What We Know About the Ubiquitous Brownfield: A Case Study of Two New Jersey Cities and Their Gas Stations

Leah Benedict Yasenchak

This article presents a preliminary case study of the impacts of former gas stations on two mid-sized New Jersey cities: Trenton and Plainfield. Historic research reveals ten former gas stations for every one gas station operating in Trenton and nearly 28 former stations for every one current station in Plainfield. Only 38% of current and former gas stations in Trenton and 23% in Plainfield have any form of environmental record associated with the site. The largest category of site reuse is auto related, to include auto repair, current gas stations, used auto sales, and parking lots: 40% in Trenton and 53% in Plainfield. The largest single reuse category in each city was as unproductive land, with 19% of former Trenton gas stations and 26% of former Plainfield gas stations lying vacant. Despite this, current and former gas stations contribute annual tax revenues of over a half million dollars to Trenton and nearly $1.3 million in Plainfield, indicating that these properties can be redeveloped to provide an important contribution to the economies of these distressed cities. Attention to the environmental issues and development potential of these sites is likely to result in social, environmental, and economic benefit to communities.

Environmental Practice 11:144–152 (2009)

Gas stations are so much a part of the American landscape that their cumulative numbers tend to escape notice. Some derelict stations have even achieved a picturesque, romanticized quality. However, the full extent of the negative social, economic, and environmental issues has not yet been explored. Many of today's abandoned gas stations, those whose pumps still stand as silent testimony to the prior use of the site, as well as those whose existence was obscured decades ago by redevelopment, are contaminating the environment, are blighting neighborhoods, and are a liability numbering in the billions of dollars.

The full magnitude of the problem is unrealized, as the United States (US) Environmental Protection Agency (EPA), the agency charged with managing this environmental issue, tracks only a small portion of former gas station tanks. The EPA tracks those tanks regulated by federal statue and regulation, but not those tanks that were in operation in the distant past and that closed prior to the EPA requirements (Northeast-Midwest Institute, 2002). Reporting requirements stipulate that tanks that were in the ground on or after May 8, 1986 must be reported, unless the tank was taken out of operation on or before January 1, 1974. Thus, any tank that was no longer used after 1973 is not tracked by the EPA, and any tank that ceased operations prior to 1986 is unlikely to have been reported.

To understand the magnitude of the problem, it is necessary to look at the condition of the tanks that are covered under federal regulation. The EPA tracks approximately 640,000 active underground storage tanks[1] (USTs) and three times that number of inactive USTs at approximately 240,000 sites. According to the EPA, only 62% of UST facilities are in significant operational compliance with the release-prevention and leak-detection requirements. Thus, even in the operating tanks that are registered with the EPA, 243,200 are known to be out of compliance. As of March 2007, a total of 468,331 releases had been confirmed and 439,450 cleanups had been initiated with 357,346 complete, according to the EPA Office of Solid Waste and Emergency Response (2007).

While these numbers should cause concern, it is even more alarming to note that, until they were prohibited in 1985,

Affiliation of author: Principal, Brownfield Redevelopment Solutions, Inc., Manasquan, New Jersey

Address correspondence to: Leah Benedict Yasenchak, Principal, Brownfield Redevelopment Solutions, Inc., 10 Acpoan Place, Manasquan, NJ 08736; (phone) 732-859-0831; (fax) 732-782-0404; (email) leah@njbrownfield.com.

 doi:10.1017/S1466046609990123

most USTs were made of unprotected steel, which is likely to corrode over time and leak. The average life expectancy of a steel tank is 30–50 years, depending on the rate of corrosion of the steel, and the geologic conditions in which it is buried (Ryan, 2007). As the reporting requirement date is just one year past the date that unprotected steel tanks were prohibited, it is likely that all the unreported tanks are constructed in this manner and are either corroded or at imminent risk of corrosion.

While rusted and abandoned gas pumps dot many cities, small towns, rural areas, and highway stretches, it is sobering to realize that, whereas gas station development began in the early 1900s and grew exponentially until the 1950s, as reported in Margolies (1993) and Vieyra (1979), awareness of environmental concerns did not surface on a broad scale in this country until the 1970s and regulations on tank closures did not appear until the mid-1980s. Thus,any redevelopment on a former gas station that occurred prior to this time was likely to have been completed without regard to leaking tanks hidden beneath the surface. Thus, the environmental threat comes not just from the tanks whose presence is indicated by obsolete pumps, but also from tanks hidden beneath highways, parks, office buildings, and other developments.

Even though remediation at gas station sites is relatively straightforward, they have been comparatively more difficult to clean up than traditional brownfield sites. This is partly because the redevelopment of gas station sites is hampered by economic factors, such as early exclusion from brownfield public funding sources. In addition, they are often small sites, with the cost to clean up per acre much higher than traditional brownfield sites, and the development potential is lower. They are also dispersed throughout the community to a greater extent than other industrial sites (Northeast-Midwest Institute, 2002).

If the site is redeveloped, these unsuspected tanks could cause soil and groundwater contamination, and perhaps indoor air pollution from vapors entering the building. In addition to the environmental threat, if the site has not been redeveloped it serves as a blighting influence in the community, representing a lost potential for jobs and services. In communities with primarily low-income or minority residents, an additional concern is that of environmental justice[2] issues, arising when a disproportionate number of unwanted uses are located in economically distressed, minority communities.

USTs can leak because of corrosion, punctures, faulty installation, or inadequate operating and maintenance procedures. It is well documented that leaking USTs can contaminate groundwater and soil, and produce vapors that can build up in structures, causing indoor air pollution and serious health effects. Sementelli and Simons (1997) report that three-fifths of leaking USTs have been found to have off-site groundwater contamination. This is a serious threat because groundwater is the source of drinking water for nearly half of the nation's residents (Northeast-Midwest Institute, 2002). Gasoline additives such as tetraethyl lead and MTBE (methyl tertiary-butyl ether) increase the environmental threat by contributing additional contaminants to the environment.

The past few decades have witnessed a fairly steady decline in gas stations (National Petroleum News, 2004).[3] An understanding of the factors contributing to the decline of gas stations is useful in gaining an appreciation of the magnitude of the problem of unknown former gas stations. Several reasons contributed to the closing of gas stations:

- Overbuilding—populations weren't sufficient to support the number of stations.
- New highway construction (particularly the construction of the interstate highway system in the 1960s), which reduced the amount of traffic on secondary roads and old commercial strips.
- Shifting population centers through sprawl development and the decline of manufacturing cities.
- Gas shocks, such as the gas shortages of 1973 and 1979, stemming from the Arab oil embargo and the Iranian revolution, caused gas prices to skyrocket and gas consumption to drop. In the five years following the 1973–74 Arab oil embargo, as many as 10,000 stations closed each year, according to Vieyra (1979).
- Closure of convenience stores also contributed to gas station closures. In the 1970s, nearly half of the 8,000 7-Eleven stores were selling gas, a total of 2 billion gallons per year. However, by the early 1980s, convenience stores began to develop financial problems, and many shut their doors along with their gas pumps, as reported by Margolies (1993).
- Environmental regulations in the 1980s required station owners to assume responsibility by carrying expensive liability insurance, upgrading the storage tanks, and installing new underground piping to accommodate the

new vapor-recovery nozzles, which, according to Margolies (1993), resulted in additional gas station closures.

- Margolies (1993) also reports that the newer models and makes of cars required much less maintenance, and specialized repair businesses like Midas Muffler and Jiffy Lube were able to undercut the price of repairs and service at gas stations.
- National Petroleum News (2004) reports that gas station closures have resulted from shrinking gas margins which provide a smaller profit per gallon to the retail distributor as gas prices increase and more customers pay by credit cards.
- The ability of individual stations to pump higher fuel volumes than in the past has led to a need for fewer stations, according to National Petroleum News (2004).
- The Northeast-Midwest Institute (2002) reports that inability to comply with the 1998 federal UST upgrade requirements also led to gas station closures.

This list underscores the point that gas station closures are not a recent phenomenon, but have occurred for various reasons throughout our history. Many of these triggers occurred prior to the 1986 reporting requirements, indicating that many USTs at former gas stations may never have been properly closed or reported.

Estimates of the costs to address the environmental issues at gas stations differ widely. Northeast-Midwest Institute (2002) provides several estimates from across the country. In South Dakota, the state funds UST removals at abandoned gas station sites and reports an average cost per site of $2,500, including tank removal, limited excavation and soil disposal, tank disposal, removal and disposal of tank contents, and testing and reporting. The Gila River Indian Community, located outside Phoenix, Arizona, has an established UST program that estimates the typical cost to remove a tank at $5,000–$10,000. Trenton, New Jersey, estimates tank removal costs at $20,000–$40,000 per site if no additional contamination is encountered. New Hampshire estimates that a site will take an average of $70,000 for assessment and remediation. Thus, although estimates of the cost varies widely, perhaps due to regional variability in the market or differences in regulatory standards, significant resources clearly are required to address the problem fully. Using this range of estimates, the cost to remove and clean the 240,000 sites currently regulated under the federal program ranges from $600 million to $9.6 billion dollars, figures that do not account for the number of sites not currently regulated.

In addition to the costs involved in addressing the contamination at a petroleum brownfield site, there are potential ramifications to the property value of the gas station site, as well as stigma effects on nearby properties. The cost of remediation, particularly if the cost is unknown, is often enough to cause a developer to look at another site. This results in a loss of tax revenue, jobs, and/or services in the community, as well as a blighting influence on neighboring properties.

Because of environmental costs, small site size, and location, public funding is often necessary to move former gas stations through remediation to redevelopment. However, statutory constraints prohibiting the use of Comprehensive Emergency Response, Compensation, and Liability Act (CERCLA) funds on petroleum sites have resulted in the exclusion of gas stations from many funding sources.

In the early 1990s, the EPA began to focus on contaminated sites that were not severe enough to be captured under the Superfund legislation,[4] but were contributing to contamination and blight. These sites were dubbed *brownfields*,[5] and grant programs were established to help states and communities address them. Estimates of the number of such brownfield sites vary, but the EPA reports that 450,000 exist across the country (US EPA, 2008). Abandoned gas stations, however, are a special subset of brownfields. Because their primary contaminant is likely to be petroleum, they were not eligible for any of this early funding, which specifically excluded petroleum. As a result, these sites were often left out of the initial brownfield inventories, many of which were funded through EPA grants.

With the passage of Public Law 107–118 (H.R. 2869) (2002)—the Small Business Liability Relief and Brownfields Revitalization Act—signed into law on January 11, 2002, brownfields became codified in federal legislation, and 25% of authorized funds were set aside specifically for use on sites contaminated with petroleum. Use of the petroleum funds to assess or remediate sites with petroleum contamination requires a demonstration of "low risk" and "no viable responsible party" (Public Law 107–118, 2002). Some grantees have found these difficult hurdles and found it difficult to use the petroleum funds (Brownfield Grants Task Force, 2008). In many cases, particularly at "mom and pop"-owned sites, the responsible party may be difficult to find and more difficult to bring into the process. Title searches and lengthy efforts to find responsible owners have hindered many communities in their attempts to use these grant funds. Uncertainty about the federal cost-recovery requirement at the state and local levels has chilled

efforts to direct Leaking Underground Storage Tank (LUST) funding toward sites where cost-recovery efforts may be futile or too time-consuming to meet the realities of the redevelopment process and local goals for reuse (Northeast-Midwest Institute, 2002).

States were given primary responsibility for implementing the federal tank regulations. Over the past four years, Congress has appropriated about $72 million per year of the LUST Trust Fund, of which the EPA distributed approximately 85% ($61.2 million) to the states and tribes. Approximately 40 states have UST cleanup funds separate from the LUST Trust Fund; collectively states raise and spend more than $1 billion annually to address home-heating oil tanks and federally registered tanks, according to the EPA's Office of Solid Waste and Emergency Response (May 2007).

The LUST Trust Fund can be used to fund response activities at former gas station sites, but once this fund is used at a site, it can, depending upon the status of the case, limit the ability to use other EPA funds on that site. Most state funds follow LUST requirements and can be used only at federally regulated LUST sites where the tanks were in operation after 1974 and registered after a 1986 tank registration deadline, leaving tanks that predate these deadlines without access to this major funding source.

Methods

To examine the impacts of former gas station sites more closely, this study undertakes an in-depth examination of two midsized cities in New Jersey. New Jersey is an appropriate focus for this research because it is densely developed; at the forefront of environmental practices, having one of the earliest state voluntary cleanup programs; historically industrialized with a commensurate large decrease in manufacturing sector jobs more recently; and located on the transportation corridor between the Washington, DC–Philly and New York–Boston corridors. These factors make it likely that New Jersey municipalities will have a significant number of abandoned gas stations and are potentially advanced in policies to identify and address these issues.

The selected cities, Trenton and Plainfield, are both midsized and economically depressed. The similar size of the cities enables some useful comparisons: Trenton is approximately 7 square miles, whereas Plainfield is slightly smaller at 6 square miles. This size is large enough to have a meaningful number of gas stations without being too large to collect the data effectively. Both target cities are economically depressed; former gas stations, because of high land values, are less likely to have been addressed through the private real estate market. In addition, both cities have active petroleum brownfield programs and are the only two cities in New Jersey that have undertaken a complete historic gas station inventory effort.

These cities have differences, as well. Trenton was a central city but is now primarily a commuter city, with a large number of state employees commuting into it. Plainfield, in contrast, grew as primarily a bedroom community but is now an older suburb. Plainfield, with a population of 47,353, is less densely developed than Trenton, which has a population of 83,923 (US Census, 2006). Trenton suffers from greater economic distress than Plainfield, but as, Table 1 indicates, both cities have density rates much greater and economic indicators much worse than their respective counties and the state overall.

The historic gas station inventories in each city were conducted primarily through means of available historic city directories[6] and, for more recent years, phone books. Criss-cross directories[7] and Sanborn fire insurance maps[8] were used to verify or supplement this information. Once the historic inventory was developed, the addresses were cross-checked with the tax assessor and tax maps for the cities. This enabled the identification of tax block and lots and also provided information on properties that have become part of road or park systems. The block and lot information was used to obtain tax information from city tax databases, including ownership information, as well as property tax information and, in some cases, reuse and size information. Windshield surveys, discussions with the city brownfield coordinators, and online mapping services were all used to identify the current use of the historic gas station. In addition, a records search of all available state and local environmental databases was conducted to determine what sites had environmental records associated with them. These databases included the New Jersey Known Contaminated Sites list, New Jersey Dataminer, the UST Summary Report, as well as city records.

Results

Trenton has a total of 162 historic gas station sites, with 16 of these still operating as gas stations. The number of gas stations in Trenton increased greatly from 1938 to 1955 as car ownership increased. After 1955, the total population of

Table 1. Comparative demographics

	US	New Jersey	Union County	Plainfield	Mercer County	Trenton
Minority population	24.9%	27.5%	34.5%	78.3%	31.5%	67.4%
Unemployment rate	5.8%	5.8%	5.6%	7.9%	7.5%	10.5%
Per capita income	$21,587	$27,006	$26,992	$19,052	27,914	14,621
Median household income	$41,994	$55,146	$55,339	$46,683	$ 56,612	$ 31,074
Families below the poverty level	9.2%	6.3%	6.3%	12.2%	5.9%	17.6%
Families with related children <5 years of age and below the poverty level	17.0%	10.9%	10.2%	19.3%	11.4%	28.3%
Families with a female householder, no husband present, and related children <18 years of age and below the poverty level	34.3%	27.4%	24.7%	27.5%	26.0%	36.9%
Individuals below the poverty level	12.4%	8.5%	8.4%	15.9%	8.6 %	21.1%
Persons per square mile	79.6	1,134.4	5,059.0	7,971.5	1,532	11,387

Source: US Census 2000.

Trenton began to decline, with a commensurate reduction in numbers of gas stations, as indicated in Figure 1. This decline in the 1950s also coincided with the construction of US Route 1 through the city.

Plainfield has 139 historic gas station sites, with only 5 currently operating as gas stations. The reason for the decline in this city does not appear to be linked to the population level, as demonstrated in Figure 2. Plainfield also experienced a large increase in gas station numbers from the late 1920s to the early 1950s as car ownership increased. The numbers of stations reached a plateau of approximately 40 sites from the early 1950s to the early 1970s, and then began a dramatic drop in numbers until the early 1990s, when the numbers again reached somewhat of a plateau near 8 stations. The decline in the 1970s and 1980s is consistent with the oil shocks of the 1970s and the closing of convenience stores in the early 1980s. In Figure 2, this pattern is compared to the population changes.

The current use of gas station sites in the two cities was also examined. It is interesting to note that a common condition of these former gas station sites is as vacant property or buildings in both cities, with 19% of former

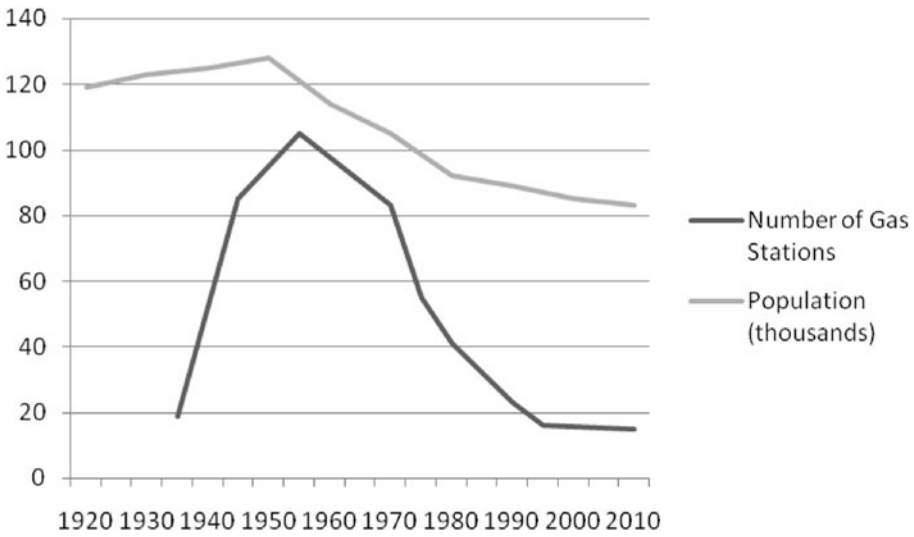

Figure 1. Pattern of operating gas stations in comparison to population levels in Trenton, NJ.

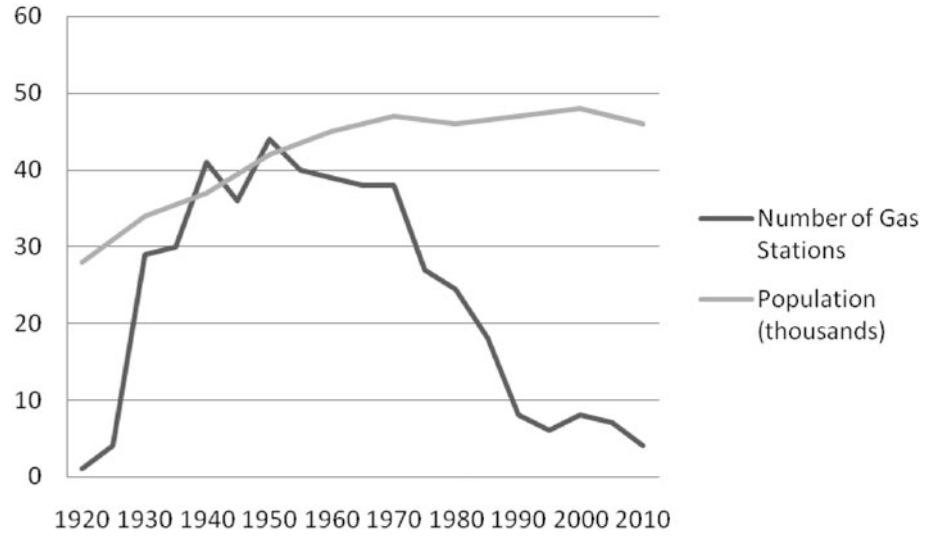

Figure 2. Pattern of operating gas stations in comparison to population levels in Plainfield, NJ.

gas stations in Trenton and 26% of former gas stations in Plainfield being unproductive land: perhaps a result of environment issues associated with the sites. The auto-related uses of auto repair, gas stations, parking, and auto sales cumulatively make up the largest reuse, with 40% in Trenton and 53% in Plainfield serving some auto-related reuse. Other identified reuses include restaurants and delis; convenience stores, storage facilities, hotels, junkyards, and other commercial/industrial reuses; both single and multi-family residential homes; a hospital; churches (including parking areas to support churches); public uses such as open space, firehouses, police stations, and schools; and a railroad. Figure 3 shows a comparison of the reuses in each city equalized by percent of total numbers of gas stations in each city.

An examination of ownership of current and former gas stations in the two cities shows similar patterns, as indicated in Figure 4. Although Trenton has a higher percentage of sites in public ownership than Plainfield, privately held sites make up the strong majority in both cities, at 62% for Trenton and 79% for Plainfield. Public ownership is the next largest category, with 28% of Trenton sites and 14% of Plainfield sites owned by public entities. For a small number of sites in each city, the ownership was unable to be definitively ascertained because of uncertainties in the

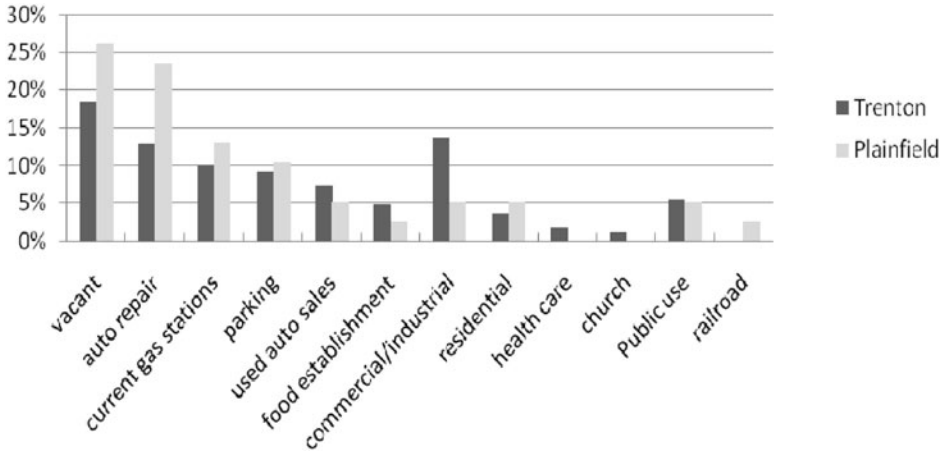

Figure 3. Comparison of Reuses of Gas Station Sites in Trenton and Plainfield, NJ.

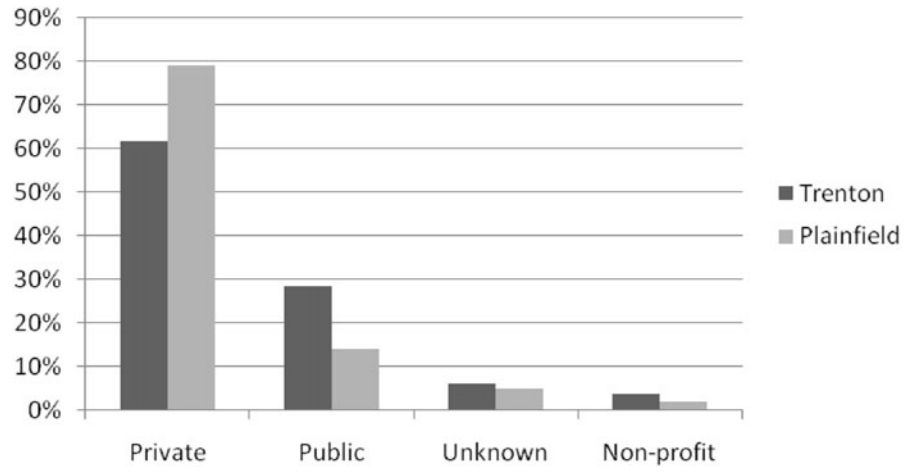

Figure 4. Categories of site ownership.

address of the site as a result of changes in street-numbering systems, lot consolidations, and road construction. In both cities, a small number of sites are owned by nonprofit organizations.

Despite differences in historic numbers of gas stations, ownership, and reuses, Trenton and Plainfield each have 86 current and former gas station sites that are generating tax revenue. However, Plainfield's higher property values generate significantly higher revenue from these sites.[9] In Trenton, taxes range from $504.30 to $80,089.40 per site, with an average of $931.27 per site and total annual revenues of $566,555.70. Plainfield, in contrast, realizes taxes of $1,291.46–$167,412.00 per site, with an average of $15,561.97 per site and total annual revenues of $1,338,329.70.

A review of the available environmental databases indicates that a large majority of these sites have no record of any environmental work having been conducted at the site. Only 38% of current and former gas stations in Trenton, and 23% in Plainfield, have some environmental record. The remaining 62% in Trenton and 77% in Plainfield have no record of any tank removal, environmental investigation, or remediation having been conducted through the state regulatory agency.

The results are even more striking when considered around the 1986 reporting deadline. In Trenton, 95% of all gas stations closed prior to 1986 and, of these, 67% have no environmental record. In Plainfield, 89% of all stations closed prior to the 1986 reporting deadline, with 87% of these having no environmental record. Of those sites having no environmental record, 96% in Trenton and 99% in Plainfield closed prior to the 1986 reporting requirement.

Discussion

The data collected from Trenton and Plainfield demonstrate the potential magnitude of the unaddressed abandoned gas station issue. The numbers of gas stations that closed prior to the 1986 federal reporting requirement dwarfs those that are subject to this requirement, and a majority of these have no associated environmental records. This indicates the potential presence of numerous USTs that are at the end of their life expectancy. This hidden threat is likely to be contributing to soil and groundwater contamination, and potentially indoor air pollution, as well.

The presence of so many unaddressed former gas stations in these two cities, both of which are primarily minority, economically challenged populations, raises environmental justice questions that also require exploration. The tax data for the redeveloped sites in each city indicate the potential these sites have for becoming an important source of tax revenue; however, the largest category of reuse for these properties is vacant land. Bringing more of these sites back into productive use will provide jobs and services to these underserved communities, as well as remove the environmental stigma from the properties immediately surrounding the sites, thus improving property values.

Trenton and Plainfield have strikingly similar patterns of former gas station numbers, use, ownership, and environ-

mental status. The larger percentage of publicly owned sites in Trenton is likely a combination of an aggressive city brownfield program coupled with the significant state ownership of properties in this capital city. The somewhat weaker market in Trenton may also have been a factor in limiting private market interest. It is also interesting to note that the gas stations closures in both cities are similar, even though Trenton has experienced severe population declines while Plainfield actually experienced a population increase during the period with the greatest gas station closures, indicating that different factors may have influenced the closures in each city.

This study examined only two cities in depth, and these are likely to be subject to the same regional variability. As the brownfield redevelopment programs, state requirements, land-use values, and development pressures will vary from state to state and locality to locality, these differences could be significant. To enable a more complete understanding of the patterns of untracked former gas stations, additional research to include areas outside New Jersey, larger cities, rural areas, and highway or geographic strip areas would be required. What is clear from this study is that many former gas stations have no environmental records and are not subject to any reporting or regulatory requirements, and this has reduced the ability to redevelop these sites, as well as posed an unaddressed environmental threat.

Conclusions

The results of this study are alarming. While this study focused on two New Jersey cities and regional variability is to be expected, somewhat similar results in disadvantaged cities across the country are indicated by the fact that the reporting deadlines are national requirements. The results from the Trenton and Plainfield research indicate that the universe of unreported and unaddressed sites may be several orders of magnitude greater than what EPA is currently tracking and regulating. Left unaddressed, these tanks pose threats to human health and the environment, as well as represent a significant unaddressed cost.

The largest single category of former gas station reuse in both Plainfield and Trenton is vacant sites, contributing to a loss of tax revenue, lost opportunity for the creation of jobs and services, and an environmental liability.

A full analysis of the extent of these unregulated tanks could have ramifications for the distribution of public brownfield funding, the criteria by which funds are distributed through states to address USTs, as well as requirements for inventories and investigations prior to real estate transactions. Liability-relief measures at the federal and state levels could also be explored to encourage municipalities or private owners to address these hidden threats. In addition, municipalities may wish to conduct historic gas station surveys as part of their brownfield inventory efforts to ensure these sites are fully captured in brownfield programs.

Notes

1. An underground storage tank (UST) system is a tank and any underground piping connected to the tank that has at least 10% of its combined volume underground.
2. *Environmental justice* is widely defined as the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies.
3. *National Petroleum News* conducts an annual survey of numbers of gas stations broken out by state. Such numbers are available beginning in 1994, when 202,878 stations were reported nationally. By 2006, this number had declined to 167,476, a decline of 17% over 12 years.
4. Superfund legislation, more formally known as Comprehensive Emergency Response, Compensation, and Liability Act (CERCLA) was passed in 1980 and created a tax on the chemical and petroleum industries. It provided federal authority to respond to the most dangerous abandoned or uncontrolled contaminated sites. Ironically, though the petroleum industry was taxed to fund the program, petroleum contamination was specifically excluded from the contaminants that could be addressed by the fund.
5. *Brownfields* are defined by federal legislation as 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 [Public Law 107-118 (H.R. 2869), Small Business Liability Relief and Brownfields Revitalization Act] States may define these sites differently. New Jersey defines a brownfield as any former or current commercial or industrial site that is currently vacant or underutilized and on which there has been, or there is suspected to have been, a discharge of a contaminant (N.J.S.A. 58:10B-23.d).
6. City directories have been published for certain areas from the mid-1800s until the present, sometimes at irregular intervals. They typically include names and addresses of businesses and residents in each city. In later years, businesses were grouped by category, with "Gasoline and Oil Service Stations" and "Gasoline Stations" representing the categories for gas stations. The available directories were searched for Trenton for the years 1938, 1948, 1955, 1958, 1970, and 1972. Plainfield had a greater number of years available, with all years searched for through 1982, with the exceptions of 1923, 1932, 1934, 1936, 1937, 1939, 1941, 1942, 1945, 1946, 1948, 1952, 1954, 1958, 1959, 1961, 1965, 1970, 1979, 1980, and 1981. Phone books were searched from 1988 to present, with the exception of 1990, 1991, and 1999.
7. Crisscross directories, also called reverse telephone directories, are phone books organized by street instead of business or resident name, en-

abling the tracking of the use of a particular site over time, even if the business name changes. These were used for the Trenton searches for the years 1980, 1990, and 1999.

8. Sanborn fire insurance maps were created to assess fire insurance liability and were produced from 1867 to 1970 for approximately 12,000 towns and cities in the United States. These detailed maps typically give the uses of a site, as well of locations of potential fire hazards such as tanks. These were used in this study to supplement information in the city directories to verify the precise location of identified gas station sites where uncertainty existed.
9. Trenton has a tax rate of $4.06 per $100 of assessed value, compared to Plainfield's $5.163. However, Trenton's equalization-average ratio of assessed to true value of real property is 94.59 compared to Plainfield's 56.48.

References

Brownfield Grants Task Force. May 2008. *Brownfield Grants: Lessons Learned from NALGEP's Brownfield Grants Task Force*. NALGEP (National Association of Local Government Environmental Professionals), Washington, DC, 11 pp.

Capasso, J.R. December 2007. Brownfields Coordinator, Trenton, NJ. Personal interview.

Margolies, John. 1993. *Pump and Circumstance: Glory Days of the Gas Station*. Little, Brown, New York, 127 pp.

National Petroleum News. 2004. *Market facts*. Available at http://www.npnnet.com (accessed December, 2007).

Northeast-Midwest Institute and National Association of Local Government Environmental Professionals. 2002. *Recycling America's Gas Stations: The Value and Promise of Revitalizing Petroleum Contaminated Properties*. Washington, DC.

Public Law 107–118 (H.R. 2869). 2002. Small Business Liability Relief and Brownfields Revitalization Act.

Ryan, J. September 14, 2007. *Leaking Underground Storage Tanks* [Update]. Available at Boulder Area Sustainability Information Network, http://bcn.boulder.co.us/basin/waterworks/lust.html (accessed December, 2007).

Sementelli, A., and R. Simons. 1997. Regulation of Leaking Underground Storage Tanks: Policy Enforcement and Unintended Consequences. *Economic Development Quarterly* 11(3):236–238.

US EPA (US Environmental Protection Agency). 2008. *Brownfields and Land Revitalization: About Brownfields*. http://www.epa.gov/brownfields/about.htm (accessed December, 2007).

US EPA Office of Solid Waste and Emergency Response. May 2007. *UST Program Facts: Data About the Underground Storage Tank (UST) Program*. EPA, Washington, DC, 2 pp.

Vieyra, D.I. 1979. "*Fill 'er Up*": *An Architectural History of America's Gas Stations*. Collier Macmillan, New York, 111 pp.

Submitted May 29, 2009; revised July 29, 2009; accepted August 21, 2009.