

# **Brownfield Cause and Effect Analysis**



Prepared by

**William P. McAndrew**

wpm124@psu.edu

Supervising Faculty Member

Dr. James A. Kurre

Director, Economic Research Institute of Erie

Sam and Irene Black School of Business

Penn State Erie, The Behrend College



November 11, 2007

This research was made possible by a grant from the  
*Penn State Behrend Summer Undergraduate Research Fellowship Program*

## Table of Contents

<b>I. Introduction</b> .....	2
<b>II. Literature Review</b> .....	3-5
<b>III. Background</b> .....	6-12
A. The Brownfield Issue	
B. The Manufacturing Sector	
1. <i>Employment</i>	
2. <i>Output</i>	
<b>IV. National Priorities List Analysis</b> .....	13-24
A. GDP's Relationship with NPL	
1. <i>Absolute Count of NPL Site Analysis</i>	
2. <i>NPL Per Capita Analysis</i>	
B. The Change in Industry Establishments Relationship with NPL	
1. <i>Absolute Count of NPL Site Analysis</i>	
2. <i>Scaling Factors Removed</i>	
C. The Chemical Industry: A Closer Look	
<b>V. Conclusion</b> .....	25
<b>VI. Appendix A</b> .....	26-31
<b>VII. Appendix B</b> .....	32-33
<b>VIII. Works Cited</b> .....	34-35

## **I. Introduction**

The issue of brownfields has been growing in significance in recent decades due many factors such as increased public awareness and increased government involvement. This paper attempts to explain the factors associated with these environmentally challenged lands. After a literature review, section III gives a brief background of the brownfield issue, as well as an overview of the manufacturing sector, which is a major contributor to the presence of these sites. Section IV will be an analysis of what causes brownfields, and why.

## **II. Literature Review**

1. Kaufman, Dennis, and Norman R. Cloutier. "The Impact of Small Brownfields and Greenspaces on Residential Property Values." *The Journal of Real Estate Finance and Economics* 33 (2006): 19-30.

In this study of an inner-city neighborhood of Kenosha, Wisconsin, a hedonic pricing scale was used to measure the responsiveness of residential values to the presence of brownfields and greenfields as they were introduced. This study found statistically significant property value gradients with respect to the greenfields and the brownfields. Using a function derived from the property value statistics, it was estimated that brownfield remediation of two brownfield sites in the study area would increase property values of 890 residences between \$2.40 and \$7.01 million. The findings in this study seem to support using tax dollars to remediate brownfield sites if the property value increase can be statistically proven to be greater than the cost of remediation efforts.

2. Kiel, Katherine, and Jeffery Zabel. "Estimating the Economic Benefits of Cleaning Up Superfund Sites: The Case of Woburn, Massachusetts." *The Journal of Real Estate Finance and Economics* 22 (2004): 163-184.

This paper explores the reason behind why in many cases the benefits of cleaning up a Superfund site have little to do with a cleanup decision. The paper applied the hedonic pricing scale to estimate an individual household's willingness to pay for a cleanup of a Superfund site, so as to create a cost-benefit analysis of a Superfund cleanup. Two Superfund sites in Woburn, Massachusetts were chosen for the study. It was found that the cleanup of these two sites would have a benefit of \$72 million to \$122 million dollars (1992 dollars) found in such things as residential property value increases. It is likely that the cost of cleaning up these sites is less than the benefits if a cleanup were to be performed, supporting the idea that taxpayer dollars should be used to create this social gain.

3. Greenberg, Michael, and Jane Lewis. "Brownfields Redevelopment, Preferences and Public Involvement: A Case Study of an Ethnically Mixed Neighborhood." *Urban Studies* 37 (2000): 2501-2514.

In this study, a survey of 200 residents in the City of Perth Amboy, NJ was taken to discover any preferences the citizens of the city had on brownfield redevelopment, and to find out their willingness to participate in the redevelopment of the city as well. Although the main focus on brownfield redevelopment has been on job creation in the form of new industry, the residents seemed to prefer recreational and cultural facilities, as well as new housing projects. A majority of those who responded to

the survey wanted to be involved in the redevelopment efforts. This study suggests that local authorities and businesses need to work closely with residents to build support for new businesses in the area.

4. Lange, Deborah, and Sue McNeil. "Clean It and They Will Come? Defining Successful Brownfield Development." *Urban Planning and Development* 130 (2004): 101-108

In this study, two nationwide surveys were taken, which statistically show that many other factors besides environmental issues contribute to a successful redevelopment project. Other statistically significant factors include: "time to occupancy, total development costs, community support, proposed land use, condition of the local infrastructure, willingness of lending institutions to participate in the financing, support of local politicians, availability of financial incentives, and number of jobs to be created." This study shows that successful brownfield redevelopment must take into consideration much more than environmental concerns. For a successful revitalization project to occur, the community, the economy, and the environment must be seriously taken into consideration.

5. De Sousa, Christopher. "Turning Brownfields into Green Space in the City of Toronto." *Landscape and Urban Planning* 62 (2003): 181-198

Since the issue of brownfields started to grab the attention of the government in the 1980's, most urban redevelopment projects have focused on reuse of brownfields in the form of new industry, commercial sites, and new residential properties. The government supports these types of recycling efforts because they typically result in an increase in the tax base and an increase in job opportunities. This study attempt to describe all the difficulties of redeveloping brownfields into green space, and all of the benefits of new green space in an urban setting. Because green space has a more subjective value, the government typically places this development option last in importance.

6. Miriam Schoenbaum, "Environmental Contamination, Brownfields Policy, and Economic Redevelopment in an Industrial Area of Baltimore Maryland." *Land Economics*. Vol. 78, No. 1. (Feb., 2002), University of Wisconsin Press. pp. 60-71

In recent decades many states have passed brownfield initiative legislation to encourage redevelopment of environmentally challenged land by limiting the liabilities developers may face. The main goal of this legislation is to reduce greenfield redevelopment in suburban areas, increase health standards, and encourage job growth in areas that most need it. Despite the growing awareness of the brownfield problem, no systematic study on the effects of contamination on land value seems to exist. This study attempts to examine the area of Baltimore, Maryland, and whether or not there is a correlation between brownfields and economic development and land use.

The area used in the study was an industrial zoned two square mile peninsula known as Fairfield in which 776 acres out of 1218 acres were unused. Many of these unused parcels of land are brownfields, which are a result of the area's industrial history. Corporate ownership left many of these sites underused due to fears of environmental liability. For the study of Fairfield, land values were assessed by city tax records and not by the real-estate market for consistency. The consumer-price index was used to convert former land values into current values for similar reasons. Because of the broad federal definition of a brownfield, this study redefined brownfields as a site in which contamination or perceived contamination is present. The years 1963 and 1999 were used to see the effect brownfields have on redevelopment. It was assumed that the following formula determines land use.

$$U_{CP} = F(Z_C, E, X_P)$$

U is a vector representing use in C the community, and P the specific property. Z is a vector of community specific standards such as zoning. E is a vector of economic conditions, and X is a vector of site specific characteristics. Because Z and E are constant in the small study area of Fairfield, the following formula is true.

$$U_{CP} = F(X_P)$$

Economic theory predicts brownfields and land values ought to be negatively related, at least in 1999 after environmental laws were passed in Maryland. For similar reasons, brownfields and vacancy rates ought to be positively related.

This study determined that there was no statistically significant reason to believe that a vacant piece of land was more likely to be bought than an active site. Although brownfield status may affect individual development, no systematic effects were determined in this study.

The conclusion reached was that environmental contamination alone cannot account for vacancy or under-use of land in Fairfield. In the 1980's, parcels of land determined to be brownfields were less likely to be sold, but in the 1990's this relationship disappeared, suggesting that the real-estate market has learned how to deal with the situation. Although this study could not prove relationship between contamination and development, this does not mean that environmental contamination is irrelevant. Numerous case studies have suggested otherwise. If contamination is not the only factor in vacancy and under-use of brownfields though, then current brownfield legislation may presumably fail to solve the problem.

### **III. Background**

#### **A. The Brownfield Issue**

The U.S. has been experiencing an unprecedented growth of brownfields since the early 1970's as the economy continues to mature into a post-industrial era. While the economy evolves into a service-oriented nation, many industries find it necessary to move their production processes to less developed countries or suburban areas where costs are lower. As a result of this manufacturing migration, many areas have been left with the presence of brownfields. According to the Environmental Protection Agency (EPA), a brownfield is a "real property, the expansion, redevelopment, or reuse of which may be complicated by the presence or potential presence of a hazardous substance, pollutant, or contaminant" (EPA 2007). In 1987, the U.S. Government Accounting Office (GAO) estimated there were 130,000 to 450,000 brownfields domestically. Put in dollar terms, it is estimated that if all brownfields in the U.S. were remediated, it would cost the country \$650 billion using data from 1987 (GAO 1995). This would mean an average cost of \$2,178 per person over the time period of total cleanup. The redevelopment of these sites remains a high priority for the EPA, but a lack of funds has continued to prevent or stall remediation efforts on many of these sites (Hopey 2006).

Currently there are many different meanings for brownfields, depending upon whether one is on a local, state, or federal level, and depending upon where one stands on the issue. The EPA's definition given previously is probably the most widely accepted definition, but there are others. The United States Office of Technology Assessment (OTA) defines a brownfield as a site in which redevelopment may be stalled not only by contamination, but also poor location, infrastructure, and neighborhood declines (OTA 1995). The European organization Concerted Action on Brownfield and Economic Regeneration Network (CABERNET) defines brownfields as sites that have been affected by former uses of the site or its surroundings, are neglected or underused, are mainly in developed urban areas, require remediation efforts to reutilize them, and have real or perceived environmental problems associated with them (CABERNET 2007). In 2001 the Small Business Liability Relief and Brownfield Revitalization Act redefined federal brownfields by excluding sites in which planned or ongoing removal is in progress, are on the National Priorities List (NPL) or are proposed for listing, and are subject to control of a department, agency, or instrument of the U.S. government excluding land held for Indian tribes. This act allows the federal government to give further financial assistance to properties to protect human health and the environment, and to promote economic development or the creation of green space which the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980 did not (Small Business Liability Relief and Brownfield Revitalization Act 2001).

Because of the varied meanings of brownfields and the large scope of the problem, exact quantitative data are missing. The EPA has cited in public statements that up to one million sites may exist domestically (Bartsch 2003, p. 3). As said previously, the GAO estimated a minimum of 130,000

brownfields in 1987 (GAO 1995). It is no shock then that “no one knows for sure how many brownfields are in each state, how much brownfields make local economies suffer, or how much their redevelopment boosts those economies” (Small Business Liability Relief and Brownfield Revitalization Act 2001).

There are many different classes of brownfields to consider as well. From a developer’s point of view, there are four main categories. There are (Davis 2002, p. 5):

1. brownfields with adequate market demand that continue to be economically feasible to redevelop;
2. sites that have potential, but financial assistance and other incentives are needed;
3. sites with limited potential, even with financial assistance; and
4. sites currently active in danger of evolving into brownfields.

The government may also place brownfields on the National Priorities List (NPL) under CERCLA. These sites are considered the most highly contaminated sites in the U.S., demanding federal attention. Without government assistance, these sites may be too costly for private developers to even consider redeveloping in some cases. Currently the EPA has close to 1,250 sites on the NPL. Over 317 sites have been deleted from this list due to successful remediation efforts. These NPL sites receive Superfund help from the federal government because of their high priority due to significant human health and safety risks (EPA 2007). All NPL sites receive Superfund financial assistance under CERCLA, but all sites that receive this assistance are not necessarily part of the NPL.

Brownfield sites are complicated in many ways. Depending upon how one is connected to a particular site, the understanding and interpretation of it can be entirely subjective. Corporate real estate owners in many cases will choose to keep the contamination of their property a secret, as advised by their lawyers. These sites may then become a “permanent fixture in their real estate portfolios,” to avoid the liabilities connected with these sites (Davis 2002, p. 3). Community leaders, regulators, and environmental interest groups obviously have a different perspective. Challenging the corporate treatment and management of land in communities has become a battle for improving human safety and health for many communities. These individuals have been the leaders in increasing awareness of the possible problems associated with environmentally challenged land (Davis 2002, p. 3). Liability concerns for lenders have consistently deterred private financing of the redevelopment of brownfields in the past. Representative Fred Upton from Michigan has introduced H.R. 200 though, removing Superfund liability from “innocent” lenders and landowners. Senator Alfonse D’Amato of New York has also introduced the *Asset Conservation, Lender Liability, and Deposit Insurance Protection Act*, which has similar protections for lenders. Because of these new government protections that continue to evolve to encourage the revitalization of brownfield inundated communities, much of the fear of lending to brownfield redevelopment projects has been removed, although much uncertainty still exists (Bartsch 2006). Loan officers may have their careers severely altered due to foreclosures on a brownfield site as a result of



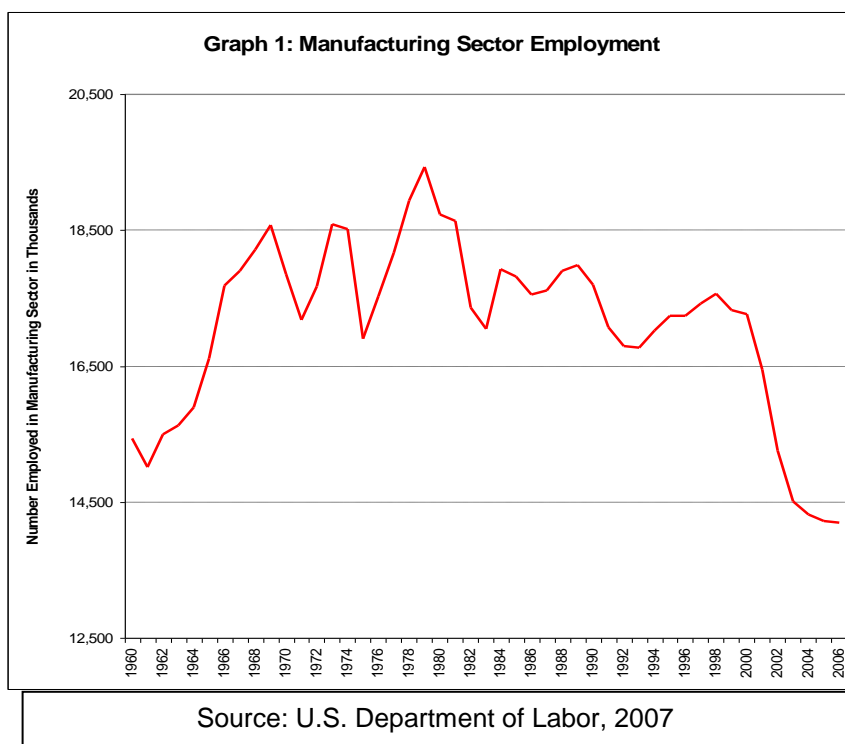
environmental issues not known before the project began. These unknowns are a major barrier in financing environmentally challenged land. Homeowners are also major players in redeveloping brownfield sites. These people are the voices in communities, whose responsibility it is to tell community leaders what they want. Mayors of cities may convert these sites into areas of community development because of the voices they hear from the general public. Homeowners show these officials what they want through their votes and letters, which may or may not include brownfield redevelopment depending upon the situation (Davis 2002, p. 3). Developers are perhaps the most important individuals or groups in brownfield redevelopment. Developers must work with all of the previously mentioned groups of people to ensure that the revitalization of environmentally challenged land is a success. These developers must work nationally and locally. They must work with owners and regulators. They must have connections with the mayor's office, and work with the general public as well. Developers are in a sense the glue in the mission to redevelop brownfields. One can see that given the multitude of perspectives one can take on this issue, brownfield redevelopment remains an increasingly complex undertaking. "Cleanup of ...[these]...sites, however, is crucial. [If left alone]...they will remain a perpetual health and environmental hazard to the community. This is unacceptable" ("Brownfields? Burden").

## ***B. The Manufacturing Sector***

Although the manufacturing sector is not the only cause of brownfields, it is certainly a major contributor to the phenomenon. Because of this relationship, a general understanding of the sector and the different factors associated with it should be helpful in understanding the brownfield issue. The Bureau of Labor Statistics (BLS) defines manufacturing as a "sector consist[ing] of establishments engaged in the mechanical, physical, or chemical transformation of materials, substances, or components into new products" (U.S. Department of Labor 2007).

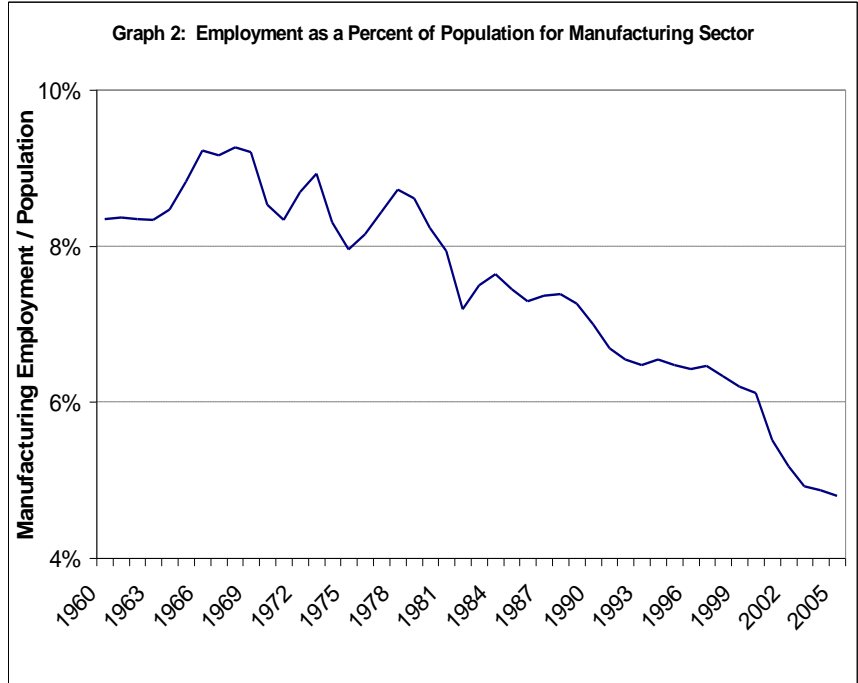
### 1. Employment

Total employment in the manufacturing sector has had its ups and downs in recent decades due to factors such as foreign competition and increasing productivity. Contrary to popular belief though, total employment in 2006 is not that much lower than it was in the early 1960's. Graph 1 shows that in the beginning of the 1960's, total employment in the United



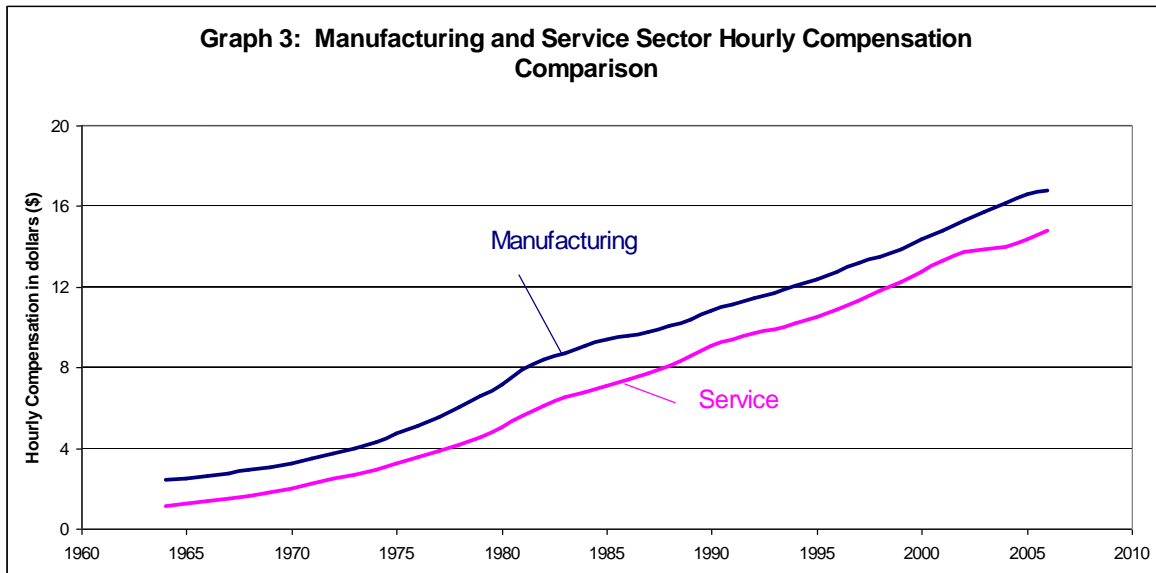
States for the manufacturing sector was roughly 15,000,000 jobs. Total employment in 2006 was around 14,000,000 jobs. Although current employment is not much lower than it was in the 1960's, this past decade shows a general trend downward.

What may be more worrying for America is not the total loss of manufacturing employment since the late 1970's, but the percentage loss in manufacturing employment compared to total population. Graph 2 shows that since the middle of the 1960's, manufacturing employment as a percentage of total population has been steadily declining. The 2006 proportion of manufacturing employees to population is around 5% lower than it was in the 1960's. Looking at the percentage of manufacturing employment rather than total numbers paints a very different picture. Manufacturing as an employment presence has unambiguously shrunk since the middle of the 20<sup>th</sup> century.



Source: U.S. Department of Labor, 2007; U.S. Census Bureau

If those individuals who were displaced from their manufacturing jobs could find work that

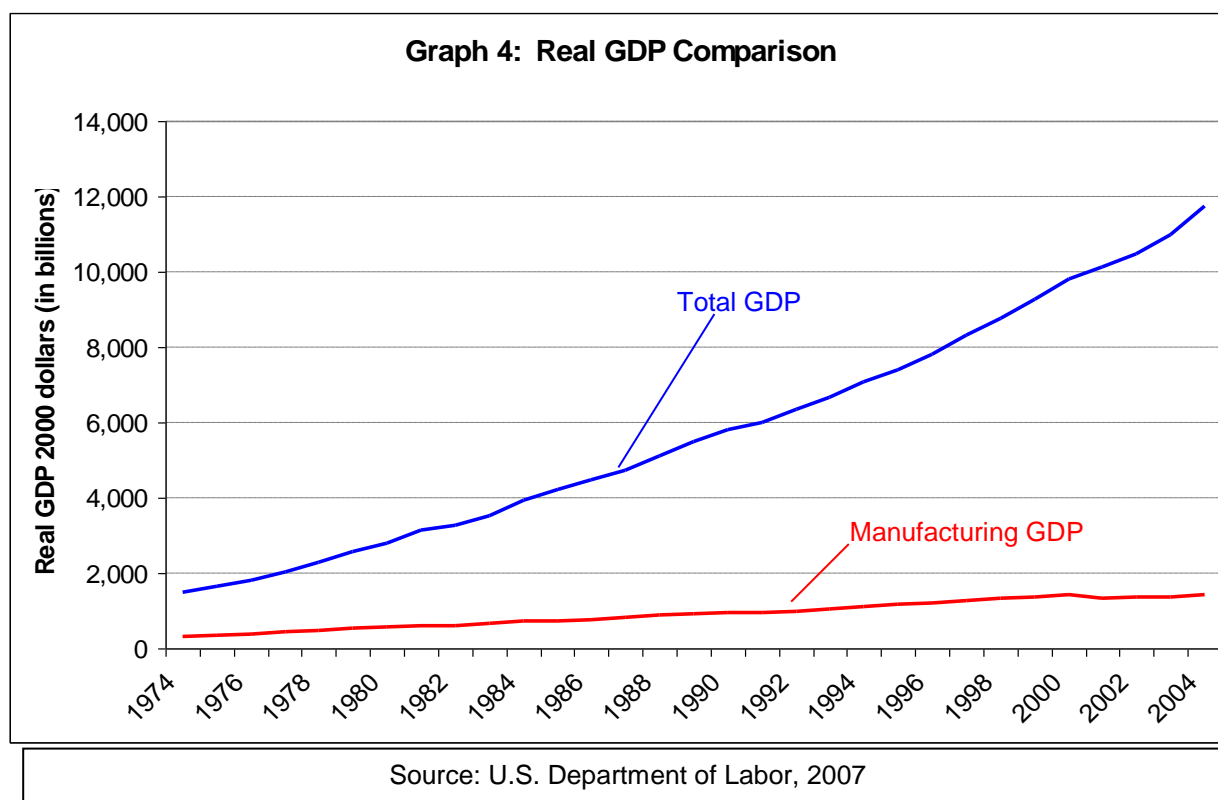


Source: U.S. Department of Labor, 2007

compensated them equivalently, there would not necessarily be a problem. What may be distressing to many Americans though is that the jobs that these former manufacturing employees find often pay less than their original jobs. Graph 3 shows that employment in the manufacturing sector has consistently received a higher wage than the service sector, approximately 24% higher over the period represented by the graph on average, although both wages are growing together. As manufacturing employment falls and service employment rises as a percentage of total population, many Americans have been forced to either accept unemployment or a lower wage.

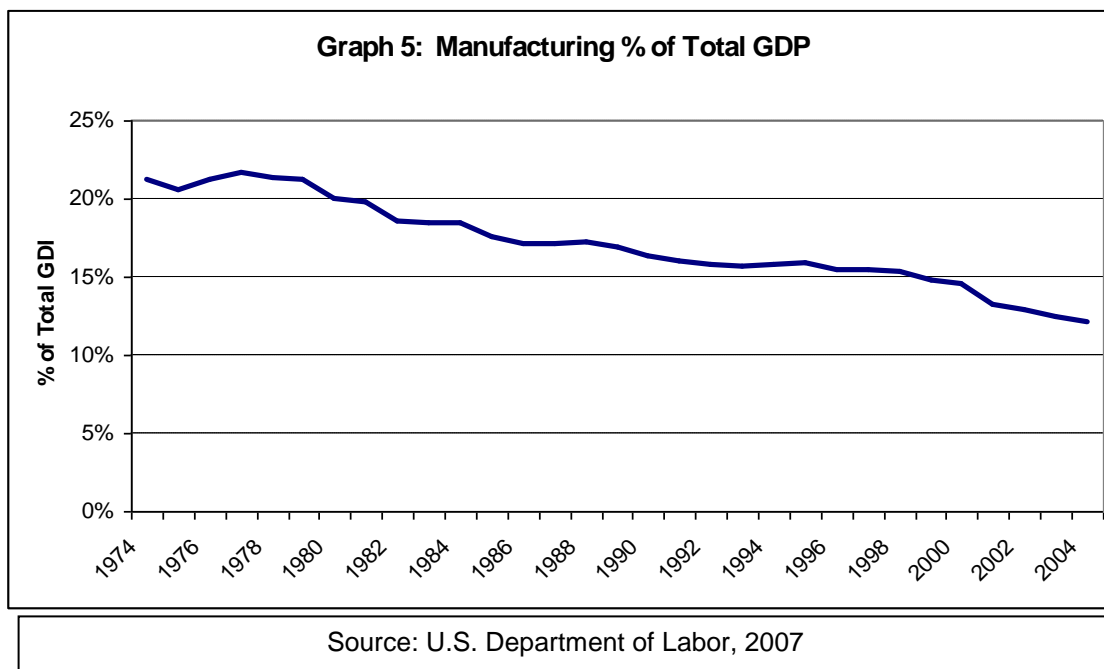
## 2. Output

Real GDP growth in the manufacturing sector has been growing these past decades, again contrary to popular belief. Graph 4 shows GDP in the manufacturing sector, as well as the Total GDP. Although growth in the manufacturing sector seems slow as compared to the total, it is indeed still positive growth. (U.S. Department of Commerce 2007).

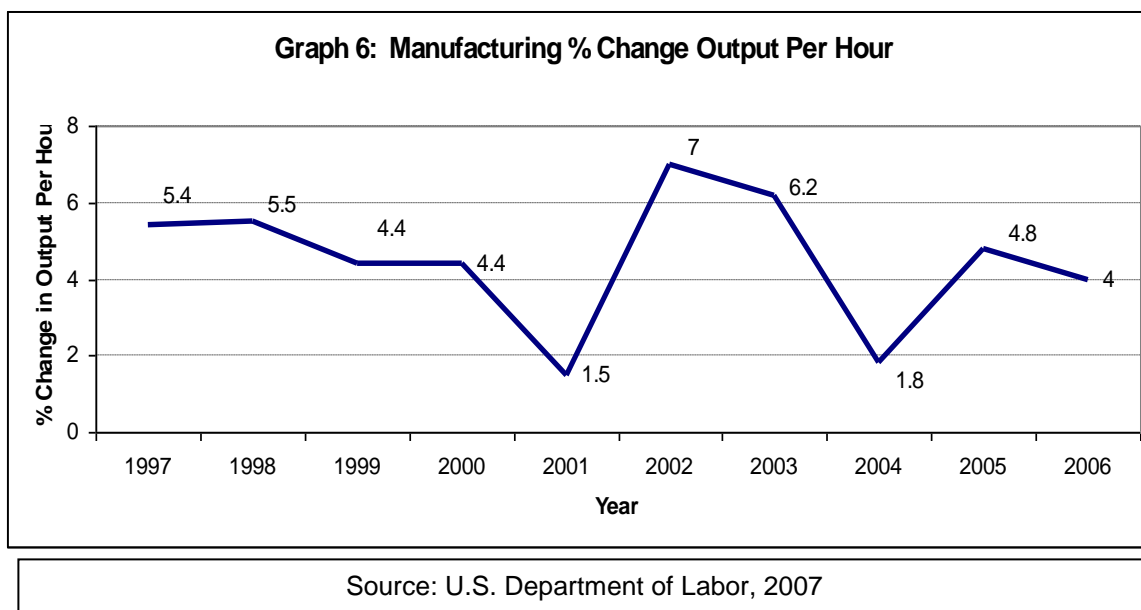


While there is positive growth in the manufacturing sector, when one looks over time at its relative size compared to total Real GDP, this sector is shrinking as a piece of the pie. As said previously, there is still real growth in the manufacturing sector, only this growth is at a much slower pace than total growth in the economy. Graph 5 shows this as a general trend downward from years 1974 to 2004. Starting

from the middle of the 1970s, manufacturing was roughly 22% of total real GDP. The 2004 figure is much lower, at close to 12%. Although popular opinion seems to be very negative toward this general trend in the economy, it is not necessarily a harmful phenomenon. If the total gain from having less expensive import prices of manufactured goods is greater than the total loss from lower wages and layoffs, the economy may be better off as a whole. This is a very controversial issue though, and is much more complex than what is presented here.



If output in the manufacturing sector is still continuing to grow, although slowly, one may find the presence of brownfields odd, since their occurrence would intuitively suggest shrinkage, not growth. This seeming contradiction may be solved though by checking one's original premises. Are brownfields caused by shrinking real GDP in the manufacturing sector? Another reasonable cause may actually be



the changing ratio of capital to labor and the increase in output per labor hour, although slow GDP growth for the sector may also contribute. Graph 6 shows that for the past decade, the manufacturing sector has consistently seen very high increases in output per labor hour. A reasonable cause of this is an increase in investment and technology. If the capital used to replace any given number of laborers can produce equivalent output while taking up less physical space, it makes sense that some firms may choose to decrease their plant size to increase efficiency, thus resulting in the possibility of a brownfield. Research and development in the manufacturing sector may possibly increase this ratio due to improved technology such as electric rather than coal burning steel mills.

Although every brownfield site is unique and has its own specific cause or causes, general trends in the manufacturing sector certainly explain many of the brownfields that currently exist in the nation's cities and industrial towns today. Whether or not current manufacturing trends and the presence of brownfields are good or bad for the nation is most likely still to be decided in decades to come. Present movements in U.S. production and labor markets may be perhaps only an economic evolution similar in many ways to the historical change in the farming sector.

## **IV. National Priorities List Analysis**

“The National Priorities List (NPL) is a list of national priorities among the known releases or threatened releases of hazardous substances, pollutants, or contaminants throughout the United States and its territories (EPA 2007).” This list is used to guide the EPA and other agencies in the direction of cleaning brownfields most in need. Brownfields on the NPL pose either a significant long term or immediate risk to the community members in surrounding areas. Contamination on these sites includes radioactive substances, volatile organic compounds, PCBs, flammables, etc.

### **A. GDP's Relationship with NPL**

In an attempt to explain what causes severely challenged land, the NPL has been selected as a sample of brownfields with significant contamination problems. Twelve variables have been chosen as possible determinants to explain the variation in NPL densities across states. How these variables were chosen is explained in section A-2. The variables measure the amount of activity in twelve industries during 1970, and are a measure of GDP in millions of current dollars for each industry. The year 1970 was chosen because it coincides with the peak of employment in the manufacturing sector. It is important to look back in time to see how activities in the past have caused brownfields today. Data were collected for each of these variables for all 50 states. These industries are explained further in Appendix A. The 12 industries and their abbreviations for this paper are:

- 28 - Chemical and Allied products (Chem)
- 34 - Fabricated Metal Products (Metals)
- 31 - Leather and Leather Products (Leather)
- 30 - Rubber and Miscellaneous Plastics Products (Rubber)
- Division C - Construction (Construction)
- 82 - Education (Education)
- 81 - Legal Services (Legal)
- 76 - Miscellaneous Repair (Repair)
- 61 - Non-depository Institutions (NonD)
- 65 - Real Estate (Real Estate)
- 83 - Social Services (Social)
- Division F - Wholesale Trade (Wholesale)

### 1. Absolute Count of NPL Site Analysis

It is hypothesized that the number of severe NPL brownfields in a state currently is a function of these industry GDPs in 1970. The hypothesized brownfield function is as follows:

$$\# \text{ severe brownfield sites} = f(\text{amount of output [GDP] of each industry})$$

To determine which of these variables are statistically significant predictors of brownfields in a state, a regression analysis must be done. The dependent variable will be the number of NPL sites within a state, and the independent variables will be the 12 previously mentioned variables. The data for Pennsylvania are shown in Table 1 as an example.

Table 1: Pennsylvania GDP during 1970 in millions of current dollars

State	PENNSYLVANIA
Chem	\$1,103
Metals	1,500
Leather	178
Rubber	453
Construction	2,896
Education	726
Legal	336
Repair	144
NonD	115
Real Estate	5,392
Social	150
Wholesale	3,842
Total GDP	\$57,075
NPL Count	93

Source: Bureau of Economic Analysis; USEPA

The results are shown in Table 2: Regression 1a.

The thirteen variables that were chosen explain more than 85% of the variation in the number of brownfield sites in a state according to the adjusted R squared. R squared, or the coefficient of determination, explains variation in the dependent variable. The higher the R squared, the more the independent variables explain the dependent variable. An R squared of 0 would mean that the independent variables explain no variation in the dependent variable, and an R squared of 1 would mean that the independent variables explain all of the variation in the dependent variable. The adjusted R squared accounts for the fact that adding any variable to the equation should increase the R squared a little even if there is virtually no actual relationship.

Table N: Regression 1a

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>
R Square	0.890			
Adjusted R Square	0.854			
Observations	50			
Intercept	6.445	2.831	2.277	0.029
Chem	0.036	0.006	6.166	0.000
Metals	0.012	0.009	1.309	0.199
Leather	0.019	0.036	0.510	0.613
Rubber	-0.057	0.015	-3.854	0.000
Construction	0.012	0.018	0.674	0.505
Education	0.027	0.030	0.909	0.369
Legal	-0.214	0.077	-2.761	0.009
Repair	-0.268	0.163	-1.648	0.108
NonD	-0.043	0.123	-0.351	0.727
Real Estate	0.021	0.005	4.705	0.000
Social	-0.145	0.425	-0.341	0.735
Wholesale	0.002	0.013	0.170	0.866

\*Variables highlighted in yellow are at the 10% significance level or better

The adjusted R squared will increase, decrease, or not change at all depending upon how well the added variable improves the fit in the equation. Because of this, the adjusted R squared is a better measure of how much the independent variables determine the dependent variable. Four of the twelve variables were found to be statistically significant with a P-value at the 10% significance level or better. A P-value, or marginal significance level, is the probability that the null hypothesis is false. Because it is a probability, it runs from 0 to 1. For this study the null hypothesis being tested is that these 12 variables do not explain the variation in severe brownfields. If the P-value is less than .10, or at the 10% significance level, it is safe to reject the null hypothesis and say that whatever variable happens to have that P-value does explain some of variation across states in severe brownfields. GDP in 1970 for chemical and allied products has a P-value close to zero and was positively related to the number of brownfield sites. This means that larger amounts of chemical producing industries, some of which are known for contaminating the environment, were positively related to the number of brownfields in a state. GDP in 1970 for the real estate industry was also statistically significant and positively related to the number of brownfields in a state, but the cause for this relationship is not intuitively obvious. Another statistically significant variable found in this regression analysis was 1970 legal services GDP. This variable was found to be negatively related to the number of severe brownfields. Seeing that legal services cause little pollution, it makes sense that they would not directly cause brownfields, but the reason behind the negative relationship is puzzling. The last variable that was found to be statistically significant was 1970 rubber and miscellaneous plastic products GDP. This variable was also found to be negatively related to the number of brownfields in a state. This negative relationship is also not intuitively obvious. One might expect this



industry to have the same type of relationship as the chemical industry does toward brownfields, but it does not.

Running the regression again including only those variables that were found to be statistically significant, the results are shown in Table 3: Regression 1b.

Table 3: Regression 1b

R Square	0.828
Adjusted R Square	0.813
Observations	50

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>
Intercept	7.1084	2.0266	3.5076	0.0010
Chem	0.0296	0.0047	6.3510	0.0000
Rubber	-0.0277	0.0105	-2.6313	0.0116
Legal	-0.1279	0.0303	-4.2231	0.0001
Real Estate	0.0142	0.0023	6.1417	0.0000

Removing the variables that were not significant and running the regression again has in effect increased the probability that the remaining variables do explain the variation in the dependent variable. Looking at the P-value column, every single variable's P-value has decreased from the previous regression 1a. The adjusted R squared has only decreased a negligible amount, implying that the amount of these four industries in a state during the 1970's explains most of the variation in the number of brownfields in states today.

Although this analysis is a good starting place, it overlooks some important statistical issues. If a true explanatory equation for the causes of severe brownfields is the main goal, scaling factors must be removed from the variables. It might be expected that states with larger GDPs would have larger numbers of brownfields. But this does not explain the brownfield problem, or point to any specific industry as the most likely source of brownfields. Also, many of the independent variables have a very high correlation among them, making the results virtually useless in predicting anything. If there is a high correlation among explanatory variables, the regression cannot make a distinction as to the individual effects of the dependent variables. The correlation matrix for these variables is found in Appendix B under Correlation 1.

To correct for these problems each industry's GDP as a percent of state total for all industries will be used instead of the absolute value of GDP in millions of current dollars. The correlation matrix for these new variables is found in Appendix B under Correlation 2. As the scaling factors are removed, the inter-correlation decreases by a noticeable amount. It is hypothesized that the number of brownfield sites within a state is a function of these industries' GDP as a percent of state total. The hypothesized brownfield function is as follows:

$$\# \text{ severe brownfield sites} = f(\text{industries' GDP as percent of state total})$$

Data for Pennsylvania are shown in Table 4.

Table 4: Pennsylvania GDP during 1970 as % State Total

State	PENNSYLVANIA
Chem	1.9%
Metals	2.6
Leather	0.3
Rubber	0.8
Construction	5.1
Education	1.3
Legal	0.6
Repair	0.3
NonD	0.2
Real Estate	9.4
Social	0.3
Wholesale	6.7
Other	70.5
Total GDP	100.0%
NPL Count	93

Source: Bureau of Economic Analysis; USEPA

The results are shown in Table 5: Regression 2b.

Table 5: Regression 2b

R Square	0.576
Adjusted R Square	0.439
Observations	50

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>
Intercept	-73.802	51.305	-1.439	0.159
Chem	235.208	128.250	1.834	0.075
Metals	1185.843	390.701	3.035	0.004
Leather	300.750	488.500	0.616	0.542
Rubber	-1725.125	762.230	-2.263	0.030
Construction	-591.193	333.696	-1.772	0.085
Education	-201.999	1057.306	-0.191	0.850
Legal	424.841	2626.884	0.162	0.872
Repair	7781.646	5719.537	1.361	0.182
NonD	-3486.547	3328.421	-1.048	0.302
Real Estate	453.158	148.806	3.045	0.004
Social	19361.813	21790.326	0.889	0.380
Wholesale	316.025	297.578	1.062	0.295

The twelve variables that were chosen explain more than 43% of the variation in the number of brownfield sites in a state according to the adjusted R squared. The chemical, rubber, and real estate industries are statistically significant again in this regression, all with the same sign as the previous

regression. Legal services, which showed up in the previous regression, is no longer statistically significant. The fabricated metal products industry, which was not statistically significant previously, now has a P-value of .004, and registers as positively related to severe brownfields. As this industry grows as a percent of state total, the number of brownfields should grow. Construction also shows up statistically significant and is negatively related to brownfields.

It makes sense that as these industries grow as an absolute value and as a percent they should affect the number of brownfields. Take for instance the chemical industry. If this industry is a true cause of severe brownfields, an increase in the amount of activity in this industry in absolute terms as well as proportionally to other industries should cause an increase in the number of brownfields caused by this industry, other things held constant.

Running the regression again including only those variables that were found to be statistically significant, the results are shown in Table 6: Regression 2b.

Table 6: Regression 2b

R Square	0.511
Adjusted R Square	0.455
Observations	50

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>
Intercept	7.723	18.259	0.423	0.674
Chem	246.287	119.091	2.068	0.045
Metals	1255.698	345.221	3.637	0.001
Rubber	-1792.139	589.688	-3.039	0.004
Real Estate	552.779	114.750	4.817	0.000
Construction	-761.718	287.227	-2.652	0.011

Removing the variables that were not significant and running the regression again has removed the “white noise” and in effect increased the probability that the remaining variables do explain the variation in the dependent variable. Looking at the P-value column, every single variable’s P-value has decreased from the previous regression 2a. The adjusted R squared has only decreased a negligible amount, implying that these four industries during the 1970’s explain more than one third of the variation in brownfields in a state today.

Although this regression is more accurate than the previous regression, it still overlooks some important statistical issues. The previously mentioned goal of this analysis is an explanatory equation for the causes of severe brownfields. How should brownfields be measured though? The previous two regressions measured brownfields as a count in absolute terms. This might not be the best measure for the true behavior of the cause and problems of brownfields though, leading to the approach in the next section.

## 2. NPL Per Capita Analysis

It is obvious to most that brownfields are a real problem, and the more there are the larger the problem. Having 200 brownfields in Texas as compared to 200 brownfields in Rhode Island are two totally different scenarios though. Assuming these numbers were true, Rhode Island would have a much larger brownfield presence than Texas, and would have a much higher environmental and human toll. To account for these differences, brownfields per capita will be tested as the new dependent variable. Using brownfields per capita instead of the absolute value of brownfields in effect removes another scaling effect. The independent variables will be the same as in the second regression. For all of the previous regressions and upcoming regressions, the industries that were chosen were chosen because as a percent of state total they were the most highly negatively or positively correlated to brownfields per capita. It is hypothesized that the number of brownfield sites per capita for a state is a function of these industry GDPs as a percent of state total. The hypothesized brownfield function is as follows:

$$\# \text{ severe brownfield sites per capita} = f(\text{industries' GDP as percent of state total})$$

Data for Pennsylvania is shown in Table 7.

Table 7: Pennsylvania GDP during 1970 as % State Total

State	PENNSYLVANIA
Chem	1.9%
Metals	2.6
Leather	0.3
Rubber	0.8
Construction	5.1
Education	1.3
Legal	0.6
Repair	0.3
NonD	0.2
Real Estate	9.4
Social	0.3
Wholesale	6.7
Other	70.5
GDP	100.0%
1970 Population	11,793,909
NPL per Capita	0.0000079

Source: Bureau of Economic Analysis; U.S. Census Bureau; USEPA

The results are shown in Table 8: Regression 3a.

Table 8: Regression 3a

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>
R Square	0.523			
Adjusted R Square	0.369			
Observations	50			
Intercept	3.883E-06	1.305E-05	0.298	0.768
Chem	6.194E-05	3.262E-05	1.899	0.065
Metals	-0.0002	9.938E-05	-1.892	0.066
Leather	0.0001	1.243E-04	0.954	0.346
Rubber	3.516E-05	1.939E-04	0.181	0.857
Construction	1.161E-05	8.488E-05	0.137	0.892
Education	0.0005	2.689E-04	1.723	0.093
Legal	-0.0010	6.682E-04	-1.429	0.161
Repair	0.0007	1.455E-03	0.485	0.631
NonD	-0.0004	8.466E-04	-0.484	0.631
Real Estate	6.282E-05	3.785E-05	1.660	0.105
Social	0.0034	5.543E-03	0.621	0.538
Wholesale	-0.0001	7.569E-05	-1.587	0.121

As the scaling factors are removed, these industries explain a bit less of the total variation in severe brownfields for a state, but what they do explain is a truer picture of reality. These twelve variables now only explain 37 percent of the variation in brownfields per capita. The inter-correlation problems between the dependent and all independent variables have been virtually removed though, allowing this regression to more accurately explain the variation in brownfields per capita.

The variables that were found to be statistically significant were chemical and allied products, metals, and education. Those variables that were positively related with severe brownfields were chemical and allied products and education. This would imply that an increase in the education or chemical industry relative to other sectors would cause more brownfields. The reasoning behind education being positively related to brownfields is again not intuitively obvious. The metal industry was negatively related with severe brownfields. It is important to remember that the first two regressions were determined to be unreliable due to inter-correlation issues and what the data represented, but the third regression has very low inter-correlation (seen in Appendix B, Correlation 3) and better represents the true human toll of severe brownfields.

Running the regression again including only those variables that were found to be statistically significant, the results are shown in Table 9: Regression 3b.

As in the previous cases, every single variable's P-value has decreased from the previous regression 3a. The adjusted R squared has decreased more than 10%, implying that the activities in these five industries during the 1970's explain more than one quarter of the variation in brownfields per capita in a state today. It is interesting to note that the chemical industry showed up statistically significant in all three regressions, showing that an increase in the activity of the chemical industry will

increase the total number of brownfields sites or brownfields per capita. The chemical industry is commonly known to cause severe brownfields, and the data here support that.

**Table 9: Regression 3b**

R Square	0.278
Adjusted R Square	0.231
Observations	50

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>
Intercept	5.566E-06	1.630E-06	3.415	0.001
Chem	7.546E-05	3.167E-05	2.382	0.021
Education	0.001	0.000	3.295	0.002
Metals	0.000	8.149E-05	-2.889	0.006

### ***B. The Change in Industry Establishments Relationship with NPL***

In the previous section, support was found that sites on the NPL are affected by the chemical, education, and fabricated metals industries using GDP as a percent of state total for analysis. Perhaps a better predictor of severe brownfields is not GDP but the change in the number of industry establishments over time. If an industry decreases the total number of plants in use for that industry, it is possible that some of the previously used plants in that given industry will become unused sites, perhaps brownfields. For this reason, those three industries will be tested again using the change in industry establishments from 1977 to 1997. The reason 1977 instead of 1970 is being used is due to data availability.

#### ***1. Absolute Count of NPL Site Analysis***

It is hypothesized that the number of severe NPL brownfields in a state is a function of the change in the number of establishments for the chemical, education, and fabricated metals industries. The hypothesized brownfield function is as follows:

$$\# \text{ severe brownfield sites} = f(\text{the change in the number of industry establishments})$$

The dependent variable will be the number of NPL sites within a state, and the independent variables will be the change in the number of establishments for the three previously mentioned industries. The data for Pennsylvania are shown in table 10 as an example.

Table 10: Pennsylvania Change in Industry Establishments from 1977 to 1997

State	Pennsylvania
Chem	-18
Metals	85
Education	788
NPL Count	93

Source: University of Virginia Library; USEPA

Running a regression, the results are shown in Table 11: Regression 4a.

Table 11: Regression 4a

R Square	0.639
Adjusted R Square	0.615
Observations	50

	Coefficients	Standard Error	t Stat	P-value
Intercept	12.059	3.038	3.970	0.000
Chem	-0.143	0.056	-2.545	0.014
Metals	0.005	0.024	0.214	0.831
Education	0.030	0.006	5.406	2.225E-06

According to the adjusted R squared, these three variables explain over 61% of the variation in the number of severe brownfields. The chemical industry is still negatively related with the number of brownfields, meaning as the number of chemical establishments fall, the number of brownfields rise, as expected. Education is also still positively related with the number of brownfields, meaning as the number of education establishments rise, the number of brownfield also rise. The fabricated metals industry was not statistically significant. When these same industries were run in regression 3b using % GDP for a state instead of the change in industry establishments over time, and NPL per capita instead of the absolute count of NPL, these industries only accounted for 23% of the variation in the number of severe brownfields.

Running the regression again including only those variables that were found to be statistically significant, the results are shown in Table 12: Regression 4b.

Table 12: Regression 4b

R Square	0.639
Adjusted R Square	0.623
Observations	50

	Coefficients	Standard Error	t Stat	P-value
Intercept	12.277	2.834	4.332	7.711E-05
Chem	-0.133	0.028	-4.720	2.157E-05
Education	0.031	0.004	8.279	9.780E-11

As in the previous cases, every single variable's P-value has decreased from the previous regression 3a. The adjusted R squared has increased almost 1%. It is interesting to note that the chemical industry was statistically significant again showing that an increase in the number of plants for the chemical industry will increase the total number of brownfields sites. The chemical industry is commonly known to cause severe brownfields, and the data here support that.

## 2. Scaling Factors Removed

Scaling factors may still be present, but if the same logic is followed, as done in section A, other problems present themselves. One might think that the % change in industry establishments instead of the absolute change in the number of establishments would be a better variable, but intuitively it would not make any sense. Scaling factors would certainly be removed, but it would no longer be logical to use it in a regression with a dependent variable of the absolute count of NPL, or NPL per capita. Percent change would no longer see the difference between a change of 1 to 2 and a change of 1,000 to 2,000. In some cases this may be desired to achieve homoskedasticity, or a constant variance, but when comparing it to a dependent variable, it must make economic and statistical sense. When comparing NPL to the change in the number of establishments for these three industries, it may make more sense to compare sites with sites, instead of forcing scaling factors to be removed. In section A, GDP was used, which obviously cannot be used to compare sites with sites.

Correlation tables for both the absolute change and % change are provided in Appendix B. It is interesting to note that when scaling factors are removed, the correlations between industries and NPL change little.

## **C. The Chemical Industry: A Closer Look**

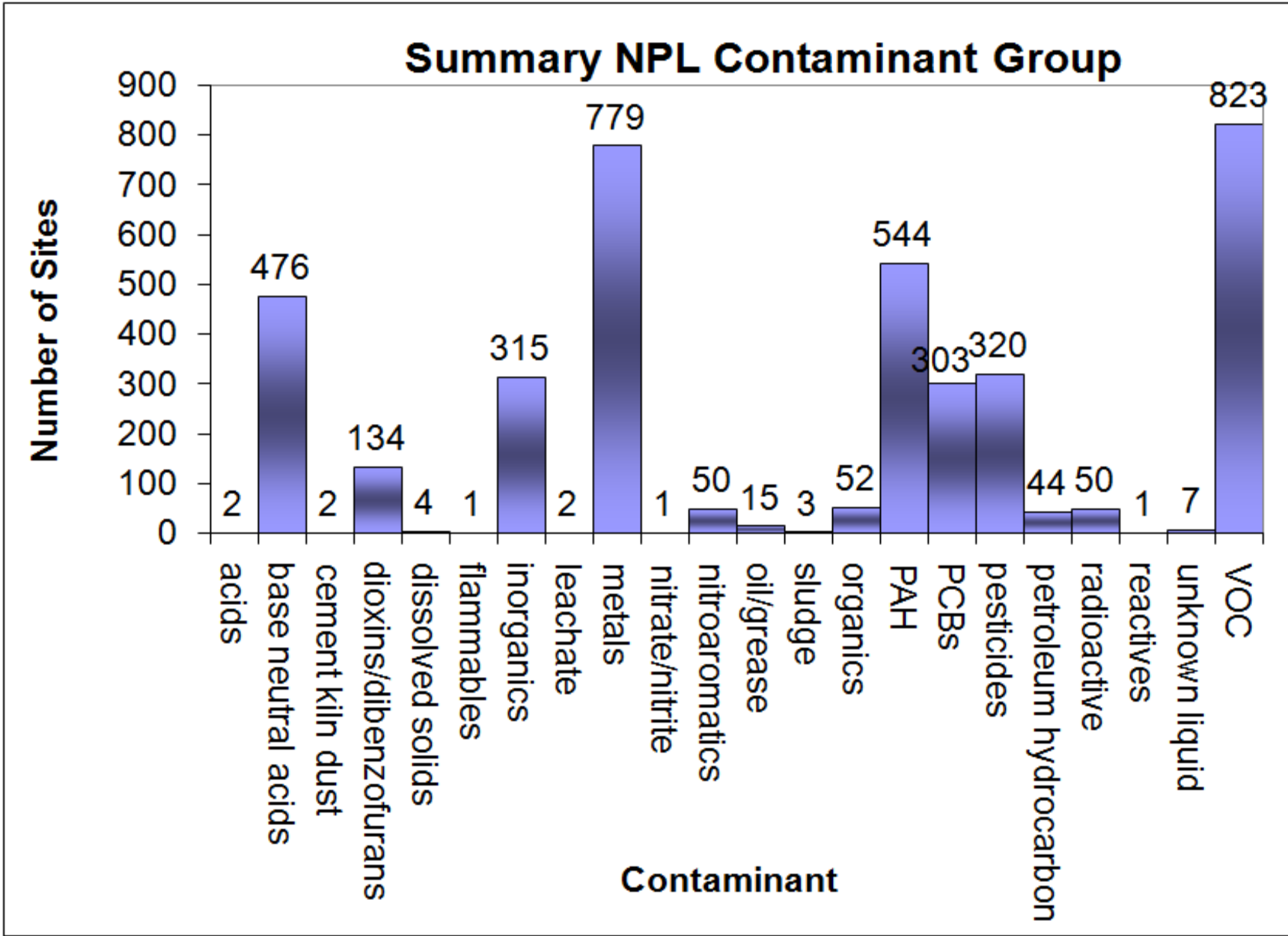
The chemical industry has been shown statistically to explain some of the variation in the number of severe brownfields. There were other industries as well, but most of these industries are not known to actually create brownfields directly. For example, the education industry is positively related to brownfields, but there are no NPL listed severe brownfields from education. The chemical industry has many brownfields listed on the NPL list though.

The USEPA has a database showing which type of contaminant is on every NPL listed brownfield. Sites may have multiple contaminants. The graph of this data is shown on the next page in graph n.

If the chemical industry is a major contributor to severe brownfields, the industry should cause a significant portion of some of the more prominent contaminants on NPL listed sites such as metal contaminants, PAH, PCBs, VOC, etc. For example, it is commonly known that the chemical industry caused many PCB contamination incidents before federal legislation banned its production in 1979 (Code of Federal Regulations 2007). The extent to which the chemical industry caused PCB incidents



compared to other industries may be much higher due to the processes that are involved in the chemical industry that are not in other industries. If this is the case, the data from the USEPA would support the previous regression analysis.



## **V. Conclusion**

The data here show that a significant contributor to brownfields is a decrease in the chemical industry's output, as well as a decrease in the number of establishments the industry occupies. This is hardly surprising due to the very nature of the industry. What is surprising though is the possible positive relationship between education and brownfields.

This study began by comparing NPL sites with the GDP of certain industries in a state, slowly removing scaling factors. To choose the industries, correlations with NPL were used. After using multiple forms of state GDPs as independent variables, it was decided that the change in industry establishments rather than GDP is a better explanatory variable for NPL sites. The industries that were found to be significant using GDP as a percent of state total and NPL per capita as the independent and dependent variables respectively were then used again in the form of the absolute change in establishments and absolute count of NPL sites. The chemical industry and education industry were found to be significant again with the expected negative and positive relationship.

In future research, a correlation between industry establishments and NPL sites could be used to choose independent variables, instead of the connection logic used in this study.

## VI. Appendix A – SIC Code

### Industry List

DIVISION A. AGRICULTURE, FORESTRY, AND FISHING

DIVISION B. MINING

DIVISION C. CONSTRUCTION

DIVISION D. MANUFACTURING

DIVISION E. TRANSPORTATION, COMMUNICATIONS, ELECTRIC, GAS, AND SANITARY SERVICE

DIVISION F. WHOLESALE TRADE

DIVISION G. RETAIL TRADE

DIVISION H. FINANCE, INSURANCE, AND REAL ESTATE

DIVISION I. SERVICES

DIVISION J. PUBLIC ADMINISTRATION

DIVISION K. NONCLASSIFIABLE ESTABLISHMENTS

01 AGRICULTURAL PRODUCTION-CROPS

02 AGRICULTURAL PRODUCTION-LIVESTOCK AND ANIMAL SPECIALTIES

07 AGRICULTURAL SERVICES

08 -FORESTRY

09 FISHING, HUNTING, AND TRAPPING

10 METAL MINING

12 COAL MINING

13 OIL AND GAS EXTRACTION

14 MINING AND QUARRYING OF NONMETALLIC MINERALS, EXCEPT FUELS

15 BUILDING CONSTRUCTION-GENERAL CONTRACTORS AND OPERATIVE BUILDERS

16 HEAVY CONSTRUCTION OTHER THAN BUILDING CONSTRUCTION-CONTRACTORS

17 CONSTRUCTION-SPECIAL TRADE CONTRACTORS

20 FOOD AND KINDRED PRODUCTS

21 TOBACCO PRODUCTS

22 TEXTILE MILL PRODUCTS

23 APPAREL AND OTHER FINISHED PRODUCTS MADE FROM FABRICS AND SIMILAR MATERIAL

24 LUMBER AND WOOD PRODUCTS, EXCEPT FURNITURE

25 FURNITURE AND FIXTURES

26 PAPER AND ALLIED PRODUCTS

27 PRINTING, PUBLISHING, AND ALLIED INDUSTRIES

28 CHEMICALS AND ALLIED PRODUCTS

29 PETROLEUM REFINING AND RELATED INDUSTRIES

30 RUBBER AND MISCELLANEOUS PLASTICS PRODUCTS

31 LEATHER AND LEATHER PRODUCTS

32 STONE, CLAY, GLASS, AND CONCRETE PRODUCTS

33 PRIMARY METAL INDUSTRIES

34 FABRICATED METAL PRODUCTS, EXCEPT MACHINERY AND TRANSPORTATION EQUIPMENT

35 INDUSTRIAL AND COMMERCIAL MACHINERY AND COMPUTER EQUIPMENT

36 ELECTRONIC AND OTHER ELECTRICAL EQUIPMENT AND COMPONENTS, EXCEPT COMPUTER

37 TRANSPORTATION EQUIPMENT

38 MEASURING, ANALYZING AND CONTROLLING INSTRUMENTS; PHOTOGRAPHIC, MEDICAL AN

39 MISCELLANEOUS MANUFACTURING INDUSTRIES

40 RAILROAD TRANSPORTATION

41 LOCAL AND SUBURBAN TRANSIT AND INTERURBAN HIGHWAY PASSENGER TRANSPORTATION

42 MOTOR FREIGHT TRANSPORTATION AND WAREHOUSING

43 UNITED STATES POSTAL SERVICE

44 WATER TRANSPORTATION

45 TRANSPORTATION BY AIR

46 PIPELINES, EXCEPT NATURAL GAS

47 TRANSPORTATION SERVICES

48 COMMUNICATIONS

49 ELECTRIC, GAS, AND SANITARY SERVICES

50 WHOLESALE TRADE&die;DURABLE GOODS

51 WHOLESALE TRADE&die;NONDURABLE GOODS

52 BUILDING MATERIALS, HARDWARE, GARDEN SUPPLY, AND MOBILE HOME DEALERS

53 GENERAL MERCHANDISE STORES

54 FOOD STORES

55 AUTOMOTIVE DEALERS AND GASOLINE SERVICE STATIONS

56 APPAREL AND ACCESSORY STORES

57 HOME FURNITURE, FURNISHINGS, AND EQUIPMENT STORES

58 EATING AND DRINKING PLACES

59 MISCELLANEOUS RETAIL

60 DEPOSITORY INSTITUTIONS

61 NONDEPOSITORY CREDIT INSTITUTIONS

62 SECURITY AND COMMODITY BROKERS, DEALERS, EXCHANGES, AND SERVICES

63 INSURANCE CARRIERS

64 INSURANCE AGENTS, BROKERS, AND SERVICE

65 REAL ESTATE

67 HOLDING AND OTHER INVESTMENT OFFICES

70 HOTELS, ROOMING HOUSES, CAMPS, AND OTHER LODGING PLACES

72 PERSONAL SERVICES

73 BUSINESS SERVICES

75 AUTOMOTIVE REPAIR, SERVICES, AND PARKING

76 MISCELLANEOUS REPAIR SERVICES

78 MOTION PICTURES

79 AMUSEMENT AND RECREATION SERVICES

80 HEALTH SERVICES

81 LEGAL SERVICES

82 EDUCATIONAL SERVICES

83 SOCIAL SERVICES

84 MUSEUMS, ART GALLERIES, AND BOTANICAL AND ZOOLOGICAL GARDENS

86 MEMBERSHIP ORGANIZATIONS

87 ENGINEERING, ACCOUNTING, RESEARCH, MANAGEMENT, AND RELATED SERVICES

88 PRIVATE HOUSEHOLDS

89 SERVICES, NOT ELSEWHERE CLASSIFIED

91 EXECUTIVE, LEGISLATIVE, AND GENERAL GOVERNMENT, EXCEPT FINANCE

92 JUSTICE, PUBLIC ORDER, AND SAFETY

93 PUBLIC FINANCE, TAXATION, AND MONETARY POLICY

94 ADMINISTRATION OF HUMAN RESOURCE PROGRAMS

95 ADMINISTRATION OF ENVIRONMENTAL QUALITY AND HOUSING PROGRAMS

96 ADMINISTRATION OF ECONOMIC PROGRAMS

97 NATIONAL SECURITY AND INTERNATIONAL AFFAIRS

## 99 NONCLASSIFIABLE ESTABLISHMENTS

011 CASH GRAINS  
 013 FIELD CROPS, EXCEPT CASH GRAINS  
 016 VEGETABLES AND MELONS  
 017 FRUITS AND TREE NUTS  
 018 HORTICULTURAL SPECIALTIES  
 019 GENERAL FARMS, PRIMARILY CROP  
 021 LIVESTOCK, EXCEPT DAIRY AND POULTRY  
 024 DAIRY FARMS  
 025 POULTRY AND EGGS  
 027 ANIMAL SPECIALTIES  
 029 GENERAL FARMS, PRIMARILY LIVESTOCK AND ANIMAL SPECIALTIES  
 071 SOIL PREPARATION SERVICES  
 072 CROP SERVICES  
 074 VETERINARY SERVICES  
 075 ANIMAL SERVICES, EXCEPT VETERINARY  
 076 FARM LABOR AND MANAGEMENT SERVICES  
 078 LANDSCAPE AND HORTICULTURAL SERVICES  
 081 TIMBER TRACTS  
 083 FOREST NURSERIES AND GATHERING OF FOREST PRODUCTS  
 085 FORESTRY SERVICES  
 091 COMMERCIAL FISHING  
 092 FISH HATCHERIES AND PRESERVES  
 097 HUNTING AND TRAPPING, AND GAME PROPAGATION  
 101 IRON ORES  
 102 COPPER ORES  
 103 LEAD AND ZINC ORES  
 104 GOLD AND SILVER ORES  
 106 FERROALLOY ORES, EXCEPT VANADIUM  
 108 METAL MINING SERVICES  
 109 MISCELLANEOUS METAL ORES  
 122 BITUMINOUS COAL AND LIGNITE MINING  
 123 ANTHRACITE MINING  
 124 COAL MINING SERVICES  
 131 CRUDE PETROLEUM AND NATURAL GAS  
 132 NATURAL GAS LIQUIDS  
 138 OIL AND GAS FIELD SERVICES  
 141 DIMENSION STONE  
 142 CRUSHED AND BROKEN STONE, INCLUDING RIPRAP  
 144 SAND AND GRAVEL  
 145 CLAY, CERAMIC, AND REFRACTORY MINERALS  
 147 CHEMICAL AND FERTILIZER MINERAL MINING  
 148 NONMETALLIC MINERALS SERVICES, EXCEPT FUELS  
 149 MISCELLANEOUS NONMETALLIC MINERALS, EXCEPT FUELS  
 152 GENERAL BUILDING CONTRACTORS-RESIDENTIAL BUILDINGS  
 153 OPERATIVE BUILDERS  
 154 GENERAL BUILDING CONTRACTORS-NONRESIDENTIAL BUILDINGS  
 161 HIGHWAY AND STREET CONSTRUCTION, EXCEPT ELEVATED HIGHWAYS  
 162 HEAVY CONSTRUCTION, EXCEPT HIGHWAY AND STREET CONSTRUCTION  
 171 PLUMBING, HEATING AND AIR-CONDITIONING

172 PAINTING AND PAPER HANGING  
 173 ELECTRICAL WORK  
 174 MASONRY, STONEMWORK, TILE SETTING, AND PLASTERING  
 175 CARPENTRY AND FLOOR WORK  
 176 ROOFING, SIDING, AND SHEET METAL WORK  
 177 CONCRETE WORK  
 178 WATER WELL DRILLING  
 179 MISCELLANEOUS SPECIAL TRADE CONTRACTORS  
 201 MEAT PRODUCTS  
 202 DAIRY PRODUCTS  
 203 CANNED, FROZEN, AND PRESERVED FRUITS, VEGETABLES, AND FOOD SPECIAL  
 204 GRAIN MILL PRODUCTS  
 205 BAKERY PRODUCTS  
 206 SUGAR AND CONFECTIONERY PRODUCTS  
 207 FATS AND OILS  
 208 BEVERAGES  
 209 MISCELLANEOUS FOOD PREPARATIONS AND KINDRED PRODUCTS  
 211 CIGARETTES  
 212 CIGARS  
 213 CHEWING AND SMOKING TOBACCO AND SNUFF  
 214 TOBACCO STEMMING AND REDRYING  
 221 BROADWOVEN FABRIC MILLS, COTTON  
 222 BROADWOVEN FABRIC MILLS, MANMADE FIBER AND SILK  
 223 BROADWOVEN FABRIC MILLS, WOOL (INCLUDING DYEING AND FINISHING)  
 224 NARROW FABRIC AND OTHER SMALLWARES MILLS: COTTON, WOOL, SILK, AND  
 225 KNITTING MILLS  
 226 DYEING AND FINISHING TEXTILES, EXCEPT WOOL FABRICS AND KNIT GOODS  
 227 CARPETS AND RUGS  
 228 YARN AND THREAD MILLS  
 229 MISCELLANEOUS TEXTILE GOODS  
 231 MEN'S AND BOYS' SUITS, COATS, AND OVERCOATS  
 232 MEN'S AND BOYS' FURNISHINGS, WORK CLOTHING, AND ALLIED GARMENTS  
 233 WOMEN'S, MISSES', AND JUNIORS' OUTERWEAR  
 234 WOMEN'S, MISSES', CHILDREN'S, AND INFANTS' UNDERGARMENTS  
 235 HATS, CAPS, AND MILLINERY  
 236 GIRLS', CHILDREN'S, AND INFANTS' OUTERWEAR  
 237 FUR GOODS  
 238 MISCELLANEOUS APPAREL AND ACCESSORIES  
 239 MISCELLANEOUS FABRICATED TEXTILE PRODUCTS  
 241 LOGGING  
 242 SAWMILLS AND PLANING MILLS  
 243 MILLWORK, VENEER, PLYWOOD, AND STRUCTURAL WOOD MEMBERS  
 244 WOOD CONTAINERS  
 245 WOOD BUILDINGS AND MOBILE HOMES  
 249 MISCELLANEOUS WOOD PRODUCTS  
 251 HOUSEHOLD FURNITURE  
 252 OFFICE FURNITURE  
 253 PUBLIC BUILDING AND RELATED FURNITURE  
 254 PARTITIONS, SHELVING, LOCKERS, AND OFFICE AND STORE FIXTURES  
 259 MISCELLANEOUS FURNITURE AND FIXTURES  
 261 PULP MILLS

262 PAPER MILLS	339 MISCELLANEOUS PRIMARY METAL PRODUCTS
263 PAPERBOARD MILLS	341 METAL CANS AND SHIPPING CONTAINERS
265 PAPERBOARD CONTAINERS AND BOXES	342 CUTLERY, HANDTOOLS, AND GENERAL HARDWARE
267 CONVERTED PAPER AND PAPERBOARD PRODUCTS, EXCEPT CONTAINERS AND BOX	343 HEATING EQUIPMENT, EXCEPT ELECTRIC AND WARM AIR; AND PLUMBING FIXT
271 NEWSPAPERS: PUBLISHING, OR PUBLISHING AND PRINTING	344 FABRICATED STRUCTURAL METAL PRODUCTS
272 PERIODICALS: PUBLISHING, OR PUBLISHING AND PRINTING	345 SCREW MACHINE PRODUCTS, AND BOLTS, NUTS, SCREWS, RIVETS, AND WASHE
273 BOOKS	346 METAL FORGINGS AND STAMPINGS
274 MISCELLANEOUS PUBLISHING	347 COATING, ENGRAVING, AND ALLIED SERVICES
275 COMMERCIAL PRINTING	348 ORDNANCE AND ACCESSORIES, EXCEPT VEHICLES AND GUIDED MISSILES
276 MANIFOLD BUSINESS FORMS	349 MISCELLANEOUS FABRICATED METAL PRODUCTS
277 GREETING CARDS	351 ENGINES AND TURBINES
278 BLANKBOOKS, LOOSELEAF BINDERS, AND BOOKBINDING AND RELATED WORK	352 FARM AND GARDEN MACHINERY AND EQUIPMENT
279 SERVICE INDUSTRIES FOR THE PRINTING TRADE	353 CONSTRUCTION, MINING, AND MATERIALS HANDLING MACHINERY AND EQUIPME
281 INDUSTRIAL INORGANIC CHEMICALS	354 METALWORKING MACHINERY AND EQUIPMENT
282 PLASTICS MATERIALS AND SYNTHETIC RESINS, SYNTHETIC RUBBER, CELLULO	355 SPECIAL INDUSTRY MACHINERY, EXCEPT METALWORKING MACHINERY
283 DRUGS	356 GENERAL INDUSTRIAL MACHINERY AND EQUIPMENT
284 SOAP, DETERGENTS, AND CLEANING PREPARATIONS; PERFUMES, COSMETICS,	357 COMPUTER AND OFFICE EQUIPMENT
285 PAINTS, VARNISHES, LACQUERS, ENAMELS, AND ALLIED PRODUCTS	358 REFRIGERATION AND SERVICE INDUSTRY MACHINERY
286 INDUSTRIAL ORGANIC CHEMICALS	359 MISCELLANEOUS INDUSTRIAL AND COMMERCIAL MACHINERY AND EQUIPMENT
287 AGRICULTURAL CHEMICALS	361 ELECTRIC TRANSMISSION AND DISTRIBUTION EQUIPMENT
289 MISCELLANEOUS CHEMICAL PRODUCTS	362 ELECTRICAL INDUSTRIAL APPARATUS
291 PETROLEUM REFINING	363 HOUSEHOLD APPLIANCES
295 ASPHALT PAVING AND ROOFING MATERIALS	364 ELECTRIC LIGHTING AND WIRING EQUIPMENT
299 MISCELLANEOUS PRODUCTS OF PETROLEUM AND COAL	365 HOUSEHOLD AUDIO AND VIDEO EQUIPMENT, AND AUDIO RECORDINGS
301 TIRES AND INNER TUBES	366 COMMUNICATIONS EQUIPMENT
302 RUBBER AND PLASTICS FOOTWEAR	367 ELECTRONIC COMPONENTS AND ACCESSORIES
305 GASKETS, PACKING, AND SEALING DEVICES AND RUBBER AND PLASTICS HOSE	369 MISCELLANEOUS ELECTRICAL MACHINERY, EQUIPMENT, AND SUPPLIES
306 FABRICATED RUBBER PRODUCTS, NOT ELSEWHERE CLASSIFIED	371 MOTOR VEHICLES AND MOTOR VEHICLE EQUIPMENT
308 MISCELLANEOUS PLASTICS PRODUCTS	372 AIRCRAFT AND PARTS
311 LEATHER TANNING AND FINISHING	373 SHIP AND BOAT BUILDING AND REPAIRING
313 BOOT AND SHOE CUT STOCK AND FINDINGS	374 RAILROAD EQUIPMENT
314 FOOTWEAR, EXCEPT RUBBER	375 MOTORCYCLES, BICYCLES, AND PARTS
315 LEATHER GLOVES AND MITTENS	376 GUIDED MISSILES AND SPACE VEHICLES AND PARTS
316 LUGGAGE	379 MISCELLANEOUS TRANSPORTATION EQUIPMENT
317 HANDBAGS AND OTHER PERSONAL LEATHER GOODS	381 SEARCH, DETECTION, NAVIGATION, GUIDANCE, AERONAUTICAL, AND NAUTICA
319 LEATHER GOODS, NOT ELSEWHERE CLASSIFIED	382 LABORATORY APPARATUS AND ANALYTICAL, OPTICAL, MEASURING, AND CONTR
321 FLAT GLASS	384 SURGICAL, MEDICAL, AND DENTAL INSTRUMENTS AND SUPPLIES
322 GLASS AND GLASSWARE, PRESSED OR BLOWN	385 OPHTHALMIC GOODS
323 GLASS PRODUCTS, MADE OF PURCHASED GLASS	386 PHOTOGRAPHIC EQUIPMENT AND SUPPLIES
324 CEMENT, HYDRAULIC	387 WATCHES, CLOCKS, CLOCKWORK OPERATED DEVICES, AND PARTS
325 STRUCTURAL CLAY PRODUCTS	391 JEWELRY, SILVERWARE, AND PLATED WARE
326 POTTERY AND RELATED PRODUCTS	393 MUSICAL INSTRUMENTS
327 CONCRETE, GYPSUM, AND PLASTER PRODUCTS	394 DOLLS, TOYS, GAMES AND SPORTING AND ATHLETIC GOODS
328 CUT STONE AND STONE PRODUCTS	395 PENS, PENCILS, AND OTHER ARTISTS' MATERIALS
329 ABRASIVE, ASBESTOS, AND MISCELLANEOUS NONMETALLIC MINERAL PRODUCTS	396 COSTUME JEWELRY, COSTUME NOVELTIES, BUTTONS, AND MISCELLANEOUS
331 STEEL WORKS, BLAST FURNACES, AND ROLLING AND FINISHING MILLS	NOT
332 IRON AND STEEL FOUNDRIES	399 MISCELLANEOUS MANUFACTURING INDUSTRIES
333 PRIMARY SMELTING AND REFINING OF NONFERROUS METALS	401 RAILROADS
334 SECONDARY SMELTING AND REFINING OF NONFERROUS METALS	411 LOCAL AND SUBURBAN PASSENGER TRANSPORTATION
335 ROLLING, DRAWING, AND EXTRUDING OF NONFERROUS METALS	412 TAXICABS
336 NONFERROUS FOUNDRIES (CASTINGS)	413 INTERCITY AND RURAL BUS TRANSPORTATION
	414 BUS CHARTER SERVICE

415 SCHOOL BUSES	523 PAINT, GLASS, AND WALLPAPER STORES
417 TERMINAL AND SERVICE FACILITIES FOR MOTOR VEHICLE PASSENGER TRANSP	525 HARDWARE STORES
421 TRUCKING AND COURIER SERVICES, EXCEPT AIR	526 RETAIL NURSERIES, LAWN AND GARDEN SUPPLY STORES
422 PUBLIC WAREHOUSING AND STORAGE	527 MOBILE HOME DEALERS
423 TERMINAL AND JOINT TERMINAL MAINTENANCE FACILITIES FOR MOTOR FREIG	531 DEPARTMENT STORES
431 UNITED STATES POSTAL SERVICE	533 VARIETY STORES
441 DEEP SEA FOREIGN TRANSPORTATION OF FREIGHT	539 MISCELLANEOUS GENERAL MERCHANDISE STORES
442 DEEP SEA DOMESTIC TRANSPORTATION OF FREIGHT	541 GROCERY STORES
443 FREIGHT TRANSPORTATION ON THE GREAT LAKES&die;ST. LAWRENCE SEAWAY	542 MEAT AND FISH (SEAFOOD) MARKETS, INCLUDING FREEZER PROVISIONERS
444 WATER TRANSPORTATION OF FREIGHT, NOT ELSEWHERE CLASSIFIED	543 FRUIT AND VEGETABLE MARKETS
448 WATER TRANSPORTATION OF PASSENGERS	544 CANDY, NUT, AND CONFECTIONERY STORES
449 SERVICES INCIDENTAL TO WATER TRANSPORTATION	545 DAIRY PRODUCTS STORES
451 AIR TRANSPORTATION, SCHEDULED, AND AIR COURIER SERVICES	546 RETAIL BAKERIES
452 AIR TRANSPORTATION, NONSCHEDULED	549 MISCELLANEOUS FOOD STORES
458 AIRPORTS, FLYING FIELDS, AND AIRPORT TERMINAL SERVICES	551 MOTOR VEHICLE DEALERS (NEW AND USED)
461 PIPELINES, EXCEPT NATURAL GAS	552 MOTOR VEHICLE DEALERS (USED ONLY)
472 ARRANGEMENT OF PASSENGER TRANSPORTATION	553 AUTO AND HOME SUPPLY STORES
473 ARRANGEMENT OF TRANSPORTATION OF FREIGHT AND CARGO	554 GASOLINE SERVICE STATIONS
474 RENTAL OF RAILROAD CARS	555 BOAT DEALERS
478 MISCELLANEOUS SERVICES INCIDENTAL TO TRANSPORTATION	556 RECREATIONAL VEHICLE DEALERS
481 TELEPHONE COMMUNICATIONS	557 MOTORCYCLE DEALERS
482 TELEGRAPH AND OTHER MESSAGE COMMUNICATIONS	559 AUTOMOTIVE DEALERS, NOT ELSEWHERE CLASSIFIED
483 RADIO AND TELEVISION BROADCASTING STATIONS	561 MEN'S AND BOYS' CLOTHING AND ACCESSORY STORES
484 CABLE AND OTHER PAY TELEVISION SERVICES	562 WOMEN'S CLOTHING STORES
489 COMMUNICATIONS SERVICES, NOT ELSEWHERE CLASSIFIED	563 WOMEN'S ACCESSORY AND SPECIALTY STORES
491 ELECTRIC SERVICES	564 CHILDREN'S AND INFANTS' WEAR STORES
492 GAS PRODUCTION AND DISTRIBUTION	565 FAMILY CLOTHING STORES
493 COMBINATION ELECTRIC AND GAS, AND OTHER UTILITY SERVICES	566 SHOE STORES
494 WATER SUPPLY	569 MISCELLANEOUS APPAREL AND ACCESSORY STORES
495 SANITARY SERVICES	571 HOME FURNITURE AND FURNISHINGS STORES
496 STEAM AND AIR-CONDITIONING SUPPLY	572 HOUSEHOLD APPLIANCE STORES
497 IRRIGATION SYSTEMS	573 RADIO, TELEVISION, CONSUMER ELECTRONICS, AND MUSIC STORES
501 MOTOR VEHICLES AND MOTOR VEHICLE PARTS AND SUPPLIES	581 EATING AND DRINKING PLACES
502 FURNITURE AND HOMEFURNISHINGS	591 DRUG STORES AND PROPRIETARY STORES
503 LUMBER AND OTHER CONSTRUCTION MATERIALS	592 LIQUOR STORES
504 PROFESSIONAL AND COMMERCIAL EQUIPMENT AND SUPPLIES	593 USED MERCHANDISE STORES
505 METALS AND MINERALS, EXCEPT PETROLEUM	594 MISCELLANEOUS SHOPPING GOODS STORES
506 ELECTRICAL GOODS	596 NONSTORE RETAILERS
507 HARDWARE, AND PLUMBING AND HEATING EQUIPMENT AND SUPPLIES	598 FUEL DEALERS
508 MACHINERY, EQUIPMENT, AND SUPPLIES	599 RETAIL STORES, NOT ELSEWHERE CLASSIFIED
509 MISCELLANEOUS DURABLE GOODS	601 CENTRAL RESERVE DEPOSITORY INSTITUTIONS
511 PAPER AND PAPER PRODUCTS	602 COMMERCIAL BANKS
512 DRUGS, DRUG PROPRIETARIES, AND DRUGGISTS' SUNDRIES	603 SAVINGS INSTITUTIONS
513 APPAREL, PIECE GOODS, AND NOTIONS	606 CREDIT UNIONS
514 GROCERIES AND RELATED PRODUCTS	608 FOREIGN BANKING AND BRANCHES AND AGENCIES OF FOREIGN BANKS
515 FARM-PRODUCT RAW MATERIALS	609 FUNCTIONS RELATED TO DEPOSITORY BANKING
516 CHEMICALS AND ALLIED PRODUCTS	611 FEDERAL AND FEDERALLY-SPONSORED CREDIT AGENCIES
517 PETROLEUM AND PETROLEUM PRODUCTS	614 PERSONAL CREDIT INSTITUTIONS
518 BEER, WINE, AND DISTILLED ALCOHOLIC BEVERAGES	615 BUSINESS CREDIT INSTITUTIONS
519 MISCELLANEOUS NONDURABLE GOODS	616 MORTGAGE BANKERS AND BROKERS
521 LUMBER AND OTHER BUILDING MATERIALS DEALERS	621 SECURITY BROKERS, DEALERS, AND FLOTATION COMPANIES

622 COMMODITY CONTRACTS BROKERS AND DEALERS	792 THEATRICAL PRODUCERS (EXCEPT MOTION PICTURE), BANDS, ORCHESTRAS, A
623 SECURITY AND COMMODITY EXCHANGES	793 BOWLING CENTERS
628 SERVICES ALLIED WITH THE EXCHANGE OF SECURITIES OR COMMODITIES	794 COMMERCIAL SPORTS
631 LIFE INSURANCE	799 MISCELLANEOUS AMUSEMENT AND RECREATION SERVICES
632 ACCIDENT AND HEALTH INSURANCE AND MEDICAL SERVICE PLANS	801 OFFICES AND CLINICS OF DOCTORS OF MEDICINE
633 FIRE, MARINE, AND CASUALTY INSURANCE	802 OFFICES AND CLINICS OF DENTISTS
635 SURETY INSURANCE	803 OFFICES AND CLINICS OF DOCTORS OF OSTEOPATHY
636 TITLE INSURANCE	804 OFFICES AND CLINICS OF OTHER HEALTH PRACTITIONERS
637 PENSION, HEALTH, AND WELFARE FUNDS	805 NURSING AND PERSONAL CARE FACILITIES
639 INSURANCE CARRIERS, NOT ELSEWHERE CLASSIFIED	806 HOSPITALS
641 INSURANCE AGENTS, BROKERS, AND SERVICE	807 MEDICAL AND DENTAL LABORATORIES
651 REAL ESTATE OPERATORS (EXCEPT DEVELOPERS) AND LESSORS	808 HOME HEALTH CARE SERVICES
653 REAL ESTATE AGENTS AND MANAGERS	809 MISCELLANEOUS HEALTH AND ALLIED SERVICES, NOT ELSEWHERE CLASSIFIED
654 TITLE ABSTRACT OFFICES	811 LEGAL SERVICES
655 LAND SUBDIVIDERS AND DEVELOPERS	821 ELEMENTARY AND SECONDARY SCHOOLS
671 HOLDING OFFICES	822 COLLEGES, UNIVERSITIES, PROFESSIONAL SCHOOLS, AND JUNIOR COLLEGES
672 INVESTMENT OFFICES	823 LIBRARIES
673 TRUSTS	824 VOCATIONAL SCHOOLS
679 MISCELLANEOUS INVESTING	829 SCHOOLS AND EDUCATIONAL SERVICES, NOT ELSEWHERE CLASSIFIED
701 HOTELS AND MOTELS	832 INDIVIDUAL AND FAMILY SOCIAL SERVICES
702 ROOMING AND BOARDING HOUSES	833 JOB TRAINING AND VOCATIONAL REHABILITATION SERVICES
703 CAMPS AND RECREATIONAL VEHICLE PARKS	835 CHILD DAY CARE SERVICES
704 ORGANIZATION HOTELS AND LODGING HOUSES, ON MEMBERSHIP BASIS	836 RESIDENTIAL CARE
721 LAUNDRY, CLEANING, AND GARMENT SERVICES	839 SOCIAL SERVICES, NOT ELSEWHERE CLASSIFIED
722 PHOTOGRAPHIC STUDIOS, PORTRAIT	841 MUSEUMS AND ART GALLERIES
723 BEAUTY SHOPS	842 ARBORETA AND BOTANICAL OR ZOOLOGICAL GARDENS
724 BARBER SHOPS	861 BUSINESS ASSOCIATIONS
725 SHOE REPAIR SHOPS AND SHOESHINE PARLORS	862 PROFESSIONAL MEMBERSHIP ORGANIZATIONS
726 FUNERAL SERVICE AND CREMATORIES	863 LABOR UNIONS AND SIMILAR LABOR ORGANIZATIONS
729 MISCELLANEOUS PERSONAL SERVICES	864 CIVIC, SOCIAL, AND FRATERNAL ASSOCIATIONS
731 ADVERTISING	865 POLITICAL ORGANIZATIONS
732 CONSUMER CREDIT REPORTING AGENCIES, MERCANTILE REPORTING AGENCIES,	866 RELIGIOUS ORGANIZATIONS
733 MAILING, REPRODUCTION, COMMERCIAL ART AND PHOTOGRAPHY, AND STENOGR	869 MEMBERSHIP ORGANIZATIONS, NOT ELSEWHERE CLASSIFIED
734 SERVICES TO DWELLINGS AND OTHER BUILDINGS	871 ENGINEERING, ARCHITECTURAL, AND SURVEYING SERVICES
735 MISCELLANEOUS EQUIPMENT RENTAL AND LEASING	872 ACCOUNTING, AUDITING, AND BOOKKEEPING SERVICES
736 PERSONNEL SUPPLY SERVICES	873 RESEARCH, DEVELOPMENT, AND TESTING SERVICES
737 COMPUTER PROGRAMMING, DATA PROCESSING, AND OTHER COMPUTER RELATED	874 MANAGEMENT AND PUBLIC RELATIONS SERVICES
738 MISCELLANEOUS BUSINESS SERVICES	881 PRIVATE HOUSEHOLDS
751 AUTOMOTIVE RENTAL AND LEASING, WITHOUT DRIVERS	899 SERVICES, NOT ELSEWHERE CLASSIFIED
752 AUTOMOBILE PARKING	911 EXECUTIVE OFFICES
753 AUTOMOTIVE REPAIR SHOPS	912 LEGISLATIVE BODIES
754 AUTOMOTIVE SERVICES, EXCEPT REPAIR	913 EXECUTIVE AND LEGISLATIVE OFFICES COMBINED
762 ELECTRICAL REPAIR SHOPS	919 GENERAL GOVERNMENT, NOT ELSEWHERE CLASSIFIED
763 WATCH, CLOCK, AND JEWELRY REPAIR	921 COURTS
764 REUPHOLSTERY AND FURNITURE REPAIR	922 PUBLIC ORDER AND SAFETY
769 MISCELLANEOUS REPAIR SHOPS AND RELATED SERVICES	931 PUBLIC FINANCE, TAXATION, AND MONETARY POLICY
781 MOTION PICTURE PRODUCTION AND ALLIED SERVICES	941 ADMINISTRATION OF EDUCATIONAL PROGRAMS
782 MOTION PICTURE DISTRIBUTION AND ALLIED SERVICES	943 ADMINISTRATION OF PUBLIC HEALTH PROGRAMS
783 MOTION PICTURE THEATERS	944 ADMINISTRATION OF SOCIAL, HUMAN RESOURCE AND INCOME MAINTENANCE
784 VIDEO TAPE RENTAL	PR 945 ADMINISTRATION OF VETERANS' AFFAIRS, EXCEPT HEALTH AND INSURANCE
791 DANCE STUDIOS, SCHOOLS, AND HALLS	951 ADMINISTRATION OF ENVIRONMENTAL QUALITY PROGRAMS



953 ADMINISTRATION OF HOUSING AND URBAN DEVELOPMENT PROGRAMS  
961 ADMINISTRATION OF GENERAL ECONOMIC PROGRAMS  
962 REGULATION AND ADMINISTRATION OF TRANSPORTATION PROGRAMS  
963 REGULATION AND ADMINISTRATION OF COMMUNICATIONS, ELECTRIC, GAS, AN  
964 REGULATION OF AGRICULTURAL MARKETING AND COMMODITIES  
965 REGULATION, LICENSING, AND INSPECTION OF MISCELLANEOUS COMMERCIAL  
966 SPACE RESEARCH AND TECHNOLOGY  
971 NATIONAL SECURITY  
972 INTERNATIONAL AFFAIRS  
999 NONCLASSIFIABLE ESTABLISHMENTS

Source: <http://www.ehso.com/siccodes.php>

## VII. Appendix B: Correlation Tables

Correlation 1: 1970 GDP in Millions of Current Dollars and NPL Count, by State

	<i>NPL Count</i>	<i>Chem</i>	<i>Metals</i>	<i>Leather</i>	<i>Rubber</i>	<i>Construction</i>	<i>Education</i>	<i>Legal</i>	<i>Repair</i>	<i>NonD</i>	<i>Real Estate</i>	<i>Social</i>	<i>Wholesale</i>
NPL Count	1.000												
Chem	0.770	1.000											
Metals	0.705	0.719	1.000										
Leather	0.477	0.409	0.414	1.000									
Rubber	0.531	0.648	0.864	0.394	1.000								
Construction	0.821	0.745	0.820	0.490	0.682	1.000							
Education	0.732	0.618	0.693	0.740	0.581	0.863	1.000						
Legal	0.735	0.661	0.684	0.593	0.544	0.912	0.910	1.000					
Repair	0.803	0.735	0.744	0.404	0.608	0.974	0.796	0.875	1.000				
NonD	0.676	0.620	0.763	0.285	0.644	0.905	0.637	0.727	0.883	1.000			
Real Estate	0.804	0.650	0.734	0.534	0.604	0.955	0.886	0.967	0.934	0.804	1.000		
Social	0.813	0.722	0.811	0.548	0.672	0.982	0.902	0.956	0.954	0.848	0.982	1.000	
Wholesale	0.772	0.697	0.735	0.575	0.582	0.955	0.907	0.984	0.931	0.808	0.976	0.985	1.000

Correlation 2: 1970 GDP as Percent of State Total and NPL Count, by State

	<i>NPL Count</i>	<i>Chem</i>	<i>Metals</i>	<i>Leather</i>	<i>Rubber</i>	<i>Construction</i>	<i>Education</i>	<i>Legal</i>	<i>Repair</i>	<i>NonD</i>	<i>Real Estate</i>	<i>Social</i>	<i>Wholesale</i>
NPL Count	1.000												
Chem	0.133	1.000											
Metals	0.420	0.169	1.000										
Leather	-0.038	-0.030	-0.023	1.000									
Rubber	0.088	0.368	0.578	0.340	1.000								
Construction	-0.294	-0.112	-0.393	-0.007	-0.278	1.000							
Education	0.188	-0.062	0.287	0.423	0.505	-0.088	1.000						
Legal	0.407	-0.097	0.202	-0.072	0.041	-0.138	0.307	1.000					
Repair	0.123	0.100	-0.131	-0.459	-0.317	-0.103	-0.438	0.114	1.000				
NonD	-0.077	0.003	-0.071	-0.367	-0.192	-0.077	-0.402	-0.074	0.320	1.000			
Real Estate	0.401	-0.127	0.013	0.119	0.096	0.231	0.366	0.389	-0.201	-0.156	1.000		
Social	0.330	0.047	0.351	0.218	0.411	0.113	0.503	0.217	-0.363	-0.128	0.538	1.000	
Wholesale	0.343	-0.103	0.129	-0.023	-0.038	-0.381	0.208	0.468	0.166	0.306	0.067	0.101	1.000

Correlation 3: 1970 GDP as Percent of State Total and NPL per capita, by State

	<i>NPL per Capita</i>	<i>Chem</i>	<i>Metals</i>	<i>Leather</i>	<i>Rubber</i>	<i>Construction</i>	<i>Education</i>	<i>Legal</i>	<i>Repair</i>	<i>NonD</i>	<i>Real Estate</i>	<i>Social</i>	<i>Wholesale</i>
NPL per Capita	1.000												
Chem	0.213	1.000											
Metals	-0.209	0.169	1.000										
Leather	0.351	-0.030	-0.023	1.000									
Rubber	0.208	0.368	0.578	0.340	1.000								
Construction	0.273	-0.112	-0.393	-0.007	-0.278	1.000							
Education	0.304	-0.062	0.287	0.423	0.505	-0.088	1.000						
Legal	-0.207	-0.097	0.202	-0.072	0.041	-0.138	0.307	1.000					
Repair	-0.257	0.100	-0.131	-0.459	-0.317	-0.103	-0.438	0.114	1.000				
NonD	-0.328	0.003	-0.071	-0.367	-0.192	-0.077	-0.402	-0.074	0.320	1.000			
Real Estate	0.309	-0.127	0.013	0.119	0.096	0.231	0.366	0.389	-0.201	-0.156	1.000		
Social	0.258	0.047	0.351	0.218	0.411	0.113	0.503	0.217	-0.363	-0.128	0.538	1.000	
Wholesale	-0.358	-0.103	0.129	-0.023	-0.038	-0.381	0.208	0.468	0.166	0.306	0.067	0.101	1.000

Correlation 4: The Absolute Change in Industry Establishments from 1977 to 1997 and NPL, by State

	<i>NPL Count</i>	2800	3400	8200
NPL Count	1.000			
Chem	-0.334	1.000		
Metals	0.080	0.781	1.000	
Education	0.684	0.113	0.544	1.000

Correlation 5: The % Change in Industry Establishments from 1977 to 1997 and NPL, by State

	<i>NPL Count</i>	2800	8200	3400
NPL Count	1.000			
Chem	-0.129	1.000		
Education	-0.125	-0.103	1.000	
Metals	-0.505	-0.013	0.643	1.000

Correlation 6: The % Change in Industry Establishments from 1977 to 1997 and NPL per capita by State

	<i>NPL per Capita</i>	2800	8200	3400
NPL per Capita	1.000			
Chem	0.107	1.000		
Education	0.075	-0.103	1.000	
Metals	0.090	-0.013	0.643	1.000

## **VIII. Works Cited**

- “Brownfields? Burden: City needs to be creative with contaminated sites.” The Michigan Daily. June 16 2002.  
<<http://www.michigandaily.com/media/storage/paper851/news/2002/06/17/Opinion/Brownfields.Burden-1411491.shtml>>.
- Bartsch, Charles. “Analysis of Pennsylvania’s Brownfield Program.” Northeast Midwest Institute. December 2003. pp. 3, 4, 10
- Bartsch, Charles. “Financing Brownfield Cleanup and Redevelopment.” Northeast-Midwest Institute. 30 Mar. 2006. <<http://www.nemw.org/brownfin.htm>>.
- CABERNET. “Brownfield Definitions Across Europe.” CABERNET. April 14, 2007  
<<http://www.cabernet.org.uk/index.asp?c=1316>>.
- Davis, Todd S. Brownfields: A Comprehensive Guide to Redeveloping Contaminated Property; Second Edition. American Bar Association, 2002, pp. 3, 5, 850
- Government Accounting Office, GAO/RCED-95-172, *Community Development – Reuse of Urban Industrial Sites*. June 1995.
- Hopey, Don. “Developing Brownfields Called Best Approach.” Pittsburgh Post Gazette. August 15, 2006
- Office of the Press Secretary, Clinton2nara.gov. June 5, 1998, April 11, 2007.  
<<http://clinton.nara.gov/WH/New/html/19980605-28045.html>>.
- United States Census Bureau. *American Fact Finder: 2007*  
<[http://factfinder.census.gov/servlet/ACSSAFFacts?\\_submenuId=factsheet\\_0&\\_sse=on](http://factfinder.census.gov/servlet/ACSSAFFacts?_submenuId=factsheet_0&_sse=on)>.
- United States Census Bureau. *State and County Quick Facts*: April 11, 2007.  
<<http://quickfacts.census.gov/qfd/states/42/42049.html>>.
- United States Department of Commerce. *News Release: Gross Domestic Product by Industry, 2006 (advance)*: 2007. <<http://bea.gov/newsreleases/industry/gdpindustry/gdpindnewsrelease.htm>>.
- United States Department of Labor. *Industry at a Glance. NAICS 31-33: 2007*  
<<http://www.bls.gov/iag/manufacturing.htm>>.
- United States Environmental Protection Agency. *Brownfields Cleanup and Redevelopment*. April 10, 2007  
<<http://www.epa.gov/swerosps/bf/>>.
- United States Environmental Protection Agency. *CERCLA Overview*. EPA.com. April 20, 2007.  
<<http://www.epa.gov/superfund/action/law/cercla.htm>>.
- United States Environmental Protection Agency. *EPA Adds Five and Proposes Five Sites to Superfund’s National Priorities List. Cleaning Up the Nation’s Hazardous Waste Sites*. March 7, 2007.  
<<http://www.epa.gov/superfund/>>.
- United States Environmental Protection Agency. *Locate Superfund Sites*. EPA.com. March 2007.  
<<http://www.epa.gov/superfund/sites/locate/index.htm>>.
- United States Environmental Protection Agency. *Small Business Liability Relief and Brownfields Revitalization Act*. EPA.com. October 10<sup>th</sup> 2007. <<http://www.epa.gov/brownfields/sblbra.htm>>.

United States Office of Technology. *State of the States on Brownfields: Program for Cleanup and Reuse of Contaminated Sites*, 1995.