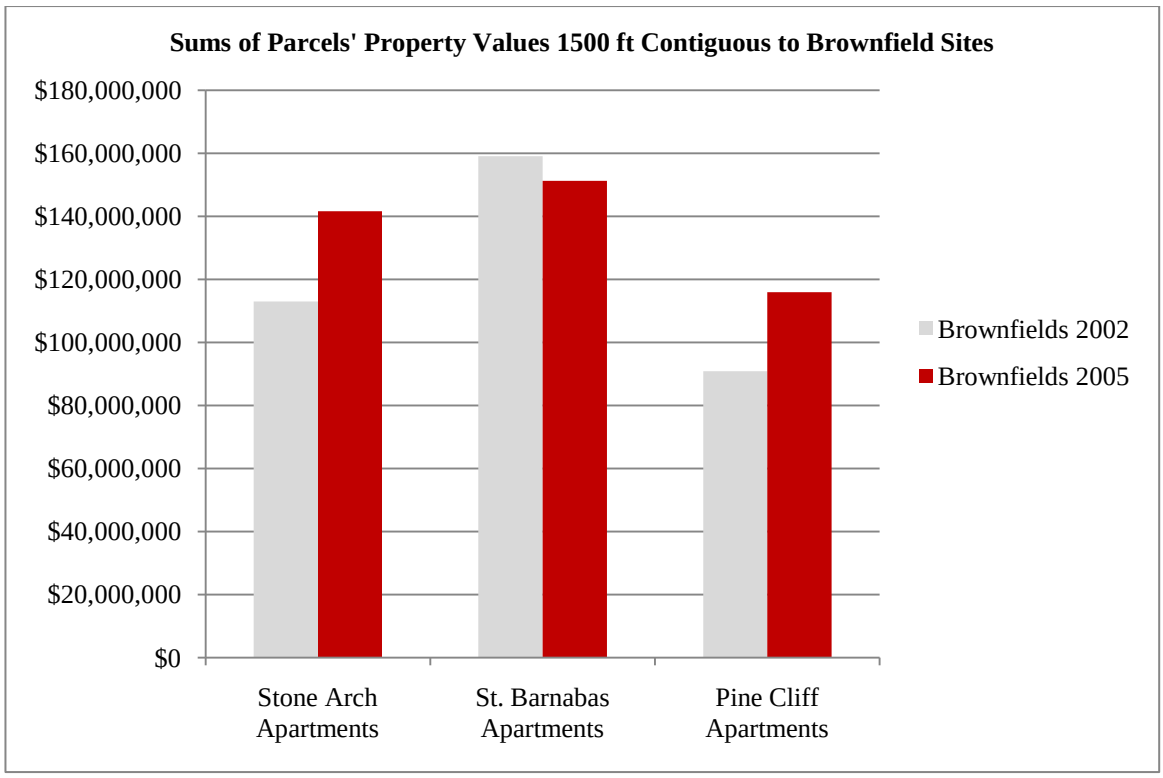

Figure 7. Total value of all contiguous parcels 1500 ft out from brownfield sites.

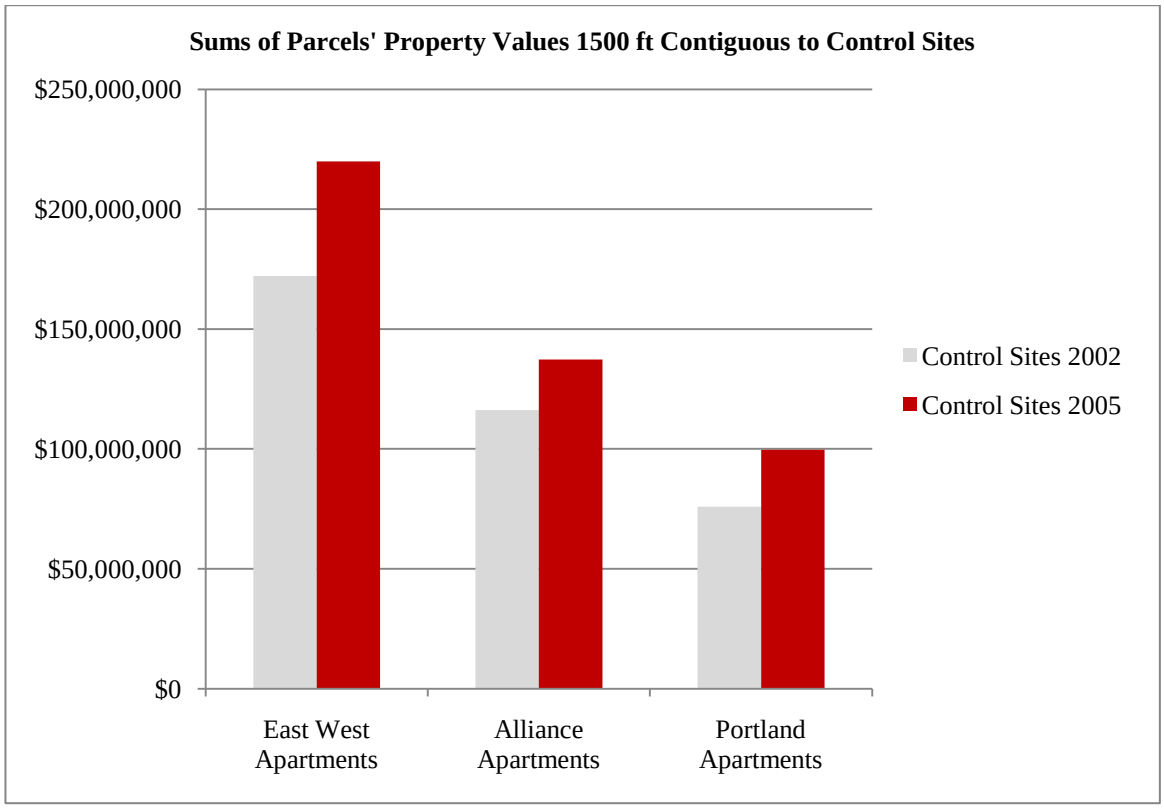

Figure 8. Total value of all contiguous parcels 1500 ft out from control sites.

the sample collection radius of 1500 ft was applied to the sample collection process, the number of parcels increases into the hundreds. In tests of individual sites within a 1500 ft collection area, sample parcels were abundant enough to increase the average sample size to 283 parcels from the average sample of seven parcels in the adjacent analysis tests. These larger samples resulted in a statistically significant increase in means in five sites except one brownfield site, Saint Barnabas Apartments as seen in Table 4.

Results of Group 3: A Comparison of 1500 ft of Contiguous Parcels to All Brownfields in Central Minneapolis in 2002 and 2005 and all Other Parcels as the Control Group

Figure 9 shows the change in land value sums of all BPGs and CPGs. From 2002 to 2005, the sum BPGs of the eleven brownfields in Central Minneapolis decreased in total land value. In contrast, the control area had an overall gain in total land value. A look at all Central Minneapolis BPGs within 1500 ft showed a decrease in average land value over time as seen in the percent change of means in Table 5. The CPG, which encompassed the inverted selection of the BPG, had a large gain in mean land value. The BPG showed statistically significant decrease in means over years 2002 and 2005 while the control group showed a statistically significant increase in means over the same period.

Table 4. Descriptive and paired t-test results from analysis of 1500 ft radius of contiguous parcel selection.

	Sample Size	Mean Land Value 2002 ($)	Mean Land Value 2005 ($)	% Change Of Means	S.D. 2002 ($)	S.D. 2005 ($)	Sig. (1-tailed) p-value
Stone Arch Apartments (Brownfield)	205	550751	690564	20.25%	1087249	1261724	0.02
St. Barnabas Apartments (Brownfield)	173	919441	873871	-5.21%	1662652	1463107	0.13
Pine Cliff Apartments (Brownfield)	314	289315	369230	21.64%	423002	513450	0.00
East West Apartments (Control Site)	431	399510	510132	21.68%	736494	900486	0.00
Alliance Apartments (Control Site)	289	401987	475181	15.40%	794914	913804	0.00
Portland Apartments (Control Site)	286	265332	348367	23.84%	704307	923074	0.00

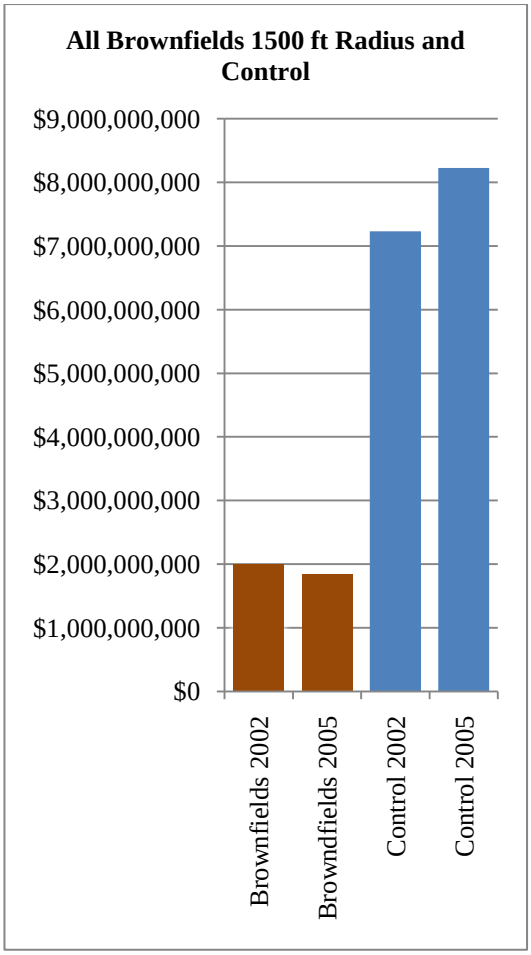

Figure 9. The sum of all BPGs and the sum of CPGs between years 2002 and 2005.

Standard Deviation and Brownfields

Universal to all sample groups near BPGs is the decrease in the standard deviation in land values. This means post brownfield investment showed samples are closer in value to each other with an overall reduction of outliers within the sample. The adjacent group, the three individual sites group, and the group containing all BPGs showed a decrease in standard deviation relative to their control group as seen in Tables 3, 4, and 5.

Results of Crime Analysis: A Comparison of Central Minneapolis Neighborhoods' Crime Levels with and without Brownfields in 2002 and 2005.

The percent change of total crime, violent crime, and property crime increased at a much smaller rate in neighborhoods where brownfields were cleaned or abated, while the percent change in neighborhoods without brownfields showed a larger increase in total and property crime (Figure 10).

Table 5. Descriptive and paired t-tests results from the 2002 -2005 analysis of all eleven brownfields in Central Minneapolis and all Central Minneapolis parcels not within 1500 ft of a brownfield (labeled Control in table).

	Sample Size	Mean Land Value 2002 ($)	Mean Land Value 2005 ($)	% Change Of Means	S.D. 2002 ($)	S.D. 2005 ($)	Significance (1-tailed) p-value
Central Minneapolis Brownfield	1,747	1,144,676	1,056,861	-8.31%	7,100,179	5,782,580	0.01
Control Group	19,716	366,839	417,349	12.10%	2,141,951	1,873,351	0.00

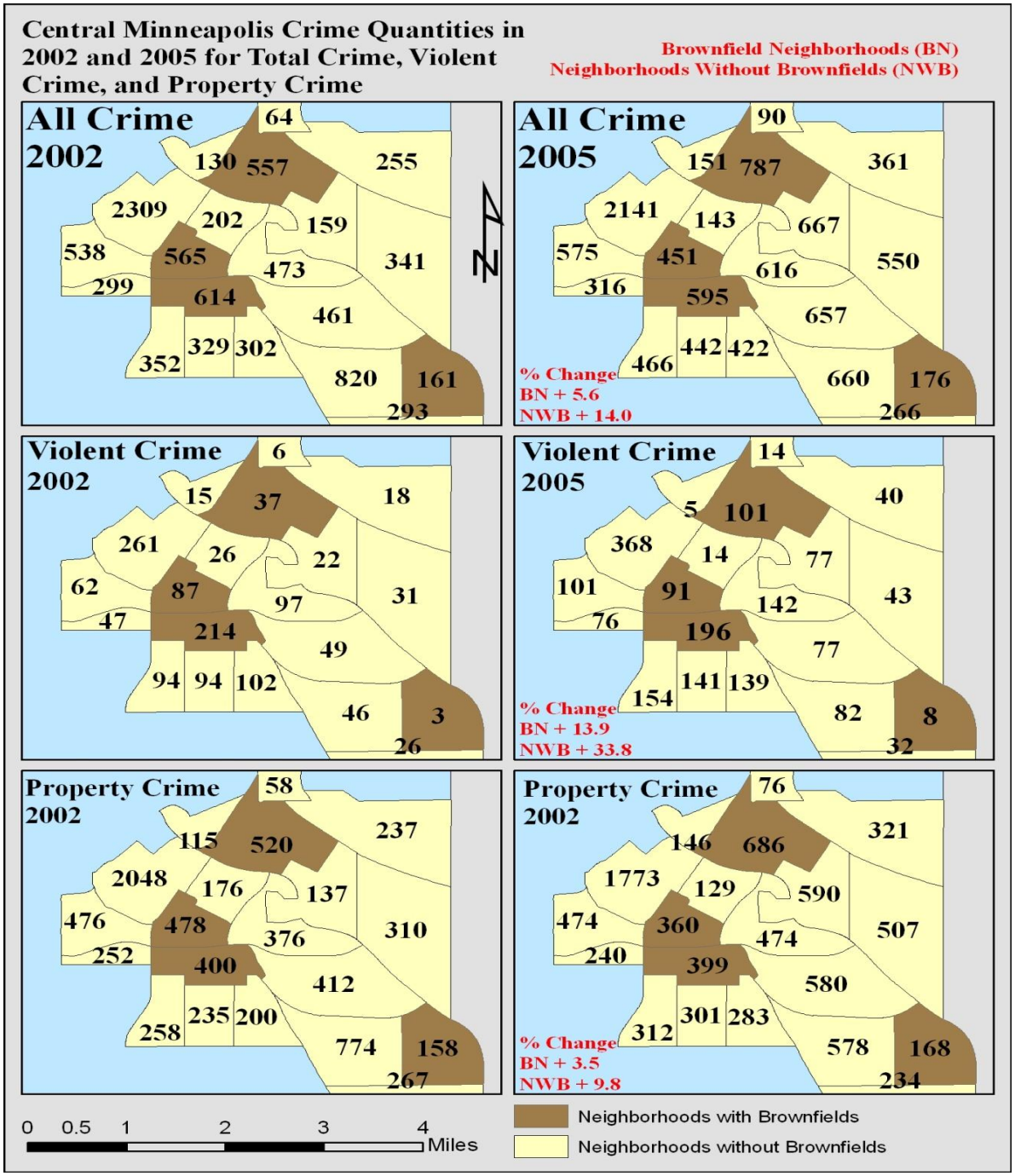

Figure 10. Maps showing the number of crimes per neighborhood in 2002 and 2005.

Crime in Central Minneapolis overall increased across all neighborhoods. As noted in Table 6, the rate of crime increase was low enough to not be of statistical significance in former Brownfield areas. All neighborhoods with brownfield reclamation performed showed no significant gain in total, property, or violent crime. In the control group of neighborhoods, total and property crime register statistically significant gains in mean while violent crime did not increase significantly.

Table 6. Results of Central Minneapolis crime analysis including descriptive statistics and paired t-test results for neighborhoods with former brownfields and the control neighborhoods without brownfields. Mean Total Crime (MTC), Mean Property Crime (MPC), Mean Violent Crime (MVC).

	Sample Size	MTC 2002 / MTC 2005	MPC 2002 / MPC 2005	MVC 2002 / MVC 2005	Total Crime Significance (1-tailed) (95% C.I.) p-value	Prop. Crime Significance (1-tailed) (95% C.I.) p-value	Violent Crime Significance (1-tailed) (95% C.I.) p-value
Brownfield Neighborhoods	4	474.25 / 502.25	85.25 / 99.27	389.25 / 403.25	0.36	0.25	0.41
Control	16	457.94 / 532.69	62.25 / 94.06	395.69 / 438.63	0.04	0.00	0.15

Results of ERF Award and Crime Correlations

A bivariate correlation analysis was performed on nine neighborhoods in Central Minneapolis in terms of types of crimes. The analysis revealed no correlation exists between dollar amount awarded and types of crime (Table 7).

Table 7. A bivariate correlation analysis between award amount and types of crime.

	Total Crime 2005	**Property Crime 2005**	**Violent Crime 2005**
N	9	9	9
Award Amount 2002 Correlation	-0.294	-0.332	-0.269
Significance (2-tailed)	0.442	0.383	0.483

Discussion

Descriptive statistics and paired t-tests indicated brownfield reclamation by itself is unable to bolster land values in surrounding parcels when a host of other variables affected the land values. The final test of all Central Minneapolis BPGs showed a significant decline in land value likely due to several reasons including the public's residual perceptions of contaminated areas, stigmas associated with low-income residents, and/or the fact that in general, many brownfield sites exist in aging industrial or economically depressed areas. The brownfields with a significant decline in their BPG land values may be in a better economic situation because improvements were made. It is likely the BPGs would have even lower land values if no intervention had been performed. Since brownfield reclamation in Central Minneapolis had cases of BPGs that increased their land value means it is a worthwhile endeavor. The fact that crime did not increase significantly in the neighborhoods with brownfields and the control sites did have significant increases in total and property crime would indicate brownfield reclamation is worth public support and funding.

Limitations of this study include lack of inclusion of all micro-level and macro-level economic factors influencing real-estate prices. This project could be more conclusive if a larger set of brownfield data were made available for paired sample t-test analysis. This project could also have been more conclusive if other sources of land value change were taken into consideration through Hedonic modeling or multiple regression analysis.

While the Hennepin County parcel dataset provided the most comprehensive collection of land value prices, it did not provide actual land values which are determined from the sale of real-estate. While the parcel dataset is based on a tax assessor's 'best estimate' of land value, it lacks true values the parcels may have been worth at the time. After consideration of the scope of this project, the tax assessor's dataset provided the only comprehensive collection of approximated land values for Central Minneapolis and was therefore used to determine land values.

Between years 2002 and 2005, total crime, property crime, and violent crime increased in all neighborhoods with brownfields and the control neighborhoods without brownfields. The difference was the neighborhoods with brownfield reclamation completed by 2005 had a much lower increase in all types of crime. Not only was the increase lower than the control areas but it had no statistically significance difference in means as revealed by the paired t-test. Alternatively, the control areas showed statistically significant increases in property crime, violent, and total crime. This would indicate brownfield reclamation may have an effect on keeping crime levels more stable compared to control areas.

It could be argued a larger influence on holding crime stable was not the brownfield reclamation, but rather the fact three of the four neighborhoods with redeveloped brownfields were designated for housing low-income residents, former drug users, and homeless young adults. Perhaps without brownfield reclamation, these residents may have been more prone to commit crimes in the area.

Suggestions for Future Studies

Creating a project from a wide variety of data inputs requires the researcher to think of creative ways to perform analysis. To enhance the work performed for this project, future research might look at collecting multiple radii footprints within the parcel layer for evaluation of means. These different sized footprints and samples might reveal the nature of the land value gradient or distance decay. These gradients may show if land values changed in a linear fashion as parcels move further out from a brownfield or if they change in a logarithmic pattern. A study of gradients could also help identify the point of diminishing returns from investment into brownfield reclamation. Furthermore, an analysis of land value changes on specific zone types (industrial, commercial, and residential) post brownfield reclamation would show the degree of change on each zone type.

In this project, some of the former brownfields were transformed into functional apartment buildings. A study on the impact of retail businesses from the new apartment buildings could give credence to further governmental brownfield investment in places private developers refuse to invest. Furthermore, a study of the number of new businesses that started after reclamation relative to similar areas without reclamation investment could show the absolute value of governmental brownfield reclamation.

Conclusion

The focus of this project was on land value changes for parcels near brownfields and the change in total crime, property crime, and violent crime before and after brownfield reclamation. It is important to note many other

variables besides land value and crime are affected by brownfield reclamation. Other intrinsic benefits of brownfield reclamation include environmental improvements and equity of resources amongst classes and racial boundaries.

In this study of Central Minneapolis, two out of the three brownfield parcel groups showed a significant gain in land value; however the analysis that included all of former brownfields revealed parcel land values within 1500 ft of brownfield sites showed a statistically significant decline in land value. When considering crime post brownfield reclamation, the control areas showed significant increases in total and property crime, but neighborhoods with brownfields did not show a statistically significant difference in total crime, property crime, and violent crime.

The results from this project indicate brownfield reclamation for low-income housing areas does not necessarily significantly increase the land value of surrounding properties or significantly decrease crime within a three year period; however the study results indicate the parcels that surround brownfields have benefitted and might have been in worse condition had reclamation not occurred. At a minimum, the environmental toll may ultimately have been more costly without brownfield reclamation for the surrounding parcels. Governmental incentives such as the ERF program provide an opportunity for private investment to supplement funding for reinvestment into economically troubled areas.

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