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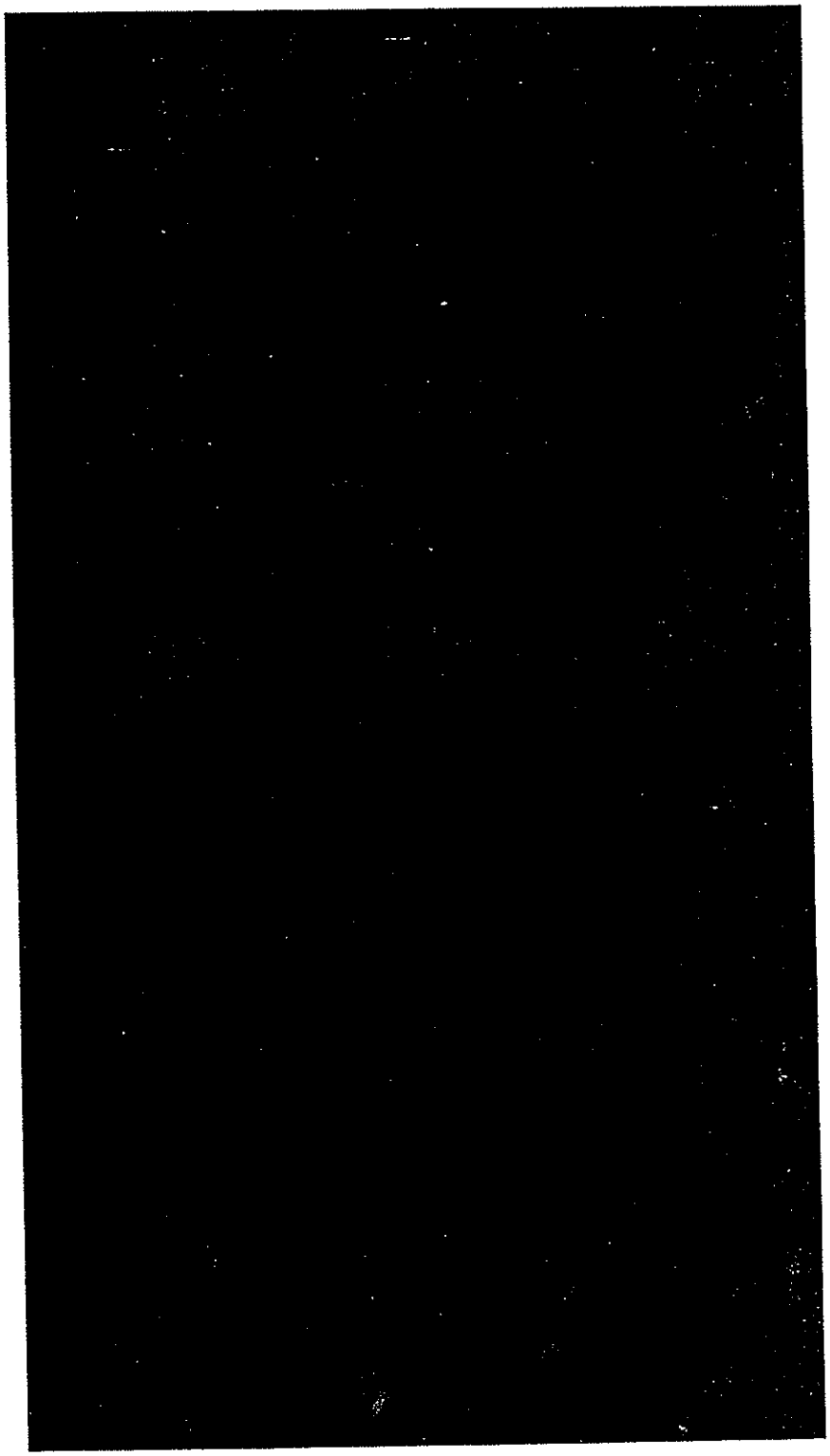
The Journal of American Economic Revitalization

Contents



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Regulation of Leaking Underground Storage Tanks: Policy Enforcement and Unintended Consequences

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Public and private developers and planners often encounter environmental contamination caused by leaking underground storage tanks (LUSTs) when redeveloping previously used urban lands (brownfields). This article addresses the process by which underground storage tanks (USTs) are regulated, how leaks are discovered, and the proportion of serious leak incidents with groundwater contamination. Empirical case-study evidence of 429 leaking tank sites in Cuyahoga County, Ohio, describes the severity of leaks, how they were discovered, and the effect of a No Further Action status, which was minimal. Programmatic failure of the state regulatory agency may be partly responsible for this lower transaction rate and may partially contribute to many closed tank locations and inadvertent loss of jobs. Trends in liability reduction for USTs may change this in the near future.

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Developers seeking to reuse nonresidential urban lands often encounter environmental costs associated with contamination from prior land uses. Parties redeveloping sites with underground storage tanks (USTs; a type of brownfield property) also face uncertainty concerning the level of site cleanliness and financial responsibility of polluters, owners, and potential lenders. This puts urban development at a disadvantage when compared with sites that have not been previously used (greenfields).

Discovery of potential contamination from leaky underground storage tanks (LUSTs) is a common brownfield problem encountered in virtually all jurisdictions in the United States. In 1982, about 6% of the estimated 1.2 million known steel tanks were believed to be leaking (Kost & Parish, 1986). Another estimate from the U.S. Environmental Protection Agency (USEPA) places the number of USTs that contain petroleum at "several million," with the leak rate as high as 25% (Page & Rabinowitz, 1994, p. 353). Although most inadvertent releases of toxic liquids from USTs involve a modest amount of contaminated soil, which is confined on-site, many cases are more severe and involve contamination of groundwater, both on- and off-site.

UST sites are among the most common brownfield problems and are more numerous than Superfund locations or sites on the toxic release inventory (TRI).[1] Many of these tanks are located at operating or former gas stations, transportation service facilities, industrial plants, and government-run service yards. Further, many LUST sites are located along major traffic arteries. Hence, they

AUTHORS' NOTE: Thanks to Norman Krumholz and Dennis Keating for their comments on earlier drafts of this article. We also appreciate the assistance of Patrick Barney, Susan, D. J., and Marc Simons in conducting the case studies and data entry. Raymond Roe of the Bureau of Underground Storage Tank Regulations (BUSTR) was very helpful in clarifying and explaining key points of underground storage tank enforcement.

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have favorable locations at strategic intersections, which makes them potentially attractive for redevelopment as fast-food sites or key corner parcels in a larger site assembly.

When LUSTs are encountered by urban developers and planners, the redevelopment project becomes subject to state UST regulation and may be delayed or abandoned. Depending on what is found, the parcel may undergo several months or years of environmental remediation to control and/or remove contamination from the site. This can add substantial costs and delay to redevelopment projects.

During and after remediation, the status of UST sites is uncertain. This article guides the public or private developer as to what to expect if a UST is found on-site. For example, how are these tanks discovered? If contamination is found, what can planners (or the private parties approaching them for financing) expect during and after remediation? How often is contamination confined to the site, and what are the potential off-site effects? Is the UST regulatory process working?

This study augments the growing body of research on redevelopment, in the context of environmental regulation, and extends work by Page and Rabinowitz (1994) and Swartz (1994) concerning brownfield development in general and USTs in particular. The objectives of this article are twofold: First, it describes the case experience of LUST incidents in highly urbanized Cuyahoga County, Ohio, the central county in the Cleveland metropolitan area. The process by which LUSTs are regulated and records are maintained in Ohio, how leaks are discovered, what happens to tank sites after detection, attributes of the leaking and nonleaking tank population, and factors associated with leaks and spills are also addressed. The study gives special attention to the magnitude of leak incidents and whether groundwater contamination extends off-site. Over 98% of the LUST sites analyzed in this study have municipal drinking water, instead of relying on wells. This alternative minimizes the potential health effects of LUST incidents in this research.

Second, the article begins examining the regulatory process, raising questions about both its appropriateness in regard to unintended side effects and its ability to bring previously contaminated sites back at rates comparable to uncontaminated sites. Once leaks are detected, property owners are expected to cooperate voluntarily with state regulators in mitigating environmental contamination. In Ohio, the regulating agency is the Bureau of Underground Storage Tank Regulations (BUSTR). Its activities include soil and water testing, engaging consultants, and either treating or removing the contaminated soil. If and when owners successfully comply with BUSTR requirements, they receive a No Further Action (NFA) letter for that incident. This is a limited type of covenant-not-to-sue (CNTS).

Known contamination can have a spillover effect on nearby properties. This uncertainty may retard completion of site mitigation until the extent of the problem is adequately demonstrated, litigated, and/or mitigated. Transaction activity for a site should increase once an NFA letter is received. However, the stigma associated with known contamination suggests that sales activity should not necessarily rebound quickly to the levels of uncontaminated properties (Patchin, 1994).

The following sections review the pertinent literature and provide an overview of the regulatory framework in Ohio, descriptive statistics on the study population of leaking tank sites in Cuyahoga County, and cursory evidence of the effect of NFA status on property transactions of contaminated lands. The article develops conclusions and policy recommendations for developers and planners and highlights how tank regulation influences the market activity of formerly contaminated real estate.

PERTINENT LITERATURE

Justifying the Government Role

There are several aspects to redeveloping contaminated real estate; they include environmental regulation, real estate market pricing considerations, and finance considerations. Combined, risk and uncertainty that surround contaminated sites are a formula for sluggish transactions that make economic redevelopment of contaminated properties difficult.

A clean environment is a public good. There are negative externalities connected to environmental contamination that are not incorporated into the polluter's pricing system. Thus, in part to mitigate market failure and internalize these costs, the USEPA was created. Over time, and after substantial further study and legislation, a need arose to regulate USTs as part of the greater problem. This was generally accomplished by largely unfunded mandates to states. In Ohio, BUSTR was created to address UST issues. It is interesting to note that BUSTR is in the Department of Commerce, rather than the state EPA, potentially giving it both multiple and conflicting objectives to achieve. Judging by the number of cases with limited information on file, BUSTR lacks sufficient staffing. Their enforcement mandate features voluntary compliance. These limitations lead to programmatic failure. BUSTR and its current management practices may be contributing to the low property transaction rates, while indirectly closing gas stations and comparable properties that are otherwise commercially viable (eliminating jobs), as it carries out its mandate to clean the environment. The NFA letter not releasing properties into the market provides evidence of this. In addition to business risk, uncertainty about environmental matters may be substantial enough that some transactions do not occur. A stigma attached to previously contaminated lands by potential buyers may interfere with determining price and sale time frame. Risk also includes liability concerns about off-site effects on nearby properties. Lender liability in financing of properties may be another reason for reduced transaction activity. Banks could be awaiting the NFA letter, which is a form of CNTS (Swartz, 1994). Simply having NFAs potentially available could make transactions less likely to occur because banks require them, leading to further delays.

. . . BUSTR lacks sufficient staffing. Their enforcement mandate features voluntary compliance. These limitations lead to programmatic failure.

Many states are in the process of revising the way that contaminated sites are regulated, especially with respect to liability for new owners and lenders (Dimsmore, 1996; Environmental Financial Advisory Board, 1995). This reform pertains not only to sites with USTs but also to those with heavy metals and multiple sources of contamination. This transition period implies that many market participants will exercise caution in moving forward with their remediation plans until a more certain outlook has been developed. Page and Rabinowitz (1994) support the notion that changing environmental rules themselves may hinder development. They assert that potential liability may affect property value more than actual contamination and that parties deterred by the threat of delays and potential cleanup costs could be waiting for relaxation of remediation criteria.

Three issues pertaining to environmentally contaminated sites in general (and LUSTs in particular) are covered. The first concerns activities common to cleaning up contaminated sites, as well as how associated costs affect the contaminated property. Next, because property owners could be held accountable for off-site effects resulting from their contamination, the evidence concerning expected effects of known contamination on nearby properties is reviewed. Third, transaction-related issues of contaminated sites, including risk and uncertainty and potential legal ramifications on lenders and other parties, are considered. This study addresses environmental regulation issues in detail later.

Cleaning Up the Subject Property

Sites contaminated with toxic substances can require both soil and groundwater cleanup. Currently, it is common practice to remove contaminated soil and dispose of it at a landfill. This can usually be performed relatively quickly (e.g., weeks or months). Soil washing (La Grega, Buckingham, Evans, & Environmental Resources Management Group, 1994; Mann, 1992) or in-situ soil remediation (Pamukcu, Wittle, & Titus, 1992) are feasible but remain very expensive and have yet to reduce the need for soil removal. Lederman and Librizzi (1996) maintain that many technologies are becoming available for treatment of contaminated soil: For example, bioremediation and separation on-site are now available at a low to moderate cost.

Mitigation of contaminated groundwater is more complex, usually requiring several wells that extract "free product" from the water table over a period of months or years. Kost and Parish (1986) provide a useful but dated discussion of cleanup and product recovery operations for UST sites. As evidenced by this case research, each site presents a unique problem for environmental mitigation firms.

Cleanup costs, including the expense of investigating the extent of potential environmental contamination, can be substantial. When soil contamination is contained on-site and the amount of the spill is a few thousand gallons or less, the water table is low, and soils are impermeable clay, the incidents covered in this research had costs in the $30,000 to $100,000 range (in current dollars) per incident. Groundwater problems are much more expensive to remediate, especially when contamination extends off-site. The responsibility for these costs generally fall on the owner, reducing the sales price of the property. Page and Rabinowitz (1993) determined that groundwater contamination (although not necessarily from LUSTs) significantly reduced industrial and commercial property values for temporarily obsolete abandoned derelict sites (TOADS). Two of their six case studies contained groundwater contamination from petroleum. The percentage decrease in value for these properties ranged from 10% to 40%.

Effects of Contamination on Nearby Properties

Known contamination may also affect the value of nearby properties. Possible lawsuits concerning off-site damages are likely to reduce the willingness of buyers to bid for or acquire properties with USTs. Proximity to toxic waste sites (Kiel, 1995; Kohlhase, 1991; Michaels & Smith, 1990), landfills (Nelson, Genereux, & Genereux, 1992; Reichert, Small, & Mohanty, 1992), and petrochemical refineries (Clark & Nieves, 1993; Flower & Ragas, 1994) has been associated with a negative effect on residential property values, diminishing with distance from the subject property. Page and Rabinowitz (1993), using a case-study design, found no diminution of value for nearby residential sites attributable to groundwater contamination. Their small sample size (two contaminated homes and five uncontaminated ones), research design (not all other factors were controlled for), and use of assessed value (rather than sales price) as the value indicator may explain these counterintuitive results. The results may also imply that the local assessor did not recognize how contamination can influence sales price.

In work pertaining directly to LUSTs, Simons, Bowen, and Sementelli (in press) provided evidence that close proximity (in the same block or within 300 ft) to a registered LUST reduced residential property values by over $12,000, or 17% of value. Most of these LUSTs had off-site groundwater contamination. Overall, evidence supports the notion that known contamination has a negative effect on nearby properties. This is relevant to sites generating contamination because of the potential financial liability.

Uncertainty, Risk, and Stigma

Even when cleanup costs are determined, contaminated properties are difficult to transact. Prices of and near the contaminated site may be reduced. Publicized discovery of contamination on Superfund sites has a negative effect on residential property in the vicinity (Kiel, 1995).

Austrian and Eichler (1994) conducted a survey on brownfields (contaminated urban lands). Of the 46 midwestern respondents, 61% indicated that contaminated sites would sell only at a discount equal to or greater than cleanup costs. Presumably, some of the discount in excess of cleanup costs dissipates when formal assessment of the cleanup costs becomes available. If not, there could be an additional price-reducing stigma associated with the property. Although real estate markets have been reluctant to include sales of contaminated properties, they are now becoming accustomed to them, with sales occurring slowly and with severe discounts (Patchin, 1994).

Lenders may be reluctant to finance properties with USTs, whether leaking or not. Page and Rabinowitz (1994) suspected that there was a tendency for financial institutions to avoid lending for these sites. Kinnard and Worzala (1996), in their nonrandom survey of 135 lenders and investors, found that some do consider participating in transactions with USTs. In cases in which USTs are present but no evidence of a leak is found, 25% would lend. If petroleum contamination was detected, 14% of lenders would probably extend financing. However, if groundwater contamination was found, less than 10% would participate in financing the property. Although lenders

have long been considered potentially responsible parties (PRPs) under the 1980 Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), lender safe-harbor legislation from UST liabilities has recently been proposed by the USEPA. This might make UST properties easier to finance (Gibson, 1994). Some states have already implemented liability exemptions for lenders (Dimsmore, 1996; Simons, 1996).

In light of these issues, this research investigates whether and when contaminated UST properties sell after completion of government-sanctioned remedial procedures. The article next reviews Ohio's regulatory framework for compliance.

REGULATORY FRAMEWORK FOR USTs

Federal supervision of USTs was set forth in 1988, with regulation guidelines (53 Fed. Reg. §37082 and 53 Fed. Reg. §37212). These regulations cover new tanks; leak, spill, and corrosion detection; construction; and cleaning and closure requirements. The USEPA is the lead federal agency overseeing USTs. Administration of USTs is delegated to the states. Donovan and O'Connor (1989) provide a summary of these regulations.

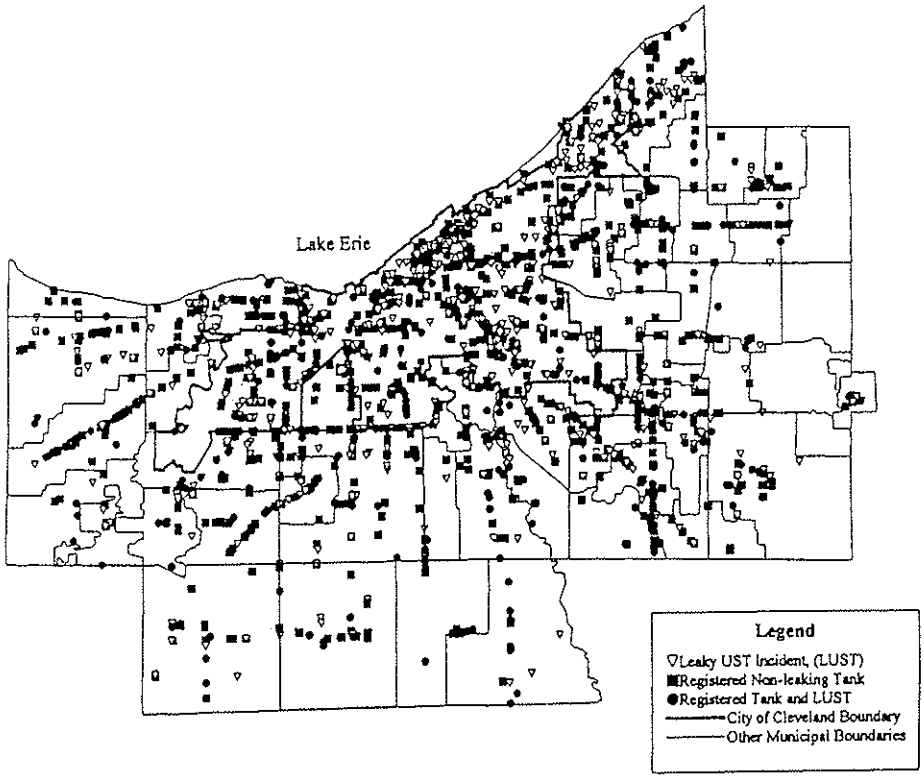
BUSTR is under the direction of the State Fire Marshal's Office, which is part of the Department of Commerce. BUSTR administers a voluntary compliance program, guided by draft regulations, issued in September 1992, which address important aspects of operations, including tank registration, oversight of tank installation, operation and closure, and management of environmental mitigation procedures (Ohio Department of Commerce, 1992). The Petroleum Release Compensation Fund (PETRO) is managed by a separate state agency that provides limited insurance coverage against mitigation expense for newer USTs that are registered with BUSTR.

BUSTR maintains two lists of known, recently active USTs: one containing the master registry of tank sites (RUST), and another with those sites where USTs are known to have leaked (LUST). These two lists are not exhaustive, excluding USTs containing heating oil for residential use (which are not regulated by BUSTR in Ohio). Among other disturbing omissions are those tanks that elude regulation; some may be actively in use, whereas others are abandoned. These are referred to as orphan tanks.

If a release from a UST is suspected, reported, or detected, the site is assigned an incident number, and a BUSTR investigation is initiated. Once the immediate threat of explosion or fire has been addressed, BUSTR generally requires the property owner to determine the extent of the problem and the source of the release and to remove and dispose of the old tank(s), piping, and contaminated soil. More serious releases may involve not only tainted soil but groundwater contamination. The most serious leaks involve off-site groundwater contamination, in which underground plumes (migration of contaminants) may affect aquifers.

BUSTR project officers work with property owners in hiring contractors and consultants to ensure voluntary compliance with state and federal regulations and to move toward mitigating the environmental contamination through testing, remediation, and cleaning up the damage resulting from releases. Although compliance with environmental regulations is voluntary, there is an increasing national trend for authorities to prosecute violators (Nooney, 1994).

BUSTR recently implemented a scoring system, prioritizing each site by severity of the problem. Although this has generally been successful in reducing subjectivity in the interpretation of consultant reports and in allocating limited BUSTR staff to more serious problems, some cases of undetermined or limited severity have not been investigated in detail.[2] Once a leak incident has been cleaned up to BUSTR's satisfaction, it may grant an NFA letter. This assures the property owner that BUSTR does not intend to pursue any further cleanup action concerning the leak incident. However, this "comfort" letter does not refer to yet-undiscovered contamination; nor does it bind other regulating agencies. A straightforward case of on-site soil contamination below mandated action limits typically takes several months to 1 year between initial discovery and issuance of the NFA letter. For properties with off-site groundwater contamination, the NFA letter may take years to obtain—if it can be attained at all.[3]



gure 1: Registered Underground Storage Tanks (RUSTs) and Leaking Underground Storage Tank (LUST) Incidents in Cuyahoga County, Ohio
SOURCES: Ohio Bureau of Underground Storage Tank Regulations (BUSTR); 1990 TIGER/Line Census Files.

During mitigation, it is less likely that properties under investigation can be sold or obtain financing, due in part to the uncertainty about the effect of environmental contamination on property value. One of the main research questions deals with the effect of the ongoing environmental mitigation and the NFA letter on transaction levels of contaminated properties.

As of January 1994, BUSTR had 18,600 registered tank sites on the statewide registry (RUST). Of these, approximately 1,680 are located in Cuyahoga County, the central county in the Cleveland primary metropolitan statistical area (PMSA) and the study area for this research. BUSTR had also accumulated 17,400 reported leak incidents statewide since 1988. Of these, approximately 1,362 had occurred in Cuyahoga County (R. Roe, personal communication, October 1994). Figure 1 shows the locations of the RUST and LUST tank sites in the county. The location of major highways can be inferred from the dense linear pattern of sites on the map.

STUDY POPULATION AND SAMPLING PROCEDURE

The BUSTR sites in our sample were drawn from randomized computer lists, with replacement generating an initial 446 observations for the study. The data were cleaned to produce the 429 final observations.[4] Both leaking tank data sets were combined with the Cuyahoga County Auditor tapes based on permanent parcel number to provide property transaction data.

The population for this research is the LUST list for Cuyahoga County, cumulative since 1988. Of the 1,362 total incidents reported through January 1, 1993, 1,000 incidents with usable street ddresses were examined—the group for which a unique permanent parcel number (property tax

TABLE 1
Descriptive Statistics of the Study Population (N = 429 sites)

Variable	n	*% of Total*
Steel tanks	257	22.6
Fiber tanks	118	10.4
Jacketed steel tanks	9	0.8
Cathodic protection tanks	4	0.4
Double hull tanks	1	0.09
Tanks containing kerosene	18	1.6
Tanks containing unknown	12	1
Tanks containing gasoline	523	46
Tanks containing diesel	115	10.1
Tanks containing hazardous waste	15	1.3
Tanks containing heating oil	8	0.7
Tanks containing unknown petroleum	45	4
Clay site	185	43
Sand site	38	8.8
Gravel site	8	1.9
Other soil site	17	4

Variable	n	*Mean*	*Minimum*	*Maximum*
Monitoring wells per site	245	6.02	1	24
Soil borings per site	199	6.74	1	23
Sump pumps per site	42	1.67	1	7
Tank capacity		5.9 K	1 K	30 K
Number of tanks	1,137	2.65	1	43

number) could be obtained. Approximately 120 incidents reported in fiscal year (FY) 1993 or later were excluded. The final sample of 429 observations contains 31 NFAs (7.2%), an underrepresentation compared with the 24.2% NFAs in the population. The overall ratio of sample to population with usable addresses initiated in FY 1992 or earlier is just under 50%. Except when noted, we believe our results are unbiased with respect to the population. The NFA letters in the sample were drawn from a population of 660 that have been issued since the inception of BUSTR, with 330 letters issued through year-end 1992. The article provides summary data for this group.

Analysis of the sample with usable addresses shows that four land uses most frequently appear: 32.0% of the reported leaks came from existing or former gas stations, where petroleum products were sold for retail; 11.3% were transportation related; 5.5% were industrial sites; and 2.5% were government or tax exempt, primarily for fueling vehicles and wastewater treatment. The remainder of sites was dispersed across numerous commercial and (in some cases) residential uses, but none with frequencies that match those listed above.

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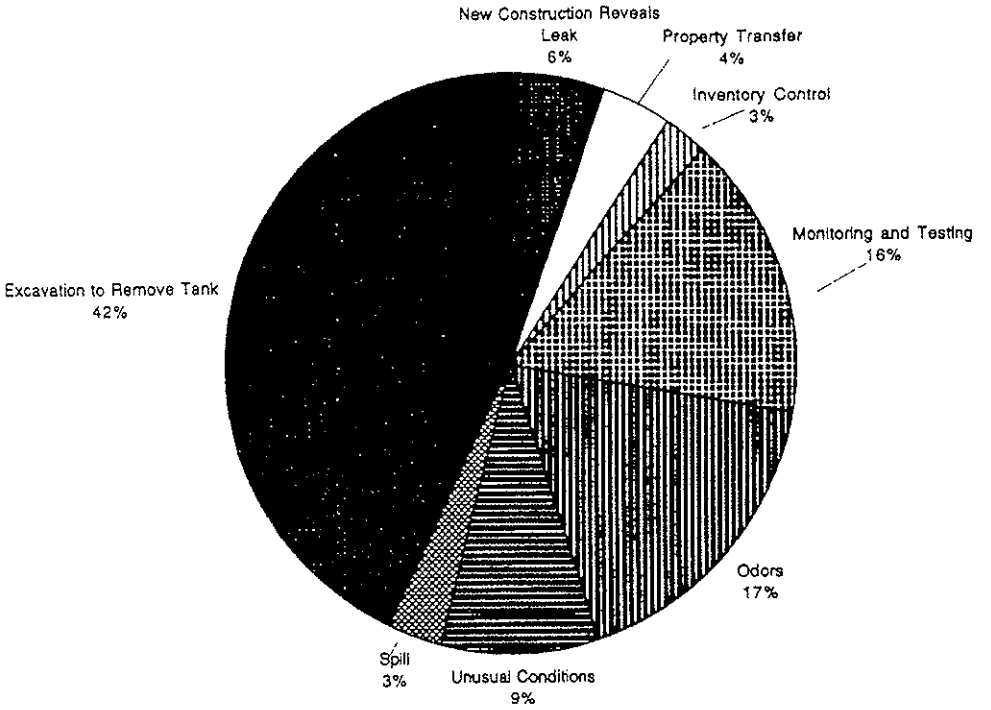
Descriptive Statistics

The descriptive statistics above refer to the sample of 429 incidents, on which are located 1,135 known tanks. Two tank farms with 20 or more tanks are excluded. The characteristics of leaking sites (number of tanks on-site, age of tanks, capacity and contents, and tank material for the first 5 known tanks [about 95% of our locations]) are covered. This is followed by a description of how the release was detected. Next, the nature and severity of the release is covered, including the site's soil and groundwater, which affect the required testing and remediation procedures such as consultant reports, soil borings, and monitoring and extraction wells.

Site characteristics

Table 1 summarizes the characteristics of leaking tank sites. A typical site is an active gas station, with two tanks containing gasoline, one with diesel fuel, and a used oil tank.



ure 2: Method of Detection for Reported Incidents in Cuyahoga County, Ohio

The mean number of tanks per site is 2.65. About one fifth of the sites had only one tank, and fewer than 5% had more than five tanks on-site. The average age of the tanks on leaking sites (whether leaking or not) was 18.3 years; only 13.3% of the tanks were older than 30 years.

There was a bimodal distribution in the capacity of tanks. A large minority (25.3%) contained 1,500 gallons or less, and 49.6% of tanks were in the 4,000-10,000 gallon range. The largest tank size was 50,000 gallons.

The contents of tanks on these sites when reported information was available were nearly always petroleum products—mostly gasoline, followed by diesel fuel and used oil. Under 5.0% of the tanks contained nonpetroleum hazardous fluids.

The most commonly reported tank material was steel, which was about twice as common as fiberglass for those tanks for which data were available. Under 5.0% of tanks reported newer antileak features such as jacketed steel, double hull, or cathodic protection.

Detection of the release

Leak detection categories include inventory control, monitoring/testing, unusual operating conditions, smells and spills observed, detection through planned tank removal, and discovery through new construction or property transfer. The first two categories are mandated by BUSTR (Ohio Department of Commerce, 1992) and can be considered proactive. The results are shown in Figure 2.

The most common method of detection was planned tank removal, with 42% of incidents. A total of 17.4% were attributed to reported odors. The next most common method was monitoring and testing, with 16.0%. Although detection attributable to investigation related to property transfer uncommon (3.8%), this is expected to change over the next few years, as more tank sites comply with periodic testing regulations. Note that the proactive detection outcomes represent less than 20% of the total—a figure that should be improved upon and is subject to policy intervention.

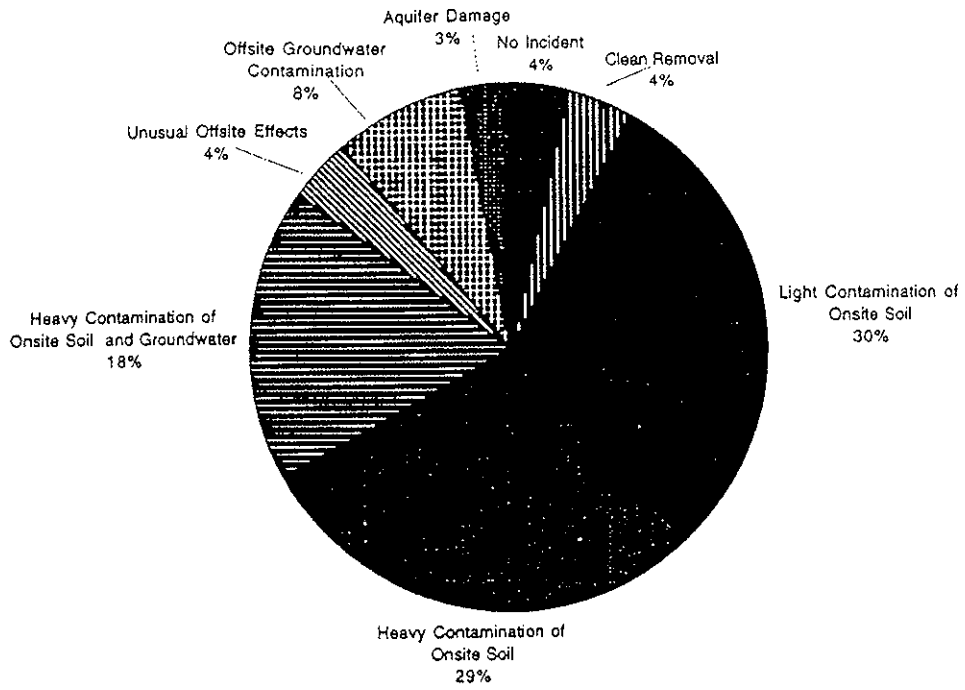


Figure 3: Severity of Underground Storage Tank Releases in Cuyahoga County, Ohio

Severity of release

Two types of release are evident. A leak occurs where there is written evidence in the case history of a hole or puncture in one or more tanks on-site. Only 125 cases (29.1% of the release incidents) were confirmed leaks from tanks. The more common case (58.7%) is a line leak (a puncture not in the tank itself but in the line connecting it to some other point) or a release of uncertain source (e.g., an undetected tank leak, spills, or overfills). The small balance of incidents had no measurable release of toxic material.

The severity of the release is categorized by the amount of substance released relative to mandated action limits, whether groundwater is affected, and if the release extends off-site (Page & Rabinowitz, 1993). Less severe incidents have very small releases, resulting in contaminated soil under mandated action limits, that are contained on-site. Next are more substantial releases that contaminate soil and/or groundwater above the action limits but are contained on-site. The most severe types of release contaminate the groundwater under nearby properties or aquifers. Figure 3 shows that about two thirds of the releases were contained on-site: 30.0% with soil contamination below action limits and 28.9% with soil contamination above action limits.

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A total of 142 incidents in our sample (33.1%) had severe problems, associated with documented groundwater contamination or other off-site effects. Almost 50 cases were very severe, with documented off-site plumes of migrating contaminated groundwater. NFA sites typically had limited on-site soil contamination. Adjusting for our sample's underrepresentation of NFA sites, it is estimated that 25% of all reported leak incidents in the population have groundwater contamination and/or reported off-site effects.[5]

Testing and mitigation procedures

The next topic is environmental testing procedures used, including borings, wells, consultant reports, and extraction devices. This information can assist economic developers in what to expect if USTs are encountered on their property. Generally, these activities pertain to sites with more serious groundwater contamination—requiring further testing, remediation, and consultant reports—than soil-related problems. The seriousness of the release, based on groundwater contamination, tends to be positively related to the quantity of material contained in the tanks. No relationship was found between seriousness of release and age of tank or among steel or fiberglass construction or tank contents.[6]

Severity of environmental contamination in a release appears to be associated with soil type. Clay soils are consistent with contamination contained on-site above action limits, whereas sand and gravel soils and high water table are positively associated with off-site water contamination.

A total of 245 tank sites had consultant reports issued, including simple closure reports by contractors indicating clean removal of one or more tanks. For those sites with reports, there was an average of 2.3 consultant reports per incident. The average number of soil borings for the 199 sites where borings were taken was 6.7. For the 165 sites where the soil borings filled with water to become water-monitoring wells, the average number per site is 6.0. On the 42 sites with sump pumps for active extraction of contaminated groundwater, there was a mean number of 1.7 pumps per site.

NFA: NO EFFECT ON SALES

Turning now to the effect of obtaining the NFA letter: Transaction levels should be higher than for properties under active mitigation, and mortgage financing should be easier to obtain.

However, it appears that the effect of the NFA letter on sales was minimal. Only two properties transacted after the NFA letter was issued (0.6%)—hardly an indicator of pent-up demand.[7] This supports the assertion that the NFA letter does not increase the level of transactions after its issuance. This rate was much lower than sales rates for other properties. For example, among 23,714 commercial and industrial properties without tanks, over 10% sold over the same 4-year period. Even among LUST sites without NFA letters, about 4% were sold over the same time frame. Further, 9 of the 34 LUST sites that did transact had groundwater contamination either on- or off-site, indicating that the markets can assess the risk of a contaminated property at a lower sales price, regardless of whether the owner is issued an NFA letter for the site. All these sales presumably occurred in the same regional economy; there were also pockets in which demand for real estate had been very low. Nevertheless, the inability of the NFA letter to release sales into the marketplace does not conform to our expectations; however, it does reinforce concerns about programmatic failure. It appears that stigma, rather than substance, is the culprit: Of the 2,900 NFA letters issued statewide by BUSTR for corrective action since 1989, fewer than 1% have been reopened for further action (R. Roe, personal communication, February 1996).

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Has BUSTR Met Its Department of Commerce Mission?

BUSTR is in the Department of Commerce and is thus interested in retention and creation of employment. However, by doing a good job regulating tanks, BUSTR has actually presided over a decrease in the number of sites with USTs in the state of Ohio. For example, from 1994 to 1995, the number of tanks regulated by BUSTR declined by over 20% to 33,000 USTs. This number is expected to decrease by another 10% by 1998, when all Ohio UST sites must be in substantial compliance with BUSTR guidelines for new tanks (R. Roe, personal communication, February 1996). Although the closing of these sites implies a loss of jobs, some former UST locations have

reopened as fast-food stores, car washes, and other retail uses. In Cuyahoga County, for example, 17% of the 429 leaking tank sites had a change in land use between the initial leak event and July 1994 (a minimum of 18 months). Further, of the 840 tank sites under regulation in 1990, 2% of those with buildings had them torn down by 1995; another 5% had a reduction in the assessor's building value (including tanks) of over 50% in real terms; and 11% had real building value decrease by at least 25%. If the additional businesses that were severely late (2 years or more) on payment of property tax are included, over 20% of those properties under regulation in 1990 were substantially worse off 5 years later, which negatively affects job retention. Subject to general economic conditions, this suggests the magnitude of unintended side effects to the economic base resulting from UST management.

CONCLUSIONS AND POLICY RECOMMENDATIONS

This article has addressed management issues regarding LUSTs. The process by which USTs are regulated, how leaks are discovered, what happens to tank sites after detection, attributes of the leaking population, and magnitude of the leak have been covered.

Evidence from LUST cases in Cuyahoga County shows that most leaks are detected by excavation to remove tanks or other reactive means; less than 20% of releases are discovered proactively. It was also determined that about two thirds of all release events are soil contamination contained on-site. The proportion of reported UST releases having more serious groundwater problems or other off-site effects is about 25% of all incidents. Sand and gravel soil types and high water table are associated with more severe releases. Clay soil is associated with less severe contamination.

Surprisingly, issuance of the NFA letter by BUSTR had a negligible effect on the transaction levels of cleaned sites. This appears to be an indicator of programmatic failure in government regulation of contaminated lands.[8] Because these sites have presumably undergone remediation, further research should be conducted to determine why transactions did not occur. One explanation is that the NFA letter is insufficient, because it does not offer property owners any protection against future regulatory action on the site for other matters. Another explanation might be that properties are not comparably marketable, due to decreasing income and population in the urban area. Also, the NFA letter does not bind other agencies, such as the Ohio EPA or USEPA; hence, it is perceived to have limited value, despite evidence that very few NFA cases are reopened. If the NFA letters were working, properties should be transacting as often as comparable uncontaminated sites shortly after the receipt of the NFA letter, rather than during the process of remediation at a severely reduced cost.

BUSTR has had substantial success in reducing the threat of environmental contamination from USTs, but unintended side effects in terms of job loss deserve more attention. Future research should address this issue. For example, what percentage of UST sites close down and remain shut for an extended period, and what percentage reopen as another land use? Is there a net increase in employment?

Large changes appear to be on the horizon, because over 25 states have adopted voluntary action programs to spur redevelopment and financing of previously contaminated brownfield properties, including USTs (Dimsmore, 1996). In Ohio, recently enacted brownfield legislation (Ohio Revised Code 3746) should loosen real estate markets for contaminated property by reducing potential risks to parties in financial transactions and putting interim guidelines for mitigation standards in place (D. Iannone, personal communication, 1995). Michigan, Illinois, and several other states are also moving toward a comprehensive regulatory framework to provide more certainty to potential buyers of contaminated property (Simons, 1996). These laws provide risk-based corrective action standards for redevelopment of USTs and other brownfield properties, based on permitted land use and local soil conditions, rather than requiring all properties to be cleaned to the same expensive standard. Laws also reduce uncertainty about future court action against lenders or property owners by providing a CNTS and liability exemptions if properties are cleaned to state standards through a recognized state-led process. These two states (and others) are also in the process of implementing

an arrangement with USEPA and other state environmental regulatory agencies to bind these agencies if the lead agency issues a CNTS. Given the inability of the NFA to remove stigma from affected sites (at least with respect to sales activity) in Cuyahoga County, these legislative initiatives should ease redevelopment of LUSTs and other brownfield sites.

Recommendations for Developers and Planners

This evidence is helpful to local public and private developers interested in revitalizing previously used properties with USTs, either individually or by including tank parcels in a larger land assembly. A proactive stance suggests that economic development planners obtain or develop a list of active UST sites in their jurisdiction, then quickly determine whether leaks have been reported at each potential redevelopment site. Many tanks are located along major thoroughfares and have a high profile because of large traffic counts.

If tanks are found, clay soil usually decreases the likelihood of serious contamination. Our research in Cuyahoga County indicated that about 25% of the cases had some type of groundwater contamination. In this case, gravel, sand, or high water table was associated with leaks that spread away from the initial release point, which is a more serious concern. Further, the extent of the contamination, including off-site effects, was not apparent until excavation was undertaken and further test wells were drilled. Obtaining permission to conduct off-site testing was problematic in most instances. Therefore, developers and planners should not include UST sites in economic redevelopment projects without first obtaining an environmental audit.

The municipal economic developer should be wary of having a municipal corporation take title to a UST site or substantially engage in removal of contaminated material, because there may be liability for site cleanup and trends lead away from governmental immunity under environmental laws (O'Leary, 1993). Because LUST properties are being transacted during the mitigation process, it would be preferable to find a private-sector party to acquire the property at a discount.

Developers who cannot avoid dealing with a UST site should consider removing tanks not needed for business purposes and then obtaining a CNTS. This should remove stigma and enable properties to more readily be financed through conventional private sources after tank removal. Note that, in Cuyahoga County, the NFA letter (a weak form of CNTS) was not associated with increased sales, indicating that it did not help remove stigma from contaminated property. Economic development planners should pursue the strongest CNTS available, recognizing that it may not help until real estate markets recognize its value. For those economic development properties with tanks still on-site, nonsecured financing may be the rule rather than the exception. There appears to be reluctance in the capital markets to finance contaminated sites. A risk-reducing role for the public sector may be appropriate. If environmental insurance is available, it may be worth pursuing.

NOTES

1. For example, in Cuyahoga County, Ohio, the core urban county in the Cleveland primary metropolitan statistical area (PMSA), there were under 20 Superfund sites, almost 300 TRI sites, and over 1,300 leaking tank sites known in late 1994.

2. A substantial portion of cases initiated has apparently not been vigorously pursued (as evidenced by the lack of follow-up reports in the case files). This may be attributable to budget or staff limitations, which may reflect programmatic failure in outcomes.

3. The NFA letter is very similar to a CNTS, described by Swartz (1994) concerning Michigan and other states, but it is weaker, because it refers only to the leak incident recently remediated.

4. Our unit of observation is sites, although our sampling is based on incidents. Only 16 sites (3.7%) had more than one incident, so for all intents and purposes, they are equivalent.

5. We conducted an analysis of 31 NFA sites in our sample. No groundwater contamination was evident, and any soil contamination was contained on-site.

6. This evidence is based on Pearson correlation coefficients significant at .10.

7. To address the issue of seller and buyer anticipating the NFA letter, we also considered those sales in which the NFA letter was issued within 1 year of sale. Even then, only four properties were sold (1.2%).

8. As an aside, tank regulating agencies should pursue policies that increase the proportion of proactively discovered leaks. For example, BUSTR has recently begun to seek out orphan tank sites to bring them under the regulatory system of systematic leak testing. This should minimize the time elapsed between leak and discovery and help contain contamination to the subject property.

REFERENCES

Austrian, Z., & Eichler, H. (1994). *Urban brownfields site survey: Preliminary analysis*. Cleveland, OH: Cleveland State University, Levin College of Urban Affairs.

Clark, D., & Nieves, L. (1993). *An interregional hedonic analysis of noxious facility impacts on local wages and property values*. Working paper, Marquette University, Milwaukee, WI.

Dimsmore, C. (1996). State initiatives on brownfields. *Urban Land, 55*, 37-42.

Donovan, B., & O'Connor, P. (1989). Underground storage tank update. *Plant Engineering, 43*, 60-62.

Environmental Financial Advisory Board (1995). *Information needs of capital providers in brownfields redevelopment*. Washington, DC: Author.

Flower, P., & Ragas, W. (1994). The effects of refineries on neighborhood property values. *Journal of Real Estate Research, 9*, 319-338.

Gibson, J. (1994). Lender safe harbor for underground storage tank liabilities proposed by EPA. In *Environmental insights*. Chicago: Chapman and Cutler Environmental Practice Group.

Kiel, K. (1995). Measuring the impact of the discovery and cleaning of identified hazardous waste sites on house values. *Land Economics, 71*, 428-435.

Kinnard, W., & Worzala, E. (1996, April). *Attitudes and policies of institutional investors and lenders toward on site and nearby property transactions*. Paper presented at the annual meeting of the American Real Estates Society, Lake Tahoe, CA.

Kohlhase, J. (1991). The impact of toxic waste sites on housing values. *Journal of Urban Economics, 30*, 1-26.

Kost, D., & Parish, W. (1986). Petroleum recovery operations in an urban area. *Journal of Water Resources Planning and Management, 112*, 542-549.

La Grega, M., Buckingham, P., Evans, J., & The Environmental Resources Management Group. (1994). *Hazardous waste management*. New York: McGraw-Hill.

Lederman, P., & Librizzi, W. (1996). Available technologies. *Journal of Urban Technology, 2*(2), 21-30.

Mann, M. (1992). European soil washing for United States applications. In *Proceedings of the Federal Environmental Restoration Conference and Exhibitions* (pp. 383-387). Greenbelt, MD: Hazardous Materials Control Resources Institute.

Michaels, R., & Smith, V. (1990). Market segmentation and valuing amenities with hedonic models: The case of hazardous waste sites. *Journal of Urban Economics, 28*, 223-242.

Nelson A., Genereux, J., & Genereux, M. (1992). Price effects of landfills on house values. *Land Economics, 68*, 359-365.

Nooney, K. (1994). Criminal sentencing guidelines and corporate compliance programs. In *Environmental insights*. Chicago: Chapman and Cutler Environmental Practice Group.

Ohio Department of Commerce, Division of State Fire Marshal, Bureau of Underground Storage Tank Regulations (BUSTR). (1992). *Draft underground storage tank regulations*. Columbus, OH: Bureau of Underground Storage Tank Regulations.

O'Leary, R. (1993). Five trends in government liability under environmental laws: Implications for public administration. *Public Administration Review, 53*, 542-549.

Page, G. W., & Rabinowitz, H. (1993). Groundwater contamination: Its effects on property values and cities. *Journal of the American Planning Association, 59*, 473-481.

Page, G. W., & Rabinowitz, H. (1994). Potential for redevelopment of contaminated brownfield sites. *Economic Development Quarterly, 8*, 353-363.

Pamukcu, S., Wittle, J., & Titus, C. (1992). Electrokinetics: Emerging technology for in situ soil remediation. In *Proceedings of the Federal Environmental Restoration Conference and Exhibitions* (pp. 399-407). Greenbelt, MD: Hazardous Materials Control Resources Institute.

Patchin, P. (1994). Contaminated properties and the sales comparison approach. *Appraisal Journal, 6*, 402-409.

Reichert, A., Small, M., & Mohanty, S. (1992). The impact of landfills on residential property value. *Journal of Real Estate Research, 7*, 297-314.

Simons, R. (1996). Financing of contaminated lands in Great Lakes empowerment zones. Cleveland, OH: Cleveland State University Great Lakes Environmental Finance Center, Levin College of Urban Affairs.

Simons, R., Bowen, W., & Sementelli, A. (in press). The effect of underground storage tanks on residential property values in Cuyahoga County, Ohio. *Journal of Real Estate Research*.

Swartz, R. (1994). Michigan's approach to urban redevelopment involving contaminated properties. *Economic Development Quarterly, 8*, 329-337.