Analysis of MTBE Groundwater Cleanup Costs

A report to the American Petroleum Institute

By

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June 2005

Executive Summary

In this study an analysis was conducted to assess ranges of costs that would be associated with corrective actions for MTBE in groundwater primarily as a result of gasoline releases from underground storage tanks (USTs). Those costs will be helpful in properly characterizing the outer bounds of the costs associated with MTBE releases to groundwater across the nation and informing the debate surrounding portions of current legislative discussions.

The costs analyzed are associated with three primary categories: (1) cleanup of MTBE at the UST gasoline release site, (2) treatment of MTBE in public water wells, and (3) treatment of MTBE in private or individual household water wells. Note that the source of MTBE is not always known to be a UST, so for categories 2 and 3, the frequency-of-occurrence data used in this analysis also includes MTBE from non-UST sources. This report also demonstrates the gross overestimates of MTBE cleanup costs that have been made in recent years by others.

The focus of this analysis is to estimate the ranges of cleanup costs that might be associated with MTBE remedial actions that are not paid for by responsible parties, state cleanup funds, or private insurance. To calculate these ranges, the primary factors that might influence total corrective costs for each category -- USTs, public wells and private household wells -- were analyzed. Those factors are:

(1) Total number of UST sites and wells with MTBE impacts at levels that would trigger corrective action.
(2) Costs for conducting corrective actions such as treatment of contaminated soil and groundwater at the source of the gasoline release, or filtering water at public and household wells to levels below applicable drinking-water criteria. (A conservative threshold level of 5 parts per billion – [ppb] - was used in the water treatment analysis in this study, far below the 20-40 ppb range of the 1997 U.S. Environmental Protection Agency [EPA] Office of Water advisory.)
(3) Frequency with which cleanup costs are paid for by a responsible party, insurance or state cleanup fund. This analysis provides the most useful characterization of the proportion of cleanup costs that are sometimes described in advocacy documents or news stories as “an unfunded mandate” or “orphan cleanup sites.”

The results of this analysis are summarized in the following table which represents the estimated upper-bound potential costs associated with MTBE corrective action activities for UST cleanup sites, public wells, and private household wells where cleanup costs are not likely to be paid by responsible parties, private insurance or state insurance funds, or state cleanup funds. Based on EPA statements, information from state funds, and the authors' experience, these figures reflect that responsible parties, private insurance or state insurance funds, or state cleanup funds pay for 96% -99.5% of UST cleanups, and for 75% or more of corrective action costs for private and public wells.

Table ES-1. Number of affected sites included in this analysis, and total estimated costs not expected to be paid by responsible parties, insurance, or cleanup funds.

Category (# of impacted sites)	Cost (Low Estimate)	Cost (High Estimate)
USTs (1,252)	$0.140 billion	$0.299 billion
Public Wells (289 CWS*, 780 NCWS**)	$0.206 "	$0.884 "
Private Wells (42,500 – 85,000)	$0.159 "	$0.319 "
TOTAL	**$0.505 billion**	**$1.502 billion**

*CWS = community water systems as defined by EPA
**NCWS = noncommunity water systems as defined by EPA

When drinking water supplies are affected and require corrective action, a robust regulatory framework exists for addressing UST cleanups and related water quality impacts. This framework has been developed through two decades of federal and state regulation of UST sites. It requires and provides sufficient financial resources for affected parties to receive satisfactory remedies undertaken by responsible parties, their insurers, or state cleanup funds that have been expressly designed for this purpose. Thus, only a small portion of the UST and drinking-water sites in the MTBE corrective action universe might not already have access to adequate financial resources for remediation.

Previous MTBE Corrective Action Cost Estimates

Over the last two years numerous statements have appeared in news articles or press releases addressing MTBE cleanup costs. Frequently the following claim, or one substantially similar, is made: "Experts conservatively estimate that MTBE cleanup will cost at least $29 billion." Sometimes a range of potential cleanup costs is mentioned, usually $29 billion - $92 billion. These numbers come from what is referred to herein as the "Komex study," after the consultants who conducted the work. The numbers represent a highly misleading characterization of the actual cleanup cost for the current population of UST sites at which MTBE has affected groundwater and drinking-water supplies, and an even more misleading estimate of potential costs that are not likely to be paid for by a responsible party, private insurance or state insurance fund, or a state cleanup fund.

The Komex estimate of national MTBE cleanup costs identifies three categories of MTBE cleanups: (1) UST site cleanups, (2) public water supply-well cleanups and (3) individual household water well cleanups. The Komex UST cost estimates:

- Do not acknowledge that according to EPA, almost all UST cleanup costs (over 96%) are paid for by responsible parties, private insurance and state insurance funds, and state cleanup funds

- Incorrectly include cleanup costs for all contaminants, not just MTBE
- Overstate the average cost of MTBE cleanup by more than 50%
- Do not account for already completed cleanup at current sites.

EPA and U.S. Geological Survey (USGS) data show that Komex overestimates the cost to clean up drinking water by overstating the impacts of MTBE in public groundwater wells. The USGS national random survey (Grady, 2003) indicates that in fewer than 0.2% of public wells was MTBE above 5 ppb. EPA's national data as of December 2004 for community water systems (U.S. EPA Office of Water, 2005) show 14 out of 1,859 groundwater systems (0.75%) that have detected MTBE at levels at or above 5 ppb in groundwater. Komex overstates the impact at between 1.2% and 2.2% of public wells, and again does not account for impacts that will be paid for by responsible parties, private insurance and state insurance funds, or state cleanup funds.

Komex also overestimates impacts and costs for individual household drinking-water wells. The most recent USGS data from 39 states show that about 0.25% of private wells have detected MTBE at levels at or above 5 ppb (Moran et al., 2002). Komex relies on data from two states to extrapolate to the entire United States, and overstates the impact on private wells as being 0.3% and 1.1%. Komex again ignores costs that are being paid for by responsible parties, private insurance and state insurance funds, and state cleanup funds. Komex also exaggerates the costs associated with private water well treatment. Typical costs are much more likely to be about $15,000 or less per well, compared to the $35,000 Komex estimate.

Collectively, these errors in the Komex estimates lead to a dramatic overestimate of the MTBE cleanup costs and fail to recognize that most costs would be paid for by responsible parties, private insurance and state insurance funds, or state cleanup funds. The following analysis provides an alternative approach to identifying these costs at UST sites, public wells and individual household wells.

Category 1:
<u>MTBE Corrective Action for UST Cleanup Sites</u>

This study calculates costs for the current population of UST cleanup sites (125,211 sites) identified by EPA as of March 2005. This study analyzed several extensive databases on UST corrective action costs to calculate typical low and high average cleanup costs for UST cleanups. These average costs include both site characterization costs ($32,000 - $66,000) and remediation costs ($154,000 - $221,000) for 26% of the current UST cleanup sites, and remediation costs only for the remaining 74% (because their characterization costs have already been incurred). The percentage of UST cleanup sites where MTBE is present was estimated from state-by-state surveys (NEIWPCC, 2003) and EPA to be between 52% and 75%, and it was estimated that MTBE is the constituent of primary concern for cleanup decisions at about one third of those sites. There is sufficient information on UST cleanup sites to document that almost all (96% - 99.5%) of MTBE-affected UST sites will be paid for by responsible parties, insurance, and/or state cleanup funds (Congressional Research Service, 1999; also see EPA LUST Trust Fund website: http://www.epa.gov/oust/ltffacts.htm). This analysis concludes that about 1,252 current

UST cleanup sites might fit the above criteria, and the cumulative cleanup costs associated with those sites would range from about $140 million to $299 million.

The current analysis did not attempt to identify the percentage of UST cleanup costs attributable to the presence of MTBE versus costs required for cleanup of other gasoline compounds, and did not attempt to identify the proportion of UST remediation costs already incurred for the 74% of UST cleanup sites where remedial activities have already begun. This study does not estimate cleanup costs for future UST release sites that may be identified in coming years. Recent EPA statistics indicate a strong downward trend in the identification of new UST releases (U.S. EPA Office of USTs, 2005). Also, MTBE bans are in place in states representing almost 50% of US gasoline use, which will also limit future MTBE releases. Perhaps as few as 3,000 to 5,000 new UST releases per year might be expected, and only a portion of those will have MTBE present as a constituent of primary concern.

Category 2:
<u>MTBE Corrective Action Costs for Public Drinking Water Wells</u>

This study evaluates costs for removing MTBE from drinking water produced from ground water wells when its concentration exceeds 5 parts per billion (ppb). This is a conservative threshold that is far below most states' action levels or drinking-water standards, and is also far below the EPA drinking-water advisory's "acceptable" taste and odor range of 20 - 40 ppb. A comprehensive national population of ground-water wells used for drinking water is evaluated. Both community water systems (CWSs) and noncommunity water systems (NCWSs) are included. Because treatment costs for MTBE in drinking-water systems will be highly dependent on the amount of water that must be treated, EPA statistics are used to determine the number of public water systems using groundwater and their water flow rates, and thereby, the total amount of groundwater used by those systems is also determined.

Community Water Systems:

According to EPA (U.S. EPA Office of Water, 2002) over 38,000 CWSs use groundwater, and over 30,000 of those systems are small or very small; over 20,000 systems serve fewer than 500 customers, and another 10,000 serve 500-3,300 customers. Using EPA national survey data for MTBE in drinking-water systems as of December 2004 (U.S. EPA Office of Water 2005), it is estimated that about 0.75% of ground-water CWSs (289/38,588) may have MTBE present at or above 5 ppb. Note that 239 of these systems would be small or very small systems using relatively small amounts of water, so MTBE treatment costs will be relatively low. To estimate the costs for treating MTBE in drinking water, the methods of the California MTBE Research Partnership (2000) were used. Three different flow rates were included that are representative of pumping rates for different sized communities: 60 gallons per minute (gpm), 600 gpm, and 6,000 gpm. For the 60-gpm and 600-gpm cases, it was assumed that MTBE was present at concentrations of 20 ppb, 200 ppb, or 2000 ppb. For the 6,000 gpm rate it was assumed that MTBE was at 20 ppb or 200 ppb. Costs for three different treatment technologies were calculated: air stripping (usually the least expensive option), granulated activated carbon (GAC), and advanced oxidation processes (AOP). A 10-year period of treatment was assumed.

Costs for treating any single small or very small community water system (239 wells were estimated to require MTBE treatment) over a 10-year period might be as low as about $500,000 - $1 million. Capital equipment costs may range from $55,000 to $100,000, and 10 years of operation and maintenance may range from $50,000 to $100,000/year. Costs will be much higher for larger water systems with their much higher flow rates. However, because there are far fewer large water systems using groundwater, fewer would be expected to have MTBE impacts. These larger wells also tend to dilute MTBE concentrations more, and so are less likely to have MTBE at or above 5 ppb. Besides the 239 small and very small CWSs, this analysis includes estimated costs for about 28 systems that serve 3,300 - 10,000 customers, 19 systems that serve 10,000 - 100,000 customers, and three systems that serve more than 100,000 customers. The estimated range of costs associated with MTBE treatment for this entire population of 289 large and small CWSs is between $0.4 and $2.4 billion.

There are no known published estimates of the frequency that corrective action costs for public or private household wells are paid for by the responsible party, insurance or a state cleanup fund. Based on discussions with professionals in the field, the experience of the authors, information from state cleanup funds, and published reports of such incidents, it appears that a responsible party usually can be identified, either soon after a well has been affected, or from subsequent site investigations to track down the source of the MTBE. For this analysis it is conservatively assumed that such impacts are addressed by responsible parties or cleanup funds at least 75% of the time. Therefore, the potential "orphan share" of these costs for CWSs is estimated to be about $100 to $596 million.

Noncommunity Water Systems:

This study uses an estimate of about 104,000 NCWSs using groundwater (EPA Office of Water 2002). These systems are considered "public water systems" and are included in most surveys of MTBE impacts to drinking water. These are systems that serve individual businesses, factories, restaurants, and schools. These systems almost always use a single well to pump ground water, and this study uses EPA data to estimate that over 99% of them pump at rates of less than 50 gpm. MTBE occurrence and treatment costs for these wells are evaluated identically to the CWSs. This analysis estimates that, nationally, 780 NCWSs might have MTBE at or above 5 ppb (i.e., 0.75% of 104,000). Treatment costs for each of these wells is estimated at between $0.54 and $1.47 million, for a national total cost of about $0.425 to $1.15 billion. Again assuming that responsible parties, private insurance and state insurance funds, or state cleanup funds will cover costs in about 75% of cases, an upper-bound estimate of the "orphan share" of these cleanups is likely to be between $106 and $287 million.

Total Costs for all Public Wells:

The above analysis concludes that 289 CWSs and 780 NCWSs might require treatment for MTBE contamination. Assuming that as many as 25% of those would not have MTBE treatment costs paid for by a responsible party, insurance, or state fund, the upper-bound estimate of "orphan share" MTBE treatment costs might be between $206 million and $884 million.

It should be noted that the above analysis assumes that the only remedial alternative used would be wellhead treatment of the water to remove MTBE. However, a variety of management options should be considered, including the practice of blending affected water with clean water to reach acceptable levels, drilling another well, intercepting or cutting off the contaminant plume before it reaches the well field, and other methods. All alternatives should be evaluated and the most effective approach adopted.

Category 3:
MTBE Corrective Action Costs for Private Individual Household Drinking Water Wells

National estimates for the number of private wells used to serve individual homes in the U.S. are in the range from about 15 million-17 million. The U.S. Census Bureau (1990) identified over 15 million "individual wells" in their Census of Housing (no similar data were collected in 2000). There is limited national data on private well impacts due to MTBE. The 2003 NEIWPCC survey provides some general indications of states' experience with such incidents, with most states reporting that fewer than 500 wells that are known to be affected by MTBE at any level (New York reports 866 wells). This current analysis uses data from a USGS sampling (Moran et al. 2002) of over 1,300 rural private wells throughout the U.S. (39 states) showing that about 0.25% had MTBE at >5 ppb (3 wells out of 1,335 sampled).

The treatment costs calculated here are for point-of-entry treatment (POET) systems that are installed to treat well water before it is used in the home. They are based on the purchase and installation of capital equipment (carbon adsorption filters) to remove MTBE from the water entering the home for use, and annual operation and maintenance costs for a period of 10 years. It is assumed that the source of the MTBE will be identified and remediated within that 10-year time frame. Costs associated with source remediation (e.g., at the UST release site) are included in the separate calculation and estimate of UST cleanup costs provided earlier. This analysis also uses a conservative 5-ppb threshold to trigger action to provide water treatment for a well.

Assuming that 0.25% of 17,000,000 private wells have MTBE impacts at or above 5 ppb, and a conservative upper bound of 0.5%, then as many as 42,500-85,000 wells might require treatment. Note that this estimate far exceeds that of state UST regulators in the recent NEIWPCC survey and so likely represents a significant overestimation of actual impacts. One reason for this likely overestimate is the use of the 5-ppb threshold. Most states have MTBE action levels much higher than 5 ppb (see Figure 1). In those states it is likely that the frequency that individual household wells have MTBE present above 20 ppb, or 70 ppb, will be much less than 0.25%. As a result, cumulative water treatment costs for household wells in those states would similarly be greatly reduced below the costs that might be predicted using the conservative estimate (0.25% of wells requiring corrective action) of this analysis. For example, the New Jersey drinking-water standard for MTBE is 70 ppb. A survey of private well testing (NJ DEP, 2003) indicated that only 1 of 5,179 wells tested exceeded the New Jersey maximum contaminant level (MCL) of 70 ppb MTBE (0.02%). Missouri has indicated that, since 1993, only about 30 private wells contain MTBE at detectable concentrations (http://dnr.missouri.gov/mtbe/tablwels.htm). If the USGS 0.25% estimate were used for the population of ~336,000 private wells in Missouri, it would predict 672 wells containing MTBE at concentrations above 5 ppb, or 20 times more than actually identified to date.

These values allow calculation of an upper-bound total cost for individual household well water treatment for MTBE as follows:

Low estimate of 42,500 wells at $15,000 each = $0.638 billion.
High estimate of 85,000 wells at $15,000 each = $1.275 billion

This estimate also assumes that no responsible parties are identified for any of those wells affected. This is a very conservative estimate, however, because frequently the source of contamination of private wells is a nearby gasoline storage facility, and it is not difficult to determine the responsible party. For private wells, it would seem more reasonable to assume that a responsible party could be identified in a majority of cases. Additionally, state funds are available in most states that can cover private well costs from UST impacts. Review of state cleanup fund information (ASTSWMO, 2004), and discussions with state personnel knowledgeable about those funds, suggests that almost all funds do cover "third-party" drinking-water treatment. Assuming that owners of 75% of MTBE-affected household wells can identify a responsible party for payment, or access a state cleanup fund, the remaining "orphan share" costs are estimated to range from $159 to $319 million.

Summary and Discussion

In general, the results of this analysis show that, while there may be many sites where MTBE corrective action is necessary, in the vast majority of those cases, the costs associated with MTBE cleanup are already being paid for by a variety of sources: responsible parties, private insurance and state insurance funds, and state cleanup funds. The results of this analysis are also consistent with the extensive work conducted by the USGS to characterize national MTBE impacts to groundwater. While low levels of MTBE may be detected frequently in groundwater, it is much more rare that concentrations exceeding levels of concern that would require corrective action might be encountered in drinking-water supplies. As noted by the USGS in past testimony to Congress: "In summary, the USGS has not found widespread, high-level MTBE contamination in rivers, reservoirs, and ground water that are actively used as the sources for Community Water Systems. Furthermore, we have not found such contamination in public wells and domestic wells sampled in our NAWQA Program, or in the drinking water of Community Water Systems in 10 Northeastern and Mid-Atlantic States" (USGS 2001, 2002).

It should also be understood that this analysis relies on national data for calculating costs. Clearly, because of differences and complexities associated with regional geology, regulatory environments, groundwater use, and use of reformulated gasoline (RFG) with MTBE, there is known to be considerable variability among (and sometimes within) states regarding MTBE impacts. As indicated by USGS studies, MTBE occurrence in water resources is up to 5 times more frequent in "high-use" MTBE areas (for example, where reformulated gasoline was required). Such differences may lead to substantial local deviation from the averages used in this analysis. Such variability can also be expressed on a very local scale due to hydrogeologic heterogeneity, complex release scenarios of fuels containing MTBE, and the operation of water supply wells. Any definitive calculation of cleanup costs would require extensive data collection on a state-by-state and site-by-site basis. Such analysis is beyond the scope of this study.

The estimates in this analysis are based on extrapolations that are considered to be reasonable, using publicly available data sources. It is important to note that assumptions have been made concerning the number of UST cleanup sites, the number of drinking-water systems that may need corrective action, and the cost of remediating this projected population of sites. If a more comprehensive and detailed assessment of these costs is required for other decisions related to MTBE cleanup costs, the assumptions of this study would require further substantial study. Such an expanded study would need to be refined using additional data and more specific information concerning site-by-site specific instances where remediation may be necessary. While the estimates and ranges presented here are believed to validly demonstrate the massive overestimates related to MTBE corrective action in prior studies (e.g., Komex), further evaluation and refinement of these assumptions and projections is likely to have a material impact on any actual calculations of alternative cost figures.

Finally, as shown in Figure 1, there is a broad range of state thresholds for MTBE action levels (or "acceptable levels"). This greatly complicates accurate estimation of MTBE cleanup costs on a national basis. Using 5 ppb as a threshold criterion for corrective action and/or drinking-water treatment for MTBE is very conservative and is used solely for simplification of this analysis. For example, several states use 70 ppb (New Jersey, Massachusetts, Connecticut), and only six states use MTBE concentrations below 20 ppb, the lower range of the EPA drinking water advisory (U.S. EPA Office of Water 1997). The 5-ppb action threshold is not used in this study as an indication of a standard or action level that should be employed widely. Clearly, either using the lower end of the EPA's 20 to 40-ppb range, or evaluating each state's impacts in relation to their specific MTBE action levels, would represent an equal or more reasonable approach in any comprehensive national cost assessment of MTBE groundwater impacts and would significantly reduce national cost estimates.

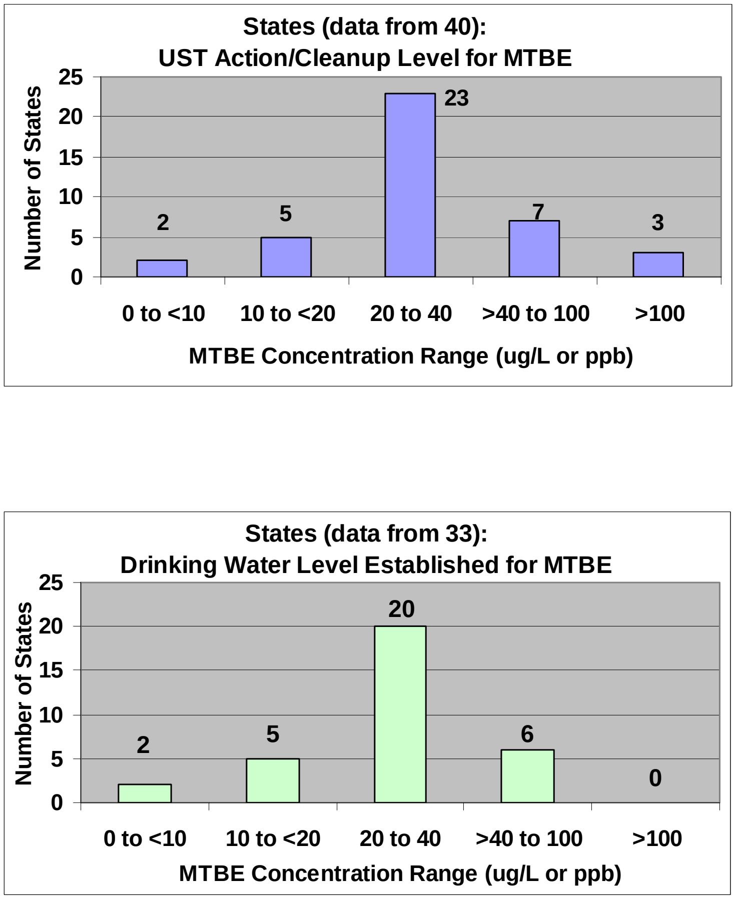

Figure 1. Range and frequency of state MTBE action levels

References

ASTSWMO. 2004. 2004 State Financial Assurance Funds Survey Results. http://www.astswmo.org/Publications/summaries.htm#2004%20State%20Financial%20Assurance%20Funds%20Survey%20Results

California MTBE Research Partnership. 2000. Treatment Technologies for Removal of MTBE from Drinking Water: Air Stripping, Advanced Oxidation Processes, Granular Activated Carbon, Synthetic Resin Sorbents, Second Edition. http://www.nwri-usa.org/asp/bookdetails.asp?prodid=38&action=prom&id=4&main=m4&sub=s4

Congressional Research Service. 1999. Leaking Underground Storage Tank Cleanup Issues Report #97-471, updated February 17, 1999 http://www.ncseonline.org/NLE/CRSreports/Waste/waste-18.cfm?&CFID=2800971&CFTOKEN=17777154

Grady, S.J. 2003. National survey of methyl *tert*-butyl ether and other volatile organic compounds in drinking-water sources: Results of the random survey: U.S. Geological Survey Water-Resources Investigations Report WRIR 02-4079, 85 p.

Moran et al. 2002. Occurrence and Status of Volatile Organic Compounds in Ground Water from Rural, Untreated, Self-Supplied Domestic Wells in the United States, 1986-1999. U.S. Geological Survey Water-Resources Investigations Report WRI Rpt 02-4085 http://sd.water.usgs.gov/nawqa/pubs/wrir/wrir02_4085.html

NEIWPCC. 2003. Survey of State Experiences with MTBE and Other Oxygenate Contamination at LUST Sites, August 2003. North Eastern Interstate Water Pollution Control Commission http://www.neiwpcc.org (click on 'USTs' on left of screen, then on 'MTBE')

New Jersey DEP. 2004. Private Well Testing Act Report: Initial Well Test Results for September 2002-March 2003. www.state.nj.us/dep/pwta

US Census Bureau. 1990. Historical Census of Housing Tables. Source of Water http://www.census.gov/hhes/www/housing/census/historic/water.html

USEPA Office of Water. 2005. Unregulated Contaminant Monitoring Data. Download database and see other background information at: http://www.epa.gov/safewater/data/ucmrgetdata.html

USEPA Office of Water. 2002. Community Water System Survey 2000 EPA 815-R-02-005A December 2002 http://www.epa.gov/safewater/cwssvr.html

USEPA Office of Water, 1997. Drinking Water Advisory: Consumer Acceptability Advice and Health Effects Analysis on Methyl Tertiary-Butyl Ether (MTBE). http://epa.gov/waterscience/criteria/drinking/mtbe.html

USEPA Office of USTs. 2005. Corrective Action Measures, 1st half of FY 2005: http://www.epa.gov/oust/cat/ca_05_12.pdf

USEPA OUST LUST Trust Fund website: http://www.epa.gov/oust/ltffacts.htm

USGS. 2001. Robert M. Hirsch, Associate Director For Water U.S. Geological Survey. Testimony To The United States House Of Representatives Committee On Energy And Commerce, Subcommittee On Oversight And Investigations. November 1, 2001 http://sd.water.usgs.gov/nawqa/vocns/USGS_MTBE_testimony.html

USGS. 2002. Timothy Miller. Chief of National Water Quality Assessment Program U.S. Geological Survey. Testimony to the House Subcommittee on Environment and Hazardous Materials. May 21, 2002 Hearing: MTBE Contamination in Groundwater: Identifying and Addressing the Problem. http://energycommerce.house.gov/107/hearings/05212002Hearing566/Miller968.htm