New England Interstate Water Pollution Control Commission
neiwpcc.org/lustline

Wannalancit Mills
650 Suffolk Street, Suite 410
Lowell, MA 01854-3694

Bulletin 81
October
2016

# L.U.S.T.LINE

A Report On Federal & State Programs To Control Leaking Underground Storage Tanks

# Is Uncontaminated Groundwater Just Another Utopian Ideal?

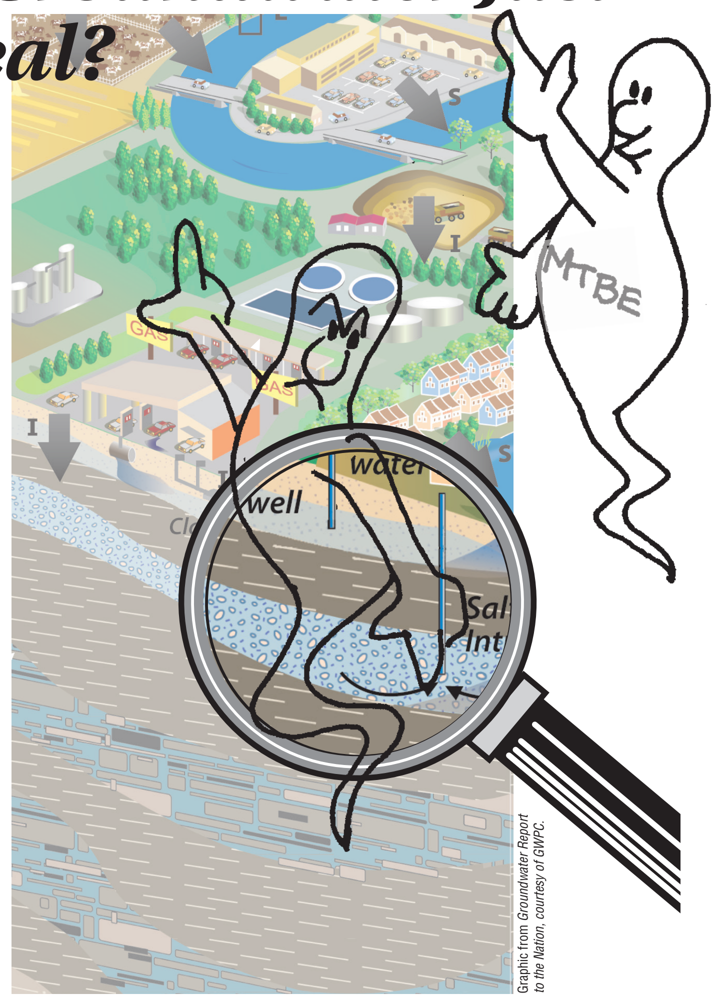
*by Gary Lynn*

*The word* utopia *was first used by Sir Thomas More in 1516. He created the word from a clever pun of the Greek words* outopos *and* eutopos *(no place and good place). Utopia has grown to mean an imaginary place in which government, laws, and social conditions are perfect. In spite of best efforts by many dedicated professionals, protection of New Hampshire's groundwater resource hasn't reached utopia, and I suspect we are not alone on that score. Last year, the U.S. Geological Survey (USGS) randomly sampled drinking water wells in our southeastern counties and detected MtBE in about 10 percent of the water supply wells. Down from about 20 percent a decade ago but still of concern to groundwater users. This year we detected perfluorooctanesulfonate (PFOS) in nearly 700 drinking water wells. Last year 1,4-dioxane was the heightened concern when it was detected in many water supply wells. Shallow depth to bedrock/water tables coupled with a very high density of shallow overburden and bedrock-fed water supplies leave many of New Hampshire's groundwater resources in a precarious situation and susceptible to contamination.*

## MtBE Highlighted Groundwater Protection Shortcomings

The detection and monitoring of MtBE in New Hampshire's groundwater supply wells highlighted shortcomings in our current groundwater protection strategies. Chemicals that are in widespread use, relatively water-soluble, resistant to biodegradation, and toxic pose a unique threat to drinking water. Widespread use of these chemicals vastly complicates release prevention efforts due to the volume of material used and transported in public commerce, the numbers of people involved, and the high number of potential release points involved in the chemical's life cycle. High solubility in water and resistance to biodegradation result in faster subsurface contaminant transport and a contaminant's long-term presence in aquifers.

■ *continued on page 2*




*Graphic from Groundwater Report to the Nation, courtesy of GWPC.*

## Inside

■ **Uncontaminated Groundwater?**
*from page 1*

MtBE is in this class of compounds and its frequency of detection highlighted gaps in our current groundwater protection strategy. Even though MtBE was removed from the gasoline supply a decade ago in New Hampshire, the Department of Environmental Services (NHDES) has detected MtBE in over 500 additional water supply wells in the last two years and MtBE contamination is still found in every corner of the state.

PFOSs pose a similar threat. These compounds are widespread because of their use in firefighting foams and manufacturing. By virtue of their strong carbon/fluorine bonds they are very difficult to biodegrade. Similar to our experience with MtBE, we are now finding PFOS compounds in a large number of drinking water wells (approximately 700 water supply wells and counting).

**L.U.S.T.Line**

Ellen Frye, *Editor*
Ricki Pappo, *Layout*
Marcel Moreau, *Technical Adviser*
Ronald Poltak, *NEIWPCC Executive Director*
Tom Groves, *NEIWPCC Project Officer*
Erin Knighton, *USEPA Project Officer*

*LUSTLine* is a product of the New England Interstate Water Pollution Control Commission (NEIWPCC). It is produced through cooperative agreements (US-83555901 and US-83556001) between NEIWPCC and the U.S. Environmental Protection Agency.

*LUSTLine* is issued as a communication service for the Subtitle I RCRA Hazardous & Solid Waste Amendments rule promulgation process.

*LUSTLine* is produced to promote information exchange on UST/LUST issues. The opinions and information stated herein are those of the authors and do not necessarily reflect the opinions of NEIWPCC.



NEIWPCC was established by an Act of Congress in 1947 and remains the oldest agency in the Northeast United States concerned with coordination of the multimedia environmental activities of the states of Connecticut, Maine, Massachusetts, New Hampshire, New York, Rhode Island, and Vermont.

NEIWPCC
Wannalancit Mills
650 Suffolk Street, Suite 410
Lowell, MA 01854
Telephone: (978) 323-7929
Fax: (978) 323-7919
*lustline@neiwpcc.org*

***LUSTLine* is printed on recycled paper.**

The regulatory weaknesses that the use of MtBE in gasoline exposed include:

- Release prevention is nearly impossible for chemicals that are in widespread use due to the magnitude of the necessary outreach, lack of release prevention knowledge, and the ethos of casual users of petroleum products.
- Little funding is available for release prevention and educational outreach efforts.
- Limited funding is available for the extension of public drinking water supplies into areas of greatest risk of contaminated private water wells (more densely developed areas with a mix of commercial businesses).
- Unregulated private drinking water wells are rarely tested, and when tested VOC testing is seldom included.
- There is no ongoing surveillance for new threats to groundwater.
- Attention is usually brought to bear after problems are discovered and impacts are relatively widespread.
- Narrowly targeted funding sources do not promote close coordination between remedial and drinking water-focused programs.

## MtBE Settlement Funds Provide Program Improvement Opportunities

New Hampshire was provided an opportunity to address the gaps in our groundwater protection safety net when funding was received from MtBE litigation settlements. The funding was restricted to MtBE contamination assessment, mitigation, and cleanup-related projects. The availability of the funding addressed a number of issues. For example, there were a number of MtBE-contaminated private wells near existing drinking water distribution systems. Developing and executing water line extension projects to these MtBE impacted areas has established a close working relationship between remedial and drinking water programs improving a key area in the existing regulatory scheme.

The water line extension initiative uses geographic information systems to evaluate the proximity of MtBE-contaminated drinking water supplies with existing community water system infrastructure. In about a dozen cases already, this approach has identified synergies between cleanup risk reduction efforts via water line extensions and existing water system needs. Examples of synergies that were identified include:

- Water line extensions that expanded small systems user bases and revenue streams;
- A water line extension that would close the gap between the water distribution network and a planned future storage tank location while interconnecting an isolated town-owned water system to the core system;
- A water line extension that would remove two distribution system dead ends;
- An opportunity to convert a fire suppression system to a potable water system to serve an area with MtBE-contaminated water supplies.

Working on a daily basis with the drinking water program makes it possible to find these synergies and leverage funding opportunities. In fact, several jointly funded state/municipal projects are currently underway that address both contaminated site and municipal water system needs.

As previously stated, gasoline release prevention was an area that needed more focus and funding. On the prevention side, New Hampshire has used settlement funds to work closely with our motor vehicle recycling facilities and their trade association on gasoline spill prevention. The program includes assistance with the purchase of spill prevention equipment (77 facilities) and concrete pads (30 facilities) for their gasoline transfer and storage areas.

One of the salvage yards was so happy with their new equipment that they created an unsolicited video. My favorite quote from the video: "Isn't a single drop or mess anywhere. System is pretty slick. Anyone that has a salvage yard should have one of these bad boys."

With low scrap prices, salvage yards are unlikely to invest in improved spill prevention equipment without assistance. This program is building good working relationships while eliminating gasoline releases. Prevention efforts also included the removal of 195 temporarily closed or obsolete underground gasoline storage tanks, some in wellhead protection areas.

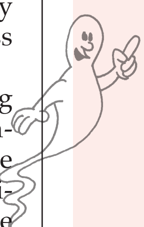
New programs also include a large scale, voluntary drinking water well sampling initiative. This initiative has already sampled approximately 3,500 drinking water wells in high-risk settings for volatile organic contaminants. The program uses the state's geographic information system to manage data, identify high-risk settings, and produce mass mailings offering sampling services.

This high-volume drinking water sampling program has identified situations where inadequate vertical characterization of contaminated groundwater resulted in the failure to detect contaminated drinking water supplies. The additional data has documented large low-level MtBE contamination halos around gasoline release sites. The program also has proven to be invaluable when combined with the program for water line extensions by mapping out MtBE-impacted areas for planned water line extensions. A major side benefit of this program is the dramatic increase in overall awareness of the need for water quality testing of private wells.

## Paradise Found?

Although a good start, these efforts are solely limited to MtBE issues and are intended to be short term in nature and focus. So what would the ideal system of groundwater protection consist of? Logically, current and future groundwater sources of drinking water need to be identified and protected. Releases from potential sources of contamination need to be prevented or drastically reduced. Surveillance of potential emerging threats should be in place so that future problems are addressed prior to widespread impacts. Impacted resources need to be restored or if restoration is not possible alternate water needs to be supplied. Most difficult of all, these efforts need to be seamlessly integrated and adequately funded to ensure the best possible outcomes.

Philosopher Michael Novak once said, "To know oneself is to disbelieve utopia." The difficulties involved in long-term integration of drinking water, remedial, and spill prevention programs are substantial and the problems related to land-use decisions divorced from drinking water aquifer protection considerations can be overwhelming. States are perfect laboratories for ideas and solutions. However, strong programs have evolved over time addressing release prevention, aquifer restoration, and safe drinking water. In this



***Sources of drinking water need to be identified and protected. Releases from potential sources of contamination need to be prevented or drastically reduced.***

longstanding tradition of state experimentation and problem solving, New Hampshire enacted a bill this legislative session (SB380) creating a groundwater and drinking water trust fund. In brief, the legislation provides the following:

- Uses the funds obtained from the MtBE trial (not the settlements) to establish a trust fund for drinking water and groundwater;
- Calls for protection against future contamination or impacted drinking water sources through drinking water source protection;
- Provides funding to assist with the development and implementation of local and regional wellhead protection programs;
- Requires mapping of classes of groundwater and groundwater contamination;
- Provides funding to "investigate, manage, and remediate contaminated groundwater";
- Provides funding to municipalities through cost-sharing grants for the design, construction, and expansion of public water systems and the expansion of wellhead protection programs.

This ambitious new statute has some groundbreaking elements including:

- integration of funding for investigation, cleanup, drinking water source area protection, drinking water infrastructure, and contamination mapping and surveillance,
- a program advisory commission tasked with statewide prioritization of drinking water and groundwater restoration needs,
- a mechanism to link additional funding to the highest priority needs, and
- funding and statutory language that cuts across arbitrary program boundaries enhancing the integration of drinking water and remedial program efforts.

There will undoubtedly be complications associated with the implementation of this new statute, but the existing programs created using the settlement funds with their intensive collaboration between drinking water and remedial programs are a good start. It is not clear how close we will eventually get to the ideal but it is our hope to create a system much better than the current one.

Canadian politician Jack Carroll probably has the best advice: "Perhaps the greatest utopia would be if we all could realize that no utopia is possible; no place to run, no place to hide; just take care of the business here and now."

With this new integrated statute and more robust funding, we hope to take care of our groundwater and drinking water protection needs now. Delays will only make it more difficult to preserve our irreplaceable groundwater resource. ■

*Gary Lynn is the Administrator of the MtBE Remediation Bureau of the New Hampshire Department of Environmental Services. Before he moved to this position he was with the NHDES UST/LUST program and authored the LUSTLine column "Cleanup Corner." He can be reached at Gary.Lynn@des.nh.gov.*

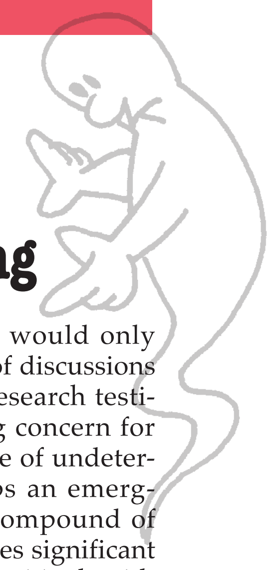
# Wander LUST

*a walkabout with Jeff Kuhn...*

**Jeff Kuhn is with the Montana Department of Environmental Quality (MDEQ) and a venerable veteran of petroleum remediation at the state and national levels. Through this column he takes us on "walkabouts" across the fascinating world of underground storage tanks. Jeff welcomes your comments and suggestions and can be reached at jkuhn@mt.gov.**

# Emerging Contaminants and Shallow Groundwater

## Recognizing and Responding to the Next New Thing



The term "emerging contaminant" was new to many Underground Storage Tank (UST) regulators when methyl-tertiary butyl ether (MtBE), a compound of concern to drinking water supplies, hit the nation's radar in the early to mid-1990s. As fuel compositional changes are considered in the future, including other alcohols or additives, we need to consider the life cycle impacts of these changes, including the potential impacts to groundwater. This is especially important given the increasing reliance on groundwater for drinking water supplies.

As an example, today, many UST regulators who address petroleum releases at larger facilities, such as military bases, railroad sites, and refineries, have become painfully aware of the perfluorinated compounds, two of which are perfluorooctanesulfonate (PFOS), the key ingredient in 3M's product *Scotchgard*, and perfluorooctanoic acid (PFOA), used in the manufacture of such prominent consumer goods as polytetrafluoroethylene (commercially known as Teflon).

In May 2009, the Stockholm Convention on Persistent Organic Pollutants added PFOS to the list of persistent organic pollutants (POPs).[1] Like our experience with MtBE, this is the latest group of emerging contaminants being detected in shallow drinking water supplies around the country. In the words of Yogi Berra, "It's like déjà vu all over again."

### What Makes a Contaminant an Emerging Contaminant?

I scoured my library and online resources for authors who sought to define this in the past. After all, the concept is not new, though the contaminant may be. USEPA defines it this way: "An emerging contaminant (EC) is a chemical or material characterized by a perceived, potential, or real threat to human health or the environment or by a lack of published health standards. A contaminant also may be 'emerging' because of the discovery of a new source or a new pathway to humans."[2]

In looking through old MtBE articles I found this from the *Washington Post:* "I don't think any of us concluded it is a major public health threat right now," said Daniel Greenbaum, Chair of the USEPA Blue Ribbon Panel on MtBE.[3]

I personally sat through a few of the Blue Ribbon Panel's meetings in Washington, D.C. and would only note that the intensity of discussions and the high level of research testimony expressed strong concern for public health in the face of undetermined risk. So perhaps an emerging contaminant is a compound of unknown risk that causes significant concern for potential public health impacts.

Samuel Luoma published a well-thought-out piece on emerging contaminants stating, "Uncertainties about the ecological implications of contamination are an important detriment to effective environmental management."[4]

I think Luoma's statement captures the essence of emerging contaminants. Without downplaying the importance of ecological implications, public health concerns will surely continue to be the driver for any new emerging contaminant. These contaminants fundamentally represent compounds of limited or unknown toxicology that are suddenly detected in monitoring well networks due to the advent of new or better analytical testing methodologies or simply the interest of regulators who choose to test for them.

## Locating Those Wells

As we improve our understanding of the potential for transport of contaminants to groundwater, either through the vadose zone or surface water/groundwater interaction, the importance of shallow groundwater contamination is more evident. An initial step in defining this vulnerability is the geolocation of shallow groundwater wells to protect this resource. The Office of Research and Development (ORD) in USEPA has undertaken research to develop a national approach to locating these wells. Given the prevalence of gas stations throughout our country and their proximity to water resources, this work will help to identify these potential vulnerabilities.

Locating these wells along with the uncertainties associated with these new compounds often represents a huge challenge to environmental management. Assessment efforts are currently underway in Vermont and the northeast region (e.g., New Hampshire, New Jersey, and New York) in response to concern over perfluorinated compounds detected in both shallow and bedrock drinking water supplies.

The Vermont DEC maintains a detailed PFOA contamination response webpage that summarizes sampling results and provides other information to the public.[5] Although the contaminants are different it's important to recognize that this is the same fractured bedrock geology that fostered the presence of MtBE in New England states in the mid-1990s. What new contaminants will be detected in the future in similar vulnerable geologic settings?

Whether we recognize it or not, it's important to note that we actually have a vast, collective experience with emerging compounds: organochlorine pesticides, poly-chlorinated biphenols "PCBs," perchlorate, complexed metals such as tributyltin, selenium, and methyl mercury, and the solvent 1-4 dioxane (a solvent commonly found in landfill leachate) all represent persistent pollutants that were new to the scene and captured national concern in one way or another.[6,7,8]

The national UST/LUST program made a huge contribution to understanding emerging contaminants through its experience with MtBE and later with the lead scavengers (ethyl dibromide, and 1,2-DCA), an experience that continues today through the efforts of state programs.

## The Onus Is on the Regulators

No doubt, state and federal regulatory programs will continue to drive the need to understand new compounds as they are detected in drinking water supplies throughout the United States. It is to those regulators charged with remediating both petroleum compounds and non-petroleum compounds that I address many of these comments.

I like the analogy that some trails become very familiar the more they are used. Those that use them recognize key landmarks and waystations that represent critical indicators of the trail they are on. The life cycle of addressing an emerging contaminant, especially those important to our fuel supply, is really no different. Although it seems that regulators in state agencies eventually do the heavy lifting, it is often the solo work of a lone scientist or regulator that paves the way for the larger efforts that come later.

Recognizing this pattern is a good thing—it means we are on the trail, and that we see familiar landmarks. This recognition allows public officials to listen more carefully to the informed scientific community conducting the health and toxicological research that places an emerging contaminant in the correct perspective. The difficulty in sorting out all of the signals comes in understanding when the sky is not falling, and when it really could. In each case, states must work closely with USEPA and the scientific community to help sort out potential new contaminants as they "emerge."

Perhaps it's time to take a broader approach and consider national drinking water vulnerability studies similar to work implemented by USEPA ORD.[9,10] Other organizations, such as the USGS Toxic Substances Hydrology Program and the USEPA Office of Ground Water and Drinking Water (OGWDW), could contribute to this effort with support from academic researchers to predict where and how to look for the emergence of new contaminants of concern.

In fact, vulnerability analyses are not new tools. They are currently being used in a variety of ways, including predicting water stress on public water supplies under changing climate conditions.[11] A national contaminant vulnerability system could interface well with state agencies that have already created sophisticated GIS map layers to plot underground storage tanks and other contaminant sources as part of source water protection efforts.

California's "GEOTRACKER" database is a good example of a data management system used for making informed decisions involving known contaminant sources. A similar national contaminant vulnerability system might help specific states anticipate if they will be the guinea pigs for the next new thing to be concerned about. It would be interesting to see if California and the New England states, those most affected by recent emerging contaminants, continue to represent the first detections of future emerging contaminants.

## It's Always Something

Despite our past experience with emerging contaminants in the form of fuel additives, such as MtBE and lead scavengers, we could find ourselves again on "terra incognita" with biodiesel and other new biofuels. It's important that we continue working with researchers and industry representatives to assess the lifecycle and potential impacts of new fuel formulations as they come online. It seems appropriate to end where an early discussion on emerging contaminants began: "If we are going to live so intimately with these chemicals—eating and drinking them, taking them into the very marrow of our bones—we had better know something about their nature and their power."[12] ■

### Endnotes


1. *https://en.wikipedia.org/wiki/Stockholm_Convention_on_Persistent_Organic_Pollutants.*
2. *https://www.epa.gov/fedfac/emerging-contaminants-and-federal-facility-contaminants-concern.*
3. Daniel Greenbaum, Blue Ribbon Panel on MTBE, in "Gas Additive Needs Less Use Panel Says," *Washington Post*, July 27, 1999.
4. Samuel, Luoma,. "Emerging Contaminant Issues from an Ecological Perspective," U.S. Geological Survey Toxic Substances Hydrology Program–Proceedings of the Technical Meeting, Charleston, S.C., March 8-12, 1999, pp. 3-8.z


■ *continued on page 22*

**A Message from Carolyn Hoskinson**

*Director, USEPA's Office of Underground Storage Tanks*

# Corrosion in Underground Tanks Storing Diesel Fuel

*There are many things about USEPA's underground storage tank (UST) program that I am proud of; one in particular is our partnerships with states, territories, tribes, industry, and other tank stakeholders. Our July 2016 corrosion in underground tanks storing diesel report and notice for owners is a good example of working with our partners to research corrosion in diesel tanks and get the word out to owners about our research results.*

*Below I share with you information about our notice to UST owners regarding corrosion in USTs storing diesel, provide a short background about corrosion in USTs storing diesel fuel, discuss what our research showed, and talk about next steps.*

## Notice to UST Owners: Check for Corrosion Inside UST Systems

USEPA's main message about our corrosion research is for UST owners. We recommend owners of UST systems storing diesel fuel check inside their tanks for corrosion. Our research suggests that corrosion is now appearing on metal components and equipment inside most tank systems storing diesel fuel. This corrosion can affect tank systems with both steel and fiberglass tanks.

Our research showed that 83 percent—that is, 35 of 42—of the USTs we studied exhibited moderate or severe corrosion. Corrosion inside UST systems can cause equipment failure by preventing proper operation of release detection and prevention equipment. If left unchecked, corrosion could cause UST system failures and releases, which could lead to groundwater contamination.

USEPA does not have documented evidence of UST or equipment failures due to internal corrosion. But we've heard anecdotes from regulators and industry that suggest that functionality failures of equipment and tanks do occur and are likely due to corrosion.

We cannot project the actual percentage of USTs storing diesel that are affected by corrosion nationwide. Nonetheless, in July 2016, through our state and industry partners, we alerted owners of USTs storing diesel fuel about risks from corrosion.

The bottom line is we recommend that owners check inside their tank systems and further investigate the condition of their diesel fuel tanks. If owners are aware of corrosion risks and take early action, they could protect themselves from higher repair costs and help protect the environment from contamination. We recommend owners refer to industry documents that suggest currently available practices, technologies, or treatments to minimize the risk of release of diesel fuel from tanks. (See text box for links to industry maintenance documents.)

### Examples of Industry Tank Maintenance Documents

- **Coordinating Research Council** *Preventive Maintenance Guide for Diesel Storage* and *Dispensing Systems* and *Diesel Fuel Storage and Handling Guide*
- **Clean Diesel Fuel Alliance** *Guidance for Underground Storage Tank Management at ULSD Dispensing Facilities*
- **Steel Tank Institute** *Recommended Practice for Storage Tank Maintenance R111 Revision*
- **ASTM D6469** (available for purchase) *Standard Guide for Microbial Contamination in Fuels and Fuel Systems*

## Background on Corrosion in USTs Storing Diesel Fuel

Prior to 2007, a corrosion risk in diesel fuel tanks was considered minor and if it occurred, appeared in the wetted or lower portion of the tank. But beginning around 2007, UST owners and servicing companies began reporting new incidents of severe and rapid corrosion of internal metal components in the vapor-space regions of underground tanks storing diesel fuel. We were told that these reports usually described severe corrosion of equipment in the upper portions of UST systems in the regions generally not submerged in fuel. Since 2007 and in an attempt to find solutions, industry and USEPA have worked to learn more about the corrosion. During this time, anecdotal reports to industry partners and USEPA regarding corrosion and its impacts in USTs have increased; those anecdotes sometimes described UST equipment failing to function correctly.

In 2009, the Clean Diesel Fuel Alliance (CDFA), an organization represented by many industry members and with whom USEPA collaborated early in the corrosion investigations, began exploring how to study this corrosion. CDFA undertook a field study in 2011. Their effort resulted in a 2012 paper, *Corrosion in Systems Storing and Dispensing Ultra Low Sulfur Diesel (ULSD), Hypotheses Investigation*, which discusses possible areas of further research.

## A Message from Carolyn Hoskinson...continued

USEPA was not involved in CDFA's study, but we worked collaboratively with industry and other agencies to develop our research beginning the next year. We completed fieldwork in 2015 and issued our peer-reviewed report on corrosion in USTs in July 2016.

### USEPA's Research—What We Did (and Didn't) Find

In our research, we examined 42 operational UST systems storing diesel fuel across the country and found a significant prevalence of corrosion of metal components inside those systems. The tank systems included both steel and fiberglass tanks, 18 and 24, respectively. In addition, our research population of 42 USTs was geographically, materially, and operationally diverse; it was the largest field research on internal corrosion in diesel USTs to date.

Our results showed that 35 of 42 of the examined diesel-fuel tank systems exhibited moderate or severe corrosion. However, less than 25 percent of owners of USTs involved in our research reported corrosion prior to internal inspections during our research.

During our research, we heard anecdotes from companies and implementing agencies about increased tank repairs over the last several years to fix corrosion holes in the bottoms of USTs storing diesel. This information is anecdotal, but warrants further attention.

While previous studies, as well as our research, have not definitively confirmed the cause of the corrosion, it appears that microbiologically influenced corrosion (or MIC) could be largely responsible. Many processes are occurring at the microscopic level in USTs. And while there is no widely accepted solution to this corrosion problem, several industry maintenance documents listed in the text box suggest that taking action to address MIC is very effective in slowing and limiting the negative impacts of corrosion in USTs storing diesel fuel.

Our research helped us identify these key takeaways:

- Corrosion of metal components in UST systems storing diesel appears to be common.
- Many owners are likely not aware of corrosion in their diesel UST systems.
- The corrosion is geographically widespread, affects UST systems with steel tanks and with fiberglass tanks, and poses a risk to most internal metal components.
- Ethanol was present in 90 percent of 42 samples, suggesting that cross-contamination of diesel fuel with ethanol is likely the norm, not the exception.
- The quality of diesel fuel stored in USTs was mixed.
- Particulates and water content in the fuel were closest to being statistically significant predictive factors for metal corrosion, but causation cannot be discerned.
- Microbiologically influenced corrosion could be involved as hypothesized by previous research.
- We recommend that, as part of routine monitoring, owners visually inspect USTs storing diesel.

We estimate there are at least 100,000 federally regulated USTs storing diesel fuel in the United States. However, the number of potentially affected tanks is significantly higher when we include similar-sized aboveground storage tanks and small, unregulated USTs, such as farm tanks and home heating oil tanks. Despite the potential universe in the United States, we do not think there is an epidemic of releases and we cannot project the actual percentage of USTs storing diesel fuel that are affected by corrosion nationwide.

Research to date by USEPA and others has not pinpointed a cause of corrosion in diesel UST systems. Although corrosion reports began around the same time as sulfur was reduced in diesel fuel, this was one of several changes to fuel production, distribution, and storage that occurred nearly concurrently in the mid-2000s. Any one factor or a combination of factors could contribute to corrosion.

Even though we don't know the exact cause of the corrosion, our research helped us gain a better understanding of the extent of corrosion and possibilities of releases associated with severe corrosion. And there are actions tank owners can take now to minimize the corrosion and the associated risks while we, in partnership with states, industry, and others, continue looking for a solution.

### Next Steps

All of us who are in partnership to promote good UST management can take actions, even while we seek more answers and a solution to corrosion in underground tanks storing diesel fuel.

#### Owners

- Act early and identify potential corrosion problems; check diesel UST systems for corrosion and, if found, take steps to address it.
- Regularly check for and remove water in diesel tanks; minimizing water is critical to protecting diesel UST systems from corrosion.
- Discuss with your UST servicing company options for preventing conditions that foster corrosion.
- Ensure proper operability of UST systems.
- Check with reputable industry sources for preventative maintenance tips, as well as fuel storage, handling, and dispensing suggestions.

#### Industry

- Conduct the planned next phase of research, which builds on previous studies and research: the Coordinating Research Council is organizing the next phase; tentatively, the research is planned to be a laboratory-

■ continued on page 22

# Tank-nically Speaking

by Marcel Moreau

*Marcel Moreau is a nationally recognized petroleum storage specialist whose column,* ***Tank-nically Speaking****, is a regular feature of* LUSTLine*. As always, we welcome your comments and questions. If there are technical issues that you would like to have Marcel discuss, let him know at* **marcel.moreau@juno.com.**

# Untangling UST Corrosion Issues

In the last decade, there have been substantial changes in motor fuels in America. The Renewable Fuel Standard, established by the Energy Policy Act of 2005 and amended by the Energy Independence and Security Act of 2007, has made E-10 gasoline (a blend of 10% ethanol and 90% gasoline) almost universally present at our gas stations. Beginning in 2006, USEPA requirements designed to improve air quality reduced the sulfur content of our diesel fuel to no more than 15 ppm. These changes have not been without some consequences. E-10 gasoline has caused some issues with engines in lawnmowers and chainsaws, and small marine engines have been plagued with phase separation issues. Unusual forms of corrosion have appeared in E-10 tank-top sumps and inside diesel tanks.

As I read various documents discussing these issues I find that there is a fair amount of confusion concerning exactly which issues are associated with which fuel, what's behind the problems, and what the possible solutions might be. So I thought it might be useful to discuss these issues here in *LUSTLine*.

Just to be clear, the three issues at hand are:

- Phase separation of E-10 gasoline
- Corrosion in tank-top sumps in tanks storing ethanol-blended gasoline
- Corrosion inside storage systems storing diesel fuel.

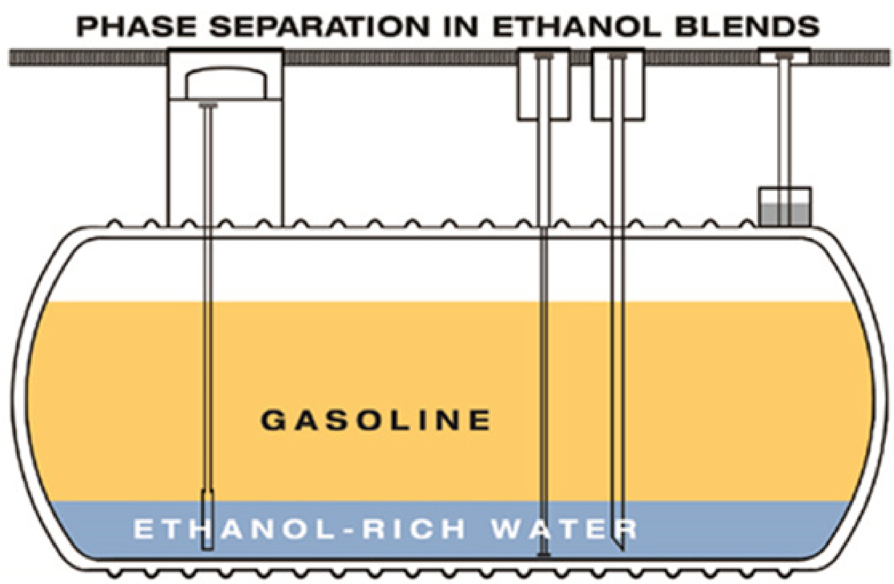
My goals in writing this article are threefold:

- To clearly distinguish the issues associated with today's motor fuels
- To explain current thinking on what is responsible for these issues
- To describe the current thinking on how to address these issues.

## Phase Separation in E-10 Gasoline

### When Does Gasoline Become E-10 Gasoline?

Because ethanol has a great affinity for water and water is commonly present at various points in our fuel distribution network, ethanol transportation systems are entirely separate from gasoline distribution systems. At most terminals and bulk plants where fuel is stored just prior to the final leg of its journey to a vehicle fueling facility, gasoline and ethanol are stored in separate bulk tanks. The ethanol and gasoline are finally blended together as the two liquids are being pumped into a tank truck for delivery to a vehicle-fueling facility. In other words, gasoline becomes E-10 gasoline as it is loaded into the truck delivering the fuel to a vehicle-fueling facility.




Graphic courtesy of Tanknology

**Figure 1.** *When the concentration of water in E-10 gasoline reaches about 0.5%, much of the ethanol mixed into the gasoline joins with the water and separates out as a separate phase that is mostly ethanol and water. For example, if 25 gallons of water were mixed into 5,000 gallons of E-10 gasoline, about 200 gallons of an ethanol/water mixture would settle to the bottom of the tank.*

### What Is Phase Separation in E-10 Gasoline?

Ethanol likes gasoline, but it loves water, making the gasoline/ethanol mixture a bit unstable. If the water content of the ethanol/gasoline mixture reaches about 0.5 percent, much of the ethanol combines with the water and separates out from the gasoline to form a liquid that consists of mostly ethanol and water plus a small amount of gasoline. This phenomenon is known as "phase separation" because what used to be a single mixture of gasoline and ethanol and a bit of water has now separated into two kinds of liquid, a mostly gasoline phase and a mostly ethanol/water phase. (See Figure 1.)

The exact ratio of ethanol/water/gasoline in the ethanol/water phase will depend on the amount of water present, the volume of gasoline, and the degree of mixing of the water and gasoline. This ethanol/water mixture is heavier than gasoline, so it will settle to the bottom of a tank. If the ethanol/water mixture is fed into an engine designed to run on gasoline, the engine quits. The remaining gasoline above this ethanol/water mixture no longer meets the specification for a motor fuel because it does not contain the required amount of ethanol. So what used to be a tank full of valuable motor fuel is now a hazardous waste (unless facilities are available at the fuel terminal to reprocess it).

### What UST Issues Are Associated with Phase Separation of E-10 Gasoline?

The ethanol content of the ethanol/water mixture will likely be quite high, so there could be some compatibility issues with this mixture and some components of the UST system. The ethanol/water mixture should be removed from the UST as soon as possible. Because phase separation poses an immediate public relations crisis for the fuel vendor, it is not likely that phase-separated ethanol will stay in a motor fuel UST for an extended period.

### Why Does Phase Separation Happen in E-10 Gasoline?

There is general agreement that phase separation only happens when a small but significant amount of water is present in E-10 gasoline. Some amount of mixing of the water and E-10 is also important to the phase-separation process. The amount of water that causes phase separation is dependent on the temperature of the fuel and the amount of alcohol blended into the gasoline.

At 60 degrees Fahrenheit, phase separation of E-10 gasoline will occur when the water content of the fuel is about 0.5 percent. If the temperature of the fuel is lowered, the amount of water that will produce phase separation is also lowered. At 10 degrees Fahrenheit, phase separation of E-10 gasoline will occur when the water content of the fuel is about 0.3 percent.[1]

The higher the percentage of alcohol in the fuel, the greater the amount of water required to produce phase separation. For E-15 gasoline (15% ethanol and 85% gasoline), phase separation occurs at a water content of about 0.75 percent when the fuel is at 60 degrees, and 0.45% when the fuel is at 10 degrees Fahrenheit.[2] Phase separation is unlikely in E-85 gasoline (85% ethanol and 15% gasoline) because the fuel consists primarily of ethanol. E-85 must reach a concentration of about 15 percent water before phase separation occurs.[3]

### What Scenarios Are Likely to Produce Phase Separation in E-10 Gasoline?

I am aware of three phase-separation scenarios that may occur in the UST world. The first scenario occurs in the following way:

1. Water enters the UST, typically through a tank-top fitting such as a spill bucket drain, loose ATG cap, broken vent line, or loose connection between a riser and the tank.
2. Some water mixes with the fuel as it settles to the bottom of the tank, raising the percentage of water in the fuel, but oftentimes not enough to produce phase separation.
3. Some water also settles through the fuel and collects on the bottom of the UST. Whether the water reaching the bottom of the UST registers on an ATG or gauge stick with water paste, depends on several factors, including:
    - the relative positions of the water entry poin t and the water measurement point
    - the degree of tank tilt
    - the presence of strike plates on the tank bottom that prevent the gauge stick or ATG probe from reaching the very bottom of the tank
    - the minimum amount of water required to cause the ATG water detection float to lift off the bottom of the tank
    - the presence of irregularities along the tank bottom (e.g., places where steel plates lap over one another) that can create separate shallow puddles of water at different locations along the tank bottom.
4. When a load of gasoline is delivered, the fuel and water on the tank bottom are mixed by the turbulence of the fuel entering the tank. If the quantity of water mixed into the fuel brings the water content of the fuel above 0.5 percent (assuming the fuel temperature is 60 degrees) phase separation will occur. If the amount of water present in the tank is not sufficient to bring the water content of the fuel above the phase-separation threshold, the water may be incorporated into the gasoline and disappear from the bottom of the tank. This is why in some cases a delivery of fuel removes a water bottom in a tank and in other cases it results in phase separation.

A second UST phase-separation scenario may occur as the tank truck is being filled. Remember that ethanol is usually blended into gasoline just before the fuel enters the truck. Ethanol and gasoline are stored in separate tanks at the terminal or bulk plant. Because the gasoline bulk tanks contain only gasoline, significant amounts of water can accumulate in the bottom of these tanks with no ill effects to the gasoline. All is well as long as the water stays in the bottom of the gasoline tank. However, when the bulk tank is receiving gasoline, perhaps via a pipeline or barge, the entering fuel may stir up water present in the bottom of the bulk tank. If fuel is being pumped to a truck

■ continued on page 10

■ **Tank-nically Speaking**
*from page 9*

loading rack while this is happening, blobs of water in the gasoline bulk tank can be drawn into the fuel outlet that leads to the truck loading rack. If the amount of water that ends up in the truck tank exceeds the phase-separation threshold, phase separation occurs in the truck before the fuel is delivered to the UST.

A third scenario may occur if water enters directly into the tank truck via the openings present along the top of the tanker. The lids covering these openings are normally liquid-tight, but under certain conditions precipitation may accumulate along the top of the tanker and infiltrate into a fuel compartment. If sufficient water is present in a tanker compartment, phase separation may occur when the compartment is filled with E-10 gasoline.

### ■ What Can Be Done to Prevent Phase Separation in E-10 Gasoline?

There are a number of UST management techniques that can help prevent the first E-10 phase-separation scenario described above:

- First and foremost, keep water out of USTs. Plug drains in spill buckets; keep an eye on all tank-top caps (i.e., fill, vapor recovery, ATG) to be sure they are in good condition. Conduct ullage tightness tests to identify any significant tank-top or vent-line leaks.
- Check for water in the tank frequently, especially after significant rain events. Check in as many places along the tank as feasible. For most tanks this will mean keeping an eye on the ATG to see if any water is present as well as using a stick and water paste at the fill opening. Keep in mind that the ATG will not register the presence of water until the water is about a half inch deep because the water must be deep enough to "float" the water float. Pump out any detectable amount of water immediately.
- Use water-blocking filters in dispensers to protect customers and provide notification that phase separation has occurred. These filters contain the same type of material found in disposable diapers. When water enters the filter, the material swells and plugs the filter, stopping the flow of fuel to the nozzle. Although interrupting fuel flow sounds like a bad thing, it is preferable to having a line of stalled cars just down the road from the facility.
- Install a special phase-separation float on the ATG probe that will sound an alarm and shut down the pump once phase separation is detected. While this device does not prevent phase separation, it does provide a fairly immediate notice that it has occurred.
- Install a special-density float on the ATG probe. While the phase-separation float only tells you that phase separation has occurred, a density float monitors the density of the fuel near the bottom of the tank so you know when the water content of the fuel itself is getting close to the point where phase separation will occur.

If the second phase-separation scenario described above is suspected, the situation must be addressed by the fuel supplier. Discuss with the fuel supplier how water is managed in the fuel supplier's bulk tanks and whether tank trucks are loaded at the same time fuel is being received into the bulk tank. If the fuel supplier insists that loading of trucks must occur at the same time as fuel is received into a bulk tank, then the fuel supplier should implement a very rigorous water management plan.

If the third phase-separation scenario described above is suspected, the situation must be addressed by the owner of the tank vehicle. The tanker should be maintained properly so that precipitation does not accumulate along the top of the tanker and the fuel compartment lids seal tightly.

## Corrosion in Tank-Top Sumps in Tanks Storing Ethanol-Blended Gasoline

### ■ What Is Happening in E-10 Tank-Top Sumps?

The below-grade environment in most parts of the country is moist enough to support corrosion of below-grade metallic UST components such as STP manifolds, steel pipefittings, and electrical conduit, so corrosion of these tank-top components is nothing new.

However, corrosion in some tank-top sumps of tanks containing ethanol-blended gasoline appears as a thick layer of flaky corrosion that coats nearly every metallic surface. In addition, copper components such as mechanical line-leak-detector vent lines turn a turquoise color. These are types of corrosion not previously seen with gasoline that did not contain ethanol. While the corrosion seems extraordinarily aggressive, there is little evidence that I am aware of that this corrosion leads to leaks or equipment failure, though this could change as time goes on. The corrosion is a nuisance to tank workers who need to adjust or replace any components in the sump.

### ■ Why Is This Type of Corrosion Happening in E-10 Tank-Top Sumps?

The prevailing theory to explain this corrosion is that in sumps where this type of corrosion occurs, vapor leaks or very small liquid leaks are present. The vapor leaks contain a significant percentage of ethanol. The small liquid leaks evaporate, also producing ethanol vapors. Because ethanol loves water, these ethanol vapors combine with water droplets that are normally present on the metallic components.

The ethanol/water mixture is an ideal environment for commonly occurring microbes in the acetobacter family. These are the microbes that turn wine into vinegar. Vinegar, as you may remember from high school chemistry class, contains acetic acid. Acids have a low pH, and liquids with a low pH are generally corrosive to metals.

The giveaway that this is what is happening is the color of the corrosion products on the copper components (e.g., mechanical line-leak-detector vent tubes). The turquoise color is characteristic of copper acetate, a result of the acetic acid reacting with the copper. (See Figure 2.)

Photo courtesy of The Iron Ox

**Figure 2.** *The combination of ethanol, water, and acetobacter produces a very rough looking corrosion product on steel components of tank-top sumps, and a turquoise colored corrosion product on copper components.*

### What Can Be Done About Corrosion in E-10 Sumps?

If the corrosion results from small product or vapor leaks into the sump, the obvious response is to stop the leaks, but this does not seem to be a popular response. Finding and fixing these leaks would require helium testing or other sensitive leak detection methods. Depending on where leaks are found, fixing the leaks could be a substantial undertaking. Still, if I were a tank owner paying for a new installation, I'd be insisting on a passing tank-top helium test before I made the final payment to the installation contractor.

Some submersible pump manufacturers are marketing corrosion-resistant pumps that use a combination of durable coatings on cast iron parts and stainless steel components to produce submersible pumps that should be very resistant to corrosion. This can address the corrosion problem for the STP, but it does not address corrosion of other components in the sump.

Some vendors are marketing products designed to remedy existing corrosion and prevent future E-10 sump corrosion by scraping off the existing corrosion and applying a preventive coating. A secondary step is to introduce a corrosion inhibitor into the sump that volatilizes slowly over a period of months. The treatment will likely need to be periodically repeated at a frequency of months or years.

Another approach has been to install subsurface vent piping that connects to the sump and leads aboveground to ventilate the sumps with fresh air so the ethanol vapors are removed from the subsurface environment.

### What Isn't Happening With Ethanol-Blended Gasoline?

Severe corrosion in some tank-top sumps in tanks containing ethanol-blended gasoline makes it seem logical that this corrosion is also happening inside the tank, but the general industry consensus to date is that this is not happening. I believe there are two reasons for this.

1. Historically, the most damaging corrosion inside of USTs has been associated with microbial activity. Microbes require water to survive, and small puddles of water in the bottom of gasoline and diesel USTs used to provide nearly ideal habitats for microbial colonies. With ethanol-blended gasoline, small quantities of water are now absorbed into the gasoline by the alcohol, so puddles of water no longer occur in the bottom of these USTs, and microbial activity is stymied.
2. Water droplets may also condense on tank walls in the ullage space above the ethanol-blended gasoline. These could become severe corrosion sites if they were hospitable to microbes. But because of the plentiful supply of ethanol vapors inside the tank, the concentration of ethanol in these water droplets is going to be substantially higher than the 10 percent that is the maximum concentration that many bacteria can tolerate.[4] In other words, the concentration of ethanol in water droplets that form on the tank walls in the ullage space is too high to support significant microbial growth. The situation is different in tank-top sumps because the volume of ethanol released from the UST into the sump is relatively small. As a result, the concentration of ethanol in the water droplets in the sump does not rise to a level where it would be toxic to microbes.

## Corrosion Inside Storage Systems Storing Diesel Fuel

### What Is Happening Inside Diesel Tanks?

Reports of unusual corrosion occurring inside the storage systems storing diesel fuel began occurring soon after the widespread introduction of Ultra Low Sulfur Diesel (ULSD) in 2006.[5] The corrosion often appears as "coffee ground" type particulates found inside the ullage spaces, below the product level, and in the piping systems. (See Figures 3 and 4.) The corrosion and/or particulates lead to failures of submersible pumps, check valves, overfill prevention valves, mechanical leak detectors, and shear valves. Component failure can be

■ continued on page 12

■ **Tank-nically Speaking**
*from page 11*

due to the corrosion itself or to the particulates produced by corrosion processes interfering with the movement of various moving parts.

A recently published USEPA study of corrosion in diesel fuel tanks concludes that this type of corrosion is likely widespread, despite finding that prior to conducting the study, the owners of less than a quarter of the USTs in the research believed that corrosion was occurring in their diesel tanks.[6] The corrosion observed in the study was present in many different types of USTs and was geographically widespread as well.[7] The Steel Tank Institute reports that this corrosion has not been observed in refineries, terminals, or pipelines, so this phenomenon appears to be restricted to diesel fuel tanks at motor-vehicle-fueling facilities.[8]

## ■ Internal Corrosion in Storage Tanks Is Nothing New

The first paper I am aware of that described internal corrosion in petroleum USTs was written in 1970.[9] Because internal corrosion is inside the tank, it is much more difficult to observe than external corrosion and so has often been overlooked. But if you go looking for it, you will find it.

A study of the causes of tank failure by Warren Rogers in the 1980s found that 29 percent of unprotected steel tanks that had perforations had holes due to internal corrosion.[10]

A USEPA-funded study published in 1988 carefully inspected 500 tanks being removed on Long Island.[11] The study found that while 6 percent of tanks had failed due to internal corrosion alone, an additional 15 percent had perforations due to both internal and external corrosion.[12] The author of the study, Jim Pim, hypothesized that once external corrosion was brought under control, internal corrosion would become a very important consideration.[13]

The nearly universal presence of E-10 gasoline has removed the free water necessary for microbes to thrive in our gasoline tanks (see above), but free water can still be present in the bottoms of our diesel tanks. Microbes have always been an issue and will likely continue to be a problem in our diesel-fuel tank bottoms.[14] The recent USEPA study noted that there have been several anecdotal reports of pinhole corrosion in diesel tank bottoms. My own suspicion is that such failures may not be entirely attributable to diesel-fuel contaminants such as ethanol and glycerol (see below), but to longstanding microbial inhabitants of our fuel storage tanks. Perhaps future studies will shed more light on these issues.

Photo courtesy of Tanknology

**Figure 3.** *This photo shows the underside of the submersible turbine pump manifold. Although this portion of the manifold is only exposed to fuel vapors, substantial corrosion is present.*

## ■ Why Is Diesel-Fuel Corrosion Happening?

Several studies have been done, and more are underway, but consensus on why corrosion is happening on the inside of diesel tanks has not occurred. It seems likely that there are multiple contributing factors. Prime suspects to date include microbial activity promoted by the presence in the fuel of substances that are not intended to be in diesel fuel, such as ethanol, glycerol, and, of course, water.

The ethanol would likely come to be in diesel fuel because of "switch loading," which is the practice of using the same tank trucks to deliver diesel fuel as gasoline. Because the compartments in a tank truck do not completely drain, small amounts of residual gasoline may be present when a truck compartment that previously contained gasoline is filled with diesel. This introduces small quantities of gasoline and ethanol into the diesel.

Because of its affinity for water and its relatively high vapor pressure relative to diesel, the ethanol in the diesel fuel will readily end up in any water that is present in the diesel tank, whether in the bottom of the tank or in the ullage space as condensation on the tank walls and fittings. Because of the small amount of ethanol present in the diesel fuel, the amount of ethanol that ends up in the condensation droplets on the inside wall of the tank is low enough that the water is not toxic to microbes such as acetobacter, the microbe that produces the corrosion in our tank-top sumps.

Switch loading is deeply ingrained in the logistics of our fuel transportation systems, so it is not likely to change anytime soon. So to the extent that ethanol is responsible for internal corrosion of metallic components inside diesel tanks, the problem is likely to be with us for some time.

Glycerol (also known as glycerin) is a compound that is a byproduct of biodiesel production and occurs as an impurity in biodiesel. A few percent biodiesel is commonly added to today's diesel fuel to improve the "lubricity" or lubricating properties of the fuel that were diminished as a result of removing the sulfur to produce ULSD. Glycerol is an attractive food source for microbes, so like ethanol, it can prove inviting to microbes who then produce various acids that increase corrosion inside the UST.

The amount of glycerol present in diesel fuel is typically small, but it is sufficient to encourage microbial growth. Increased usage of biodiesel is part of the Renewable Fuel Standard, so biodiesel and hence glycerol is likely to continue to be a component of diesel for the foreseeable future as well.

Whatever else might be in a tank, water is an essential ingredient for microbial activity, so water is an important player if microbes are involved in diesel-tank corrosion. Water enters diesel tanks through the same avenues as gasoline tanks (see above). Diesel and water don't mix much at all, so even small amounts of water that enter a diesel tank (say through humid air that enters the tank ullage as the fuel is pumped out of the tank) can condense and reside on the surfaces of the tank ullage or make their way to the bottom of the tank.

Small puddles of water can accumulate in the bottoms of tanks because of unevenness of the tank bottom. These puddles can be difficult to detect because the strike plates that are typically installed in tanks beneath tank openings prevent gauge sticks or ATG probes from getting to the very bottom of the tank. In addition, water condensing as droplets on metallic components inside tanks can provide mini-environments that are quite hospitable to microbes.

## What Can Be Done About Corrosion Inside Diesel Tanks?

Of the issues discussed in this article, corrosion inside diesel tanks is perhaps the most intractable issue, if only because agreement on a clear cause for the corrosion has yet to be reached. It is likely that microbial activity plays a significant role, and water is a prerequisite for microbial activity that could accelerate corrosion as well as straightforward corrosion that results from chemical reactions.

So all we need to do is get rid of all the water in our diesel tanks. This is easier said than done, however, as the amount of water necessary to sustain microbial activity is believed to be on the order of a millimeter (a little less than the thickness of a dime). Detection and removal of water at this level is very difficult. To begin with, tanks are large and access points are limited, so puddles of water can easily hide in relatively inaccessible locations.

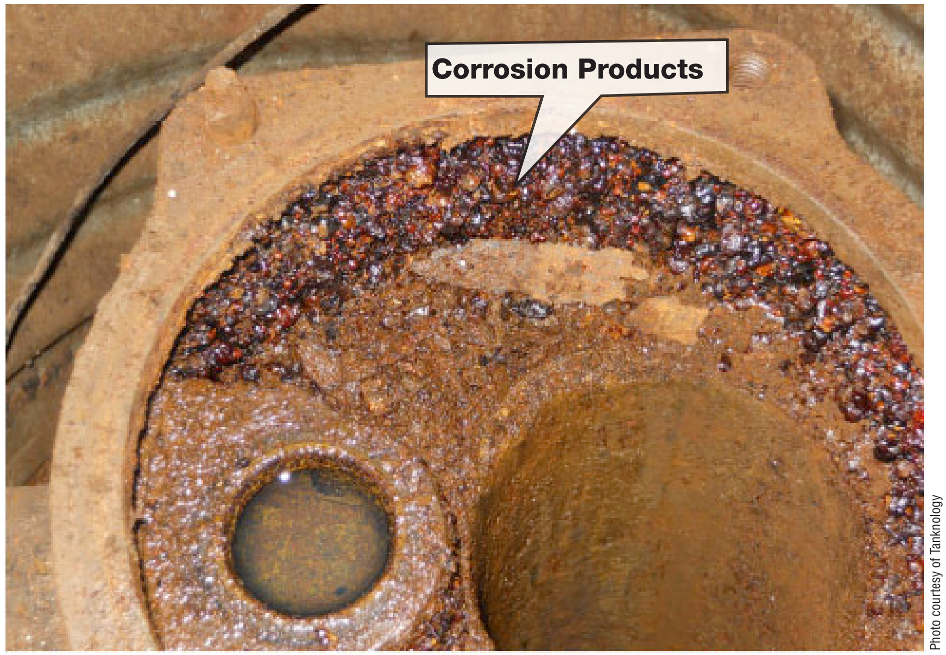



**Figure 4.** *In this photo, the top section of the submersible turbine pump manifold (the part that is normally visible during an inspection) has been removed. The opening in the lower right of the photo is the riser that leads to the top of the tank. Although this portion of the manifold is only exposed to fuel vapors, corrosion products have accumulated along the inside rim.*

Traditional water removal methods using a pipe inserted in the fill opening or perhaps the ATG riser will not remove water below the level of the strike plate, let alone locations remote from the fill and ATG risers. There are tank-cleaning methodologies that essentially run a vacuum cleaner down the length of the tank that will likely be more effective in removing water, sludge, and whatever else is sitting in the bottom of the tank, but this approach is not commonly used.

There are no water removal techniques that I am aware of that will address droplets of water that condense on tank walls and on tank components like flapper valves, submersible pumps, and the inside of risers. And even if this water were removed, it would likely soon return in most environments as humid air is drawn into the tank as fuel is pumped out.

Recognizing that elimination of water in diesel tanks is a noble but likely unreachable goal, it is still worthwhile to make reasonable efforts at controlling water and microbial activity. Commonly suggested techniques include:

- Check for the presence of water at multiple locations in the tank using ATGs and gauge sticks with water paste.
- Obtain fuel samples from the bottom of the tank using special samplers and checking for the presence of microbial activity that may be indicated by cloudy fuel or slimy materials. (See *LUSTline* Bulletin #39 for techniques on how to inspect fuel for microbial activity.)[15]
- Use tank-cleaning techniques that remove water along the entire bottom of the tank.
- If evidence of microbes is found, implement a biocide program with the assistance of a fuel quality specialist.
- Conduct internal video inspections of the tank to evaluate the level of corrosion in the ullage space.

Other than water management and biocides, approaches for dealing with diesel corrosion are limited. Installing corrosion-resistant submersible pumps that use stainless steel components is an option, but I am not aware of any manufacturer selling stainless steel overfill-prevention valves.

My suspicion is that failure of mechanical line-leak detectors, check valves, and shear valves is more often due to particulates interfering

■ continued on page 23

# Field Notes

*from Robert N. Renkes, Executive Vice President, Petroleum Equipment Institute (PEI)*

## A Lament, a Few Excuses, Three Promises, and a Huge Thank You

### Zero, Zip, Zilch, Nada, Nothing

That's what PEI has managed to publish—despite our best intentions—on the recommended practice front since the last *LUSTLine* article. It's not that we haven't made progress over the last three months—it's just that we have nothing tangible to show for it—and we had to get it right. But we can provide an update.

### PEI/RP900

PEI's Underground Storage Tank (UST) System Inspection and Maintenance Committee met on September 8 to put the finishing touches on a new appendix to PEI's *Recommended Practices for the Inspection and Maintenance of UST Systems* (PEI/RP900) that deals with the important topic of water management in underground storage systems. The public comment period for the appendix is now over, the committee will meet in November to address the comments, and the RP will be published in February 2017. I am trying to be realistic so regulators that want to reference the document can have an idea when they can get their hands on it.

### PEI/RP1200

We expected a July/August meeting of the committee responsible for PEI's *Recommended Practices for the Testing and Verification of Spill, Overfill, Leak Detection, and Secondary Containment at UST Facilities* (PEI/RP1200). That didn't happen—for several good reasons I won't delve into here. The committee will meet in December to act on the 58 comments to the document. Publication of RP1200 should coincide with RP900 in February 2017.

### PEI/RP100

Back in June, I wrote that the PEI Tank Installation Committee would meet in July to review the comments offered to amend and/or clarify PEI's *Recommended Practices for Installation of Underground Liquid Storage Systems* (PEI/RP100). That Meeting took place in September. The committee is busy revamping the diagrams, and the 2017 edition of RP100 should finally be published in February 2017. Hooray!

### Thank You

In 1985, USEPA awarded the New England Interstate Water Pollution Control Commission (NEIWPCC) a grant to publish and distribute five issues of a bulletin that would inform and update state and federal regulatory agencies across the country on topics related to the RCRA Subtitle I requirements. This legislation called for USEPA to promulgate regulations to prevent, detect, and correct the problem of leaking underground storage tanks. The new publication was called *LUSTLine*. It was at the top of the "must read" list for everyone in the industry back then, and it remains so today.

Two years later I attended a conference on underground storage tanks in Washington DC with *LUSTLine* editor Ellen Frye and NEIWPCC project officer Jennie Bridge. As we discussed how an already great publication might be improved, we toyed with the idea of adding a column about what really was happening at these underground storage tank sites throughout the country. Since I represented the folks who made, installed, and serviced these tanks, I "volunteered" to write about what PEI members heard and saw in the field. Ellen decided to call the new column "Field Notes."

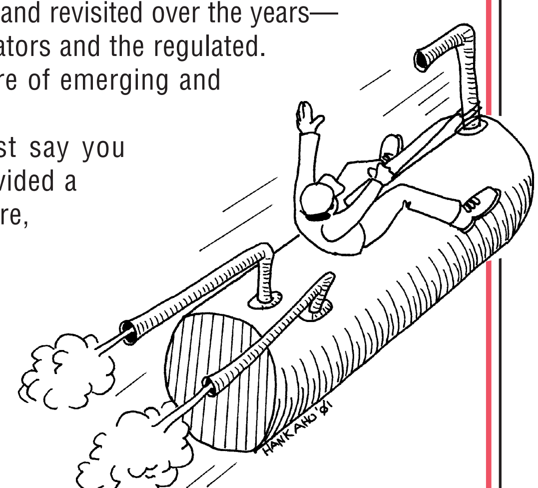
I penned the first Field Notes for *LUSTLine* Bulletin 10 in February 1989. I wrote about a city manager of a small college town in

### Thank YOU Bob, It's Been Quite a Ride

It was clear at the get-go that those in the PEI world and those in the UST regulatory world were fundamentally connected. Your "Field Notes" have served to keep *LUSTLine* readers up-to-date on the PEI recommended practices (RPs) that were developed and revisited over the years—RPs that have well served the regulators and the regulated. Your columns also kept us all aware of emerging and ongoing issues.

As editor of *LUSTLine*, I must say you will be missed. You graciously provided a wonderful column, and what is more, I learned a lot from you and enjoyed our friendship. You have always had a pile of extra curricular activities on your plate, so enjoy and stay in touch. ■

*Ciao,*
*Ellen Frye*



## *Field Notes continued*

Arkansas who called our office to ask if $11,200 was a fair price to "acoustically" protect his tanks. He had the impression that underground sound waves were causing his tanks to corrode.

Now, 71 issues later, I am writing my last "Field Notes." I will retire from my full-time position at PEI next June. Rick Long has been named to replace me at that time. He will also write "Field Notes" going forward. He is an exemplary writer and will continue to provide useful information from the field.

Public service is more than just a job. For many of you it is a calling—a way to contribute to our society every day. You may not be in one of the highly visible jobs, but our nation depends on you and your work. You make a difference every day, and most Americans appreciate what you do.

People and organizations involved with and dedicated to our state and federal underground storage tank programs have earned the respect of the regulated community. Why? I think it is because you were anxious to learn about the industry from the beginning of the program and continue to be receptive to improving the program that has served our nation so well over the years. I have worked (and played) with you guys for nearly 30 years. You have been helpful, cordial, and cooperative to the regulated community, and to me. It is indeed a true partnership. From one person's first-hand perspective, we couldn't ask for anything more. ■

Thank you.

# Greetings from ASTSWMO

*by Charles Reyes*

## Our UST/LUST Connection

ASTSWMO, Providing Pathways to Our Nation's Environmental Stewardship Since 1974

The Association of State and Territorial Solid Waste Management Officials (ASTSWMO) is a nonprofit environmental trade association representing the waste, materials management, and cleanup programs of the 50 states, five territories, and the District of Columbia (states). Our mission is to enhance and promote effective state and territorial programs and to affect relevant national policies for waste and materials management, environmentally sustainable practices, and environmental restoration.

For nearly 20 years, through our Tanks Subcommittee, ASTSWMO has enjoyed a cooperative relationship with USEPA's Office of Underground Storage Tanks (OUST) to promote state and federal cooperation in the management of the UST prevention and compliance programs, remediation of LUST facilities, and implementation of state financial assurance programs. The bulk of our work is conducted by issue-specific Task Forces, which currently include:

- UST Task Force
- LUST Task Force
- State Fund / Financial Responsibility Task Force
- Emerging Fuels Task Force

Each Task Force is comprised of approximately 10 state representatives, one for each USEPA Region, all of whom are policy and/or technical experts within their state programs. The regional representatives keep each state within their home region up-to-date on issues and solicit and represent each state's viewpoint. Our current membership is available at: *http://www.astswmo.org/main/subcommittees.html# tanks.*

Through the Tanks Subcommittee and Task Forces, ASTSWMO produces a wide range of policy, guidance, and research documents. Recent examples include compiling and submitting formal state comments on the 2015 federal UST Regulation; survey reports about state activities on various topics such as lead scavengers, institutional controls, and common compliance violations; compendiums of state cases on redevelopment successes and emergency response incidents; and our Annual State Fund Survey. Copies of our publications are available at: *http://www.astswmo.org/main/tanks_pubs.html.*

ASTSWMO's Tanks Subcommittee also hosts a number of dialogues, trainings, and workshops throughout the year. These include sessions and roundtables at ASTSWMO's Annual and Mid-Year Meetings and program-specific workshops. We also work closely with NEIWPCC, USEPA OUST, and others as a cosponsor of the National Tanks Conference. All of ASTSWMO's meetings are free and open to the public, and we look forward to seeing you at our next event, the ASTSWMO Annual Meeting, October 27-28, in Washington, DC! ■

*Charles Reyes is ASTSWOMO's Senior Program Manager. For more information about ASTSWMO's Tanks Subcommittee or to learn more about the Association and its other program areas, visit http://www.astswmo.org/.*

## A Thoughtful Column Engineered by Mahesh Albuquerque

*Mahesh Albuquerque, Director of the Colorado Division of Oil and Public Safety, is on the lookout for articles from creative thinkers and experts willing to share ideas, insights, and stories on a wide variety of issues related to underground storage tanks. Topics include policy, strategy, successes, failures, and lessons learned. "Now that we have been regulating USTs for 30 years," says Mahesh, "my hope is that this column will help stimulate readers to 'think outside the tank,' to ponder why we do what we do, and to consider and share creative ways to improve our effectiveness—as we strive toward environmental protection." Mahesh can be reached at mahesh.albuquerque@state.co.us.*

# There's a Hole in the Bucket…

## *Some Angst with the Three-Year Testing of Spill-Containment Equipment and Containment Sumps Requirement*

I often read to my two year old, and every now and then I come across a nursery rhyme that hits the nail of life right on the head. Case in point is the guy whining to Liza about his conundrum with fixing a hole in the bucket; it brings to mind some of the challenges in our tanks program. This year we met with Colorado stakeholders to discuss revisions to our Storage Tank Regulations. Our proposed changes focused primarily on adopting the 2015 revisions to USEPA's regulations related to underground storage tanks (USTs) found in 40 CFR part 280 and 281. The revisions increase emphasis on properly operating and maintaining UST equipment, which we hope will help prevent and detect UST releases earlier. We have always believed it makes sense to focus on prevention, as the saying goes "an ounce of prevention is worth a pound of cure."

Like a number of states, Colorado has already adopted many of the new requirements in USEPA's 2015 revised rule, as part of the UST provisions in the Federal Energy Policy Act of 2005. Requirements for secondary containment, under-dispenser containment, operator training, and installer certification had been in our rules since 2008, which really helped our stakeholder meetings run smoothly. We were able to focus our attention on the removal of deferrals for emergency generator tanks, field-constructed tanks, and airport hydrant systems, as well as the new periodic operation and maintenance requirements.

We even took a few field trips. The first trip was to a top-secret federal facility to determine whether or not their in-ground fuel storage reservoir fell under the definition of a field-constructed tank. The second was to Denver International Airport to inspect their airport hydrant system, which includes six 2.6 million gallon plus aboveground storage tanks (ASTs) connected to approximately 27 miles of underground-pressurized piping.

As expected, most of the discussion in our stakeholder meetings centered on periodic operation and maintenance requirements, most specifically the three-year testing of spill buckets and containment sumps. In Colorado, these new requirements will take effect on January 1, 2017, and the first three-year testing of spill buckets and containment sumps must be completed by January 1, 2020. We were able to gain support from stakeholders on all of the proposed revisions and implementation timeframes. Our public rulemaking hearing went off very well, and our revised rules were adopted in August 2016.

### But, There's a Hole in the Bucket, Dear Liza…

The three-year testing requirement of spill-containment equipment and containment sumps is likely the most significant change in our revised rules, and probably causes the most angst to regulated entities. First, this equipment likely has never have been tested since installation and will likely fail a hydrostatic test. Second, a failed test could trigger a suspected release which will require investigation and may result in costly cleanup. And finally, potentially contaminated water associated with the testing of this equipment could lead to costly water disposal or reuse restrictions. So what did we do?

### Then Fix It Dear Henry…

We are considering the use of incentives to alleviate some of the concerns caused by the fear of finding a hole in the bucket. Knowing that it is human nature to procrastinate, we want to motivate tank owners and operators to test their equipment early, and not wait until our January 1, 2020 deadline. Waiting can be costly, as contractors will be swamped and prices for services usually follow demand.

### With What Should I Fix It?

Here are a couple of our hole-in-the-bucket fixes.

#### ■ Financial Incentives per HB15-1299

Two years ago, in anticipation of the federal UST rule revisions and testing requirements, we crafted a bill to amend our statutes to allow monies from our Petroleum Storage Tank Fund to be used as incentives for significant operational compliance (SOC) and for equipment upgrades. House Bill 15-1299 was introduced in early 2015 with strong industry stakeholder support. It passed both houses of the Colorado General Assembly and was adopted into law and signed by our Governor in early May 2015, five months prior to the finalization of the revised federal UST rules. This bill strategically placed us in a good position to adopt and effectively implement many of the new requirements in the federal UST rules.

***The three-year testing requirement of spill-containment equipment and containment sumps is likely the most significant change in our revised rules, and probably causes the most angst to regulated entities.***

If an owner/operator encounters new contamination at a site while replacing all spill containment equipment and/or containment sumps that failed testing in 2017, we will waive the entire $10,000 deductible to our Petroleum Storage Tank Fund. If an owner/operator waits a year later and does this work, we would waive 50 percent of the deductible in 2018. The incentive goes away in 2019 as the testing has to be completed by the end of that year. The hope is that this would prevent procrastination by creating an incentive to conduct containment testing early.

### Alternate Testing Procedure

Since 2008, our storage tank rules have required that all new secondary containment piping and containment sumps, including spill buckets, be tightness-tested upon installation and retested within a year thereafter. These containment sumps and spill buckets are usually hydrostatically tested by filling them up to the top or an inch above the highest penetration. Consequently, the vast majority of UST systems in Colorado that are required to use interstitial monitoring as a primary method of leak detection were installed after 2008, have already been hydrostatically tested, and are the systems that would be subject to the three-year containment-sump testing requirement.

We have developed an alternative testing procedure for containment-sump testing, which we, as the implementing agency, believe is no less protective than those developed by the manufacturer or in a code of practice. In fact we believe our alternate procedure may be more protective than those listed in the federal rule. In Colorado, if sump sensors used for interstitial monitoring are wired to shut down the submersible turbine pump when the sensors go into alarm (detect liquid), and the sensors are tested annually for functionality, then that containment sump would only need to be hydrostatically tested up to the level of the sensor. Utilizing this alternate test procedure drastically minimizes the amount of water necessary to conduct the test.

### With a Straw, Dear Henry...

Our hope is that these incentives motivate owners to begin testing their spill-containment equipment and containment sumps early, which should help alleviate their fear of picking the short straw. Since implementing the Energy Policy Act UST provisions in 2008, we have already seen an inverse correlation between SOC and new releases—as SOC goes up, new releases go down. More importantly, new releases are being detected earlier, and therefore they tend to be less extensive in magnitude and cheaper to clean up.

We believe the periodic testing requirements in our new rules will help maintain this trend. So while the impact to our Petroleum Storage Tank Fund could be substantial over the next two years, we believe that continuing to invest in release prevention makes sense, and implementing these incentives and alternate testing method enables us to walk the talk in Colorado. Most importantly we believe this approach will free us from the circular conundrum associated with leaking buckets, which Liza and Henry in the nursery rhyme seem to be stuck in. ■

# Using Environmental Covenants to Facilitate LUST Site Closure

*by John Menatti*

Many states are using Environmental Covenants or similar instruments to enable closure (i.e., no further action at this time under the current property use) of LUST sites with residual soil and groundwater contamination remaining in the subsurface. The primary purposes of Environmental Covenants (ECs) are:

- To document the presence of subsurface contamination underlying a property so that prospective purchasers/developers can estimate the costs of dealing with the contamination during property redevelopment.
- To notify workers that will be excavating or drilling in the contaminated area so they can safely deal with the contaminated soil and/or groundwater.

In order for ECs to work, the information they provide must be readily available to the public. In 2006, the Utah legislature passed the Uniform Environmental Covenants Act. The Utah Division of Environmental Response and Remediation (DERR) has used ECs to manage sites that have been "closed" (issued a "No Further Action at this time under the current property use" letter) with contaminated soil and groundwater remaining in the subsurface. Since 2008, the DERR has issued closure letters on 19 LUST sites using ECs. ECs for these sites can be viewed on our website: *http://www.deq.utah.gov/ProgramsServices/programs/tanks/ust/releases/remediation.htm.*

In order to qualify for an "EC closure," the environmental consultant must perform a risk assessment and show that there are no adverse risks to human health or

■ continued on page 18

**■ Using Environmental Convenants** *from page 17*

the environment (under the current property use) from the subsurface contamination at the site. The next step is for the environmental consultant to prepare a draft EC for DERR review. The draft EC must be written using the instructions and template that can be found on our website. The EC must include site maps and data tables documenting the locations, depths, and types of contamination left under the property. The EC must also include activity and land use limitations.

As part of its EC process for LUST sites, the DERR sends the site location (coordinates) to Blue Stakes of Utah (the "811 dig alert" service) where the site goes into the Blue Stakes system. When a party proposes to drill or dig in Utah, Blue Stakes must be notified. Blue Stakes then notifies the DERR that a company intends to drill or dig in the vicinity of the EC-closed LUST site.

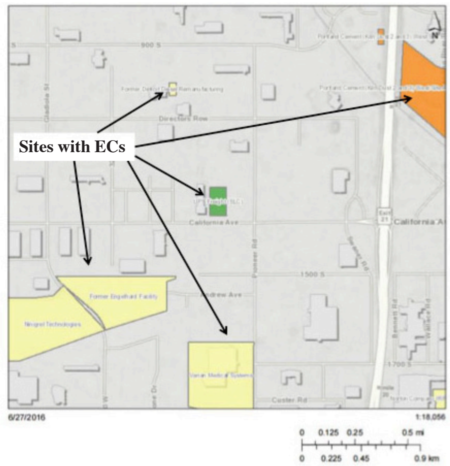



**Figure 1**. *Screen shot from the Utah Department of Environmental Quality's Interactive Map.*

The DERR emails the excavating company, providing information on the location, depth, and type of contamination in the area of the proposed subsurface work.

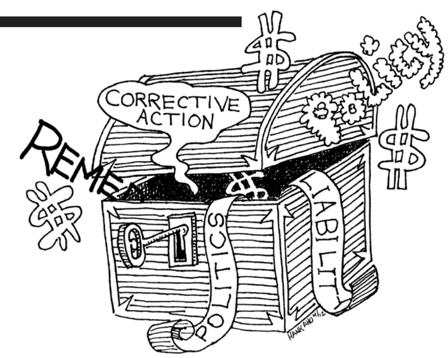
Following DERR approval of the EC, the property owner must record the EC on the property deed. When proof of recordation is submitted, the DERR issues a No Further Action letter. Realtors and prospective purchasers can find properties with ECs on the DERR's Interactive Map (See Figure 1). More information on termination and enforcement of ECs in Utah can be found in the Utah Code, Real Estate – Uniform Environmental Covenants Act (Title 57, Chapter 25, Sections 101-114, last revised 2008).

For more information on ECs, see *State Approaches to Managing Institutional Controls and Ensuring Long-Term Protectiveness at Leaking Underground Storage Tank (LUST) Sites*, May 2015, ASTSWMO LUST Task Force. In addition, the ITRC IC Team is preparing a document titled *Long-Term Contaminant Management Using Institutional Controls*, which will be published in 2016. ■

*John A. Menatti, M.S., P.G. is Environmental Manager with the Utah Department of Environmental Quality. He can be contacted at: jmenatti@utah.gov.*

# Unlocking the Mystery of FR

*A straight-talking column by Jill Williams-Hall, Senior Planner with the Delaware Department of Natural Resources and Environmental Control (DNREC). Jill can be reached at jill.hall@state.de.us. This issue of Jill's column discusses aging USTs and private insurance and has two parts. In the first part Jill lays out the issues associated with financial assurance and aging tanks. In the second part Keith Cannon, President of Cortland Management/CEI Environmental Insurance discusses the insurance industry's perspective on risk. He can be reached at keith@ceienvins.com.*




## Why States Should Be Concerned About Aging Tanks and Private Insurance

In October 2015 the Association of State and Territorial Solid Waste Management Officials (ASTSWMO) Tanks Subcommittee released a rport titled *An Analysis of UST System Infrastructure in Select States* (*http://www.astswmo.org/files/policies/Tanks/2015-10-ASTSWMO-AgingTanks%20Report-Final.pdf*). The purpose of the report was to analyze whether the aging UST infrastructure poses a higher risk of leaks, thus creating higher risks for state tank funds and private insurers.

Data detailing the source and cause of leaks in the nation's population of tanks, particularly those 25–40 years old, would need to be analyzed to determine whether aging UST systems pose a higher risk of leaks. Unfortunately while most states collect this data in some form, many acknowledge that their data collection is inadequate or incomplete; thus a detailed analysis that would lead to a comprehensive answer is not currently viable.

What is known is that private insurers do utilize certain information (e.g., profitability and risk considerations) regarding the tank system in their underwriting criteria. Tank data including age and material of construction are some of the factors used to determine the type of insurance coverage offered, retroactive dates, the premium costs for the policy, possible non-renewal of existing polices, and whether a new owner can purchase a policy for an older tank.

So why should states be concerned about the possible effect of aging tanks on a private insurance market? For those states that rely entirely on the private market to provide financial assurance mechanisms, a lack of insurers for aging tank systems can leave them with several possible unwanted scenarios:

- A state may have an increasing number of aging tanks that continue in operation after insurance has been cancelled or not renewed, leaving the state exposed for cleanup costs if the owner does not have the financial resources.

- There may be an increase in the number of tank sites abandoned by owners that find they can neither afford to replace an aging system nor find a carrier that will insure the aged system in place.
- Tank owners may be forced to pay higher insurance premiums and in exchange have a limited cash flow for equipment maintenance and upgrades.
- Insurance companies may limit retroactive dates leaving the owner responsible for historic contamination.

## So What Is a State to Do?

- To reduce the risk of tanks operating without insurance, states may want to require tank owners to submit documentation of financial assurance on an annual basis, especially if the inspection rotation is less frequent than annually.
- States should contact the insurance carriers currently providing insurance in their state and begin a dialogue regarding the internal policies of the companies regarding aging tanks. States can then determine how much of an issue aging tanks and the effect on the insurance market in their state will be.
- States should begin aggressive outreach to tank owners with information regarding the policies of the insurance carriers operating in their state. Tank owners may need to make business decisions regarding tank upgrades, replacements, or removals.
- States may want to consider creating financial assistance programs (e.g., loans, grants) to help tank owners replace or remove aging tank systems.
- States should inform all tank owners utilizing private tank insurance that their pollution liability insurance policy, by regulation, includes a six-month extension period. During this timeframe insurance covers claims, otherwise covered by the policy, that are reported to the insurance company within six months of the effective date of the cancellation or non-renewal of the policy.
- States should consider working with the insurance carriers to have the state receive notice of any cancellation or non-renewal of tank policies. The state can then contact the tank facility to ensure that tanks are not operating without financial responsibility. It may also assist the tank owner regarding policy requirements that may include notification to the insurance company prior to tank removal, timely notification of contamination identification, and the six-month tail.

While it is the responsibility of the tank owner and operator to comply with the financial responsibility requirements, the more informed tank owners and operators are, the less likely the state will be left to finance the cleanup of sites that are no longer insured.

## That Hazy Issue of Risk: An Insurer's Perspective

It's been nearly 28 years since the nation's UST requirements (40 CFR Part 280) were first promulgated and 18 years since the extended compliance deadline of December 22, 1998. During that ten-year phase-in period, a majority (if not all) of the nation's USTs were upgraded (replaced or retrofitted) to meet the new construction and leak detections standards. Now, more than a quarter century later, we are facing emerging risk and compliance issues surrounding the aging tank population and changes in the industry.

State tank funds and pollution insurance continue to be the two most common financial assurance mechanisms used to meet the UST Financial Responsibility (FR) requirements, and while we could debate the pros and cons of each mechanism, the issues presented by aging tanks threaten both mechanisms. Any piece of equipment, be it an automobile, construction equipment, HVAC unit, or underground storage tank system, will eventually outlive its useful life. The difference is that when the UST system breaks down it has the potential to cause significant environmental damages. Some would argue that tank age is not the best indicator of the viability of an UST system; that other components are more often the cause of most leaks at UST sites.

Yes, there are the anecdotal stories of the 30-year-old tank that was in such great condition "you could still read the serial number on the tank" when it was removed from the ground. But for every such story, there are those cases where a leak from a tank less than five years old resulted in a million dollar loss. The fact is, there is no comprehensive data from the tank community (e.g., state funds, insurers, tank manufacturers) that can be used in trying to convince an actuary that the older tanks and their systems are "safe."

While ASTSWMO's report, *An Analysis of UST System Infrastructure in Select States*, presents some data that may be representative of the average age of the nation's USTs and piping, there is no conclusive data that can be used to determine at what age a storage tank presents an increased risk of leaking. The question still remains: how old is too old? At what point should insurers and state funds be concerned about loss potential from USTs?

## Beware the Changing Tank Insurance Market

The environmental insurance marketplace has never seen more capacity and competition; however, the pollution insurance market for USTs is quickly tightening—coverage is becoming difficult to obtain. Just a year ago there were nearly 20 qualified insurance companies aggressively providing insurance for storage tanks. At renewal, coverage terms could be broadened, deductibles reduced, and premiums unchanged despite the fact that the risk of a leak grows as tank systems age.

In just the last six months, the UST pollution market has changed dramatically, especially when deal-

■ continued on page 22

## From Our Readers

# Clarification of Hawaii's Use of Silica Gel Cleanup

The Hawaii Department of Health (HDOH) appreciates the research being carried out by the authors of the *LUSTLine* #80 article "What Are You Really Measuring Using an Extractable TPH Analysis at LUST Sites?" and reference their work in our guidance for the investigation of petroleum-contaminated groundwater (HDOH 2011, 2014). As noted in the article, we encourage the collection of data based on the use of silica gel cleanup (SGC) to remove polar, TPH-related degradation compounds or "metabolites" from water samples prior to testing. It is important to clarify, however, that HDOH specifically *does not* support the stand-alone use of SGC for risk assessments or for direct comparison to drinking water or ecological-based screening levels, as might be inferred from the article.

For initial screening purposes, we consider heavily degraded, petroleum-contaminated groundwater to be as *equally toxic* as the parent petroleum compounds. While we agree in principle that TPH-related metabolites are likely to be *less* toxic than parent compounds, in part due to reduced volatility, we do not concur with the conclusion stated later in the article that "metabolites pose low risk to human (and ecological) health" and the subsequent inference that they can thus be ignored.

It is important to distinguish between "toxicity" and "risk." Compounds that are of relatively low toxicity can still pose a potentially significant risk under the right exposure conditions, as any emergency room doctor who has treated patients that have overdosed on aspirin can attest to: "dose makes the poison." If necessary then, risk posed to human health and the environment by petroleum-related metabolites, as well as any remaining parent compounds, must undergo a site-specific risk assessment.

For initial screening purposes, our guidance specifically states that: "the sum of the polar compounds and nonpolar compounds (i.e., the concentration of TPH reported in the absence of a silica gel cleanup)…should be directly compared to (TPH) Environmental Action Levels." If collected, SGC data are primarily used to simply assess the degradation state of the plume. This is then taken into consideration for development of remedial action plans.

In most cases, we do not require active remediation of heavily degraded, dissolved-phase, petroleum-related contaminants in groundwater, even if screening levels for drinking water or aquatic toxicity are exceeded. We do, however, often require a basic, long-term management plan to ensure that impacted groundwater is not inadvertently discharged into an aquatic habitat (e.g., during site construction and dewatering activities and discharge into a storm drain). The inclusion of SGC data in long-term monitoring programs can also help identify when a new release has occurred.

Similar guidance on the appropriate use of SGC data for groundwater has been published by other state agencies, including the San Francisco Bay Area Regional Water Board, a part of the California Environmental Protection Agency (CalEPA 2016a). Environmental Screening Levels for TPH published by that office are used throughout California as well as in other states and are very similar to TPH "action levels" published by the State of Hawaii. Their office recently published more detailed guidance on the assessment of petroleum-related metabolites in water and the appropriate (and inappropriate) use of SGC data (CalEPA 2016b).

Staff from both the Hawaii and California agencies, as well as several of the recent *LUSTLine* #80 article authors, are part of a nationwide team preparing detailed guidance on the risk-based assessment of TPH in water as well as other media. When completed (anticipated 2018), the guidance should represent a significant step forward in a subject that has drawn much attention and healthy debate over the past twenty-plus years. ■

*This clarification was written by Roger Brewer, PhD, and Iris van der Zander, PhD, Senior Environmental Scientists with the Hawaii Department of Health. They can be reached at: roger.brewer@doh.hawaii.gov and iris.vanderzander@doh.hawaii.gov.*

### References:

HDOH, 2011, "Screening for Environmental Concerns at Sites with Contaminated Soil and Groundwater" (Fall 2011 and updates) Hawai'i Department of Health, Office of Hazard Evaluation and Emergency Response, *http://eha-web.doh.hawaii.gov/eha-cma/Leaders/HEER/EALs*.

HDOH, 2014, *Technical Guidance Manual* (Section 9) Hawai'i Department of Health, Office of Hazard Evaluation and Emergency Response, April 2014, *http://www.hawaiidoh.org/*.

CalEPA, 2016a, "User's Guide: Derivation and Application of Environmental Screening Levels (ESLs)," Interim Final. California Environmental Protection Agency, San Francisco Bay Regional Water Quality Control Board. February.

CalEPA, 2016b. "Petroleum Metabolites: Literature Review and Assessment Framework." California Environmental Protection Agency, San Francisco Bay Regional Water Quality Control Board. June 27.

To read the response to this letter from the authors of the *LUSTLine* #80 article, "What Are You Really Measuring Using an Extractable TPH Analysis at LUST Sites?,"go to page 25 of the online version of this *LUSTLine* #81 issue at www.neiwpcc.org/lustline.

# Former Tennessee Gas Station Is Transformed into a Local Produce Hub

*by Kim Schoetzow*

An Exxon gasoline/service station located in historic downtown Jonesborough, Tennessee, had been operational from the 1930s until 2003, when it became an unwanted property. It was eventually placed on the real–estate market…along with its three out-of-service gasoline underground storage tanks (USTs). Due to the location of the land in the historic downtown, city leaders were interested in purchasing and developing the unused property into an enhancement for downtown activity and commerce.



*Exterior and interior of Boone Street Market, giving new life to a former gas station site.*

Photos by Don Taylor, TDEC–UST

The property/tank owner at the time was Tri-Cities Petroleum, Inc., who wanted to sell the property and gasoline tanks all together. It took some time for the details to be ironed out, as the town was not interested in the USTs or any potential associated liability. In 2011, the town purchased the property and registered the USTs for the purpose of permanent tank closure. The tanks were subsequently closed in March 2013, with assistance and oversight by the Tennessee Department of Environmental and Conservation's Division of UST personnel from the Johnson City Environmental Field Office and the Nashville Central Office.

After much effort and fundraising, the former Exxon gas station is now a year-round retail store—Boone Street Market, which opened for business in October 2014. Boone Street Market is part of Jonesborough Locally Grown, a nonprofit that leases and operates the Jonesborough Farmers' Market. The Farmers' Market is a community-organized and operated market offering locally grown produce, baked goods, flowers, and more, and featuring live music every Saturday. Produce sold here must be grown within 100 miles of Jonesborough, ensuring the best local foods are made available to shoppers.

Boone Street Market is operated for the benefit of both its customers and suppliers. Volunteers help supplement the work alongside staff members. Operating costs are sustained by sales fees assessed to the growers from consignment of their goods, and through membership support and fundraisers, including monthly dinners. Cooking classes are offered as well to help sustain the business. In addition to the town of Jonesborough and Jonesborough Locally Grown, major supporters of the effort include the Tennessee Department of Agriculture, USDA Rural Development, the Washington County Commission, numerous individuals, civic groups, and banks.

"The Tennessee UST program is glad to see a former petroleum site being reused as a productive new business with an exciting draw to the community," says Stan Boyd, Director of the Division of Underground Storage Tanks. "Many times these former sites have been vacant for years and are unproductive. Now they are providing local jobs and income to the tax bases of their home cities and counties. By returning the property to usefulness, the new business brings opportunities for employment beyond the facility itself through local farms and other supplying merchants. We are proud to be involved in the revitalization of this property and will work to see others happen in the future." ■

*Kim Schoetzow is Communications Officer with the Tennessee Department of Environment and Conservation. For more information on this subject contact Stan Boyd at: stan.boyd@tn.gov.*

## A Message from Carolyn Hoskinson… continued from page 7

based study and would attempt to determine through independent variables which specific changes to fuel formulation, if any, are associated with corrosion occurrence.

- Continue to widely share information, such as USEPA's notice, and anecdotes or reports of corrosion.

### State and Territorial UST Implementing Agencies

- Share with owners in your states and territories USEPA's notice and urge owners to check for corrosion inside their diesel UST systems.
- Continue sharing information with USEPA and others when you hear of anecdotes or reports of corrosion.

### USEPA

- Collaborate with all UST stakeholders, support research efforts to identify causes of and solutions to the corrosion, and widely share information as we learn of it.
- Reach out to UST owners—via states, territories, and industry—about corrosion risks and ways they can lower the risk of releases.
- Encourage partnerships among companies and state implementing agencies interested in the corrosion issue.

Together, we can conquer this issue, as we have done with other challenges so many times before.

To read our July 2016 report, *Investigation of Corrosion-Influencing Factors in Underground Storage Tanks with Diesel Service*, and find more information on corrosion in USTs storing diesel fuel, see USEPA's website at *https://www.epa.gov/ust/alternative-fuels-and-underground-storage-tanks-usts#tab-5*. ■

## ■ Aging Tanks and Private Insurance *from page 19*

ing with small portfolios (fewer than 10 facilities and 30 tanks) of tanks more than 20 years old. Over the last few months, the industry has seen both premiums and deductibles rise, with carriers looking to collateralize those higher retentions, and many insurance companies nonrenewing policies.

The writing of private insurance to comply with financial assurance requirements for USTs is becoming more and more difficult, and in some circumstances unavailable. Owners and operators of newer tanks can still expect competitive renewals with affordable premiums and lower deductibles. However, for older tank systems, deductibles can quickly grow more than $50,000 per claim and, in some cases, closer to $100,000 per claim. These insureds must provide financial information demonstrating their ability to handle the larger retentions, or collateralize the deductible with an approved letter of credit, which is most often not possible by the smaller tank owners.

The answer to the dilemma of how owners/operators meet their financial responsibility requirement will ultimately have to come from the joint efforts of all stakeholders—insurance companies, state funds, equipment manufacturers—in conjunction with the owners/operators. ■

## ■ Emerging Contaminants *from page 5*


5. *http://dec.vermont.gov/commissioners-office/pfoa*.
6. Rachel Carson. *Silent Spring*, Houghton Mifflin, 1962.
7. Theo Colborn, Dianne Dumanoski and John Peterson Myers, *Our Stolen Future: Are We Threatening Our Fertility, Intelligence, and Survival? A Scientific Detective Story*, Dutton, 1996.
8. Interstate Technology and Regulatory Council (ITRC), *Perchlorate: Overview of Issues, Status, and Remedial Options*, 2005.
9. Rob Earle, John Wilson, Fran Kremer, Jim Weaver, and David Burden. GIS Analysis to Assess Where Shallow Ground Water Supplies in the United States Are Vulnerable to Contamination by Releases of Motor Fuel from Underground Storage Tanks, USEPA, EPA/600/R-11/108, December 2011
10. James Weaver, Andrew Murray, Fran Kremer, Kevin Blackwood, and Ashley McElmurry. *GIS Analysis of Private Domestic Wells and Aquifer Vulnerability*, National Tanks Conference. September 2015, Phoenix, AZ.
11. Julie Hall and Conor Murphy, Vulnerability Analysis of Future Public Water Supply Under Changing Climate Conditions: A Study of the Moy Catchment, Western Ireland. *Water Resources Management*, 2010, Vol. Issue 13, pp. 3527–3545.
12. Rachel Carson. .


## SNAPSHOTS FROM THE FIELD

*Astute inspectors sometime see these stubs attached to the shear valve. Notice the vertical tube with valve handle attached to the right of each shear valve. These are quick connect test ports installed (but not removed) by line testers so the tester can quickly attach to the product line to perform a tightness test. If the test stub is not removed and the dispenser is struck while the pump is on, fuel goes everywhere, and the the shear valve is bypassed.*

Courtesy of Ben Thomas

■ **Tank-nically Speaking** *from page 13*

with the function of the device rather than corrosion directly affecting the components. If this is the case, then making these components out of stainless steel or other noncorrosive materials is not going to solve the problem. What is needed is a filter that removes particulates before they can reach these components.

Because diesel corrosion can interfere with the operation of important UST hardware (e.g., overfill prevention devices, mechanical line-leak detectors, shear valves) increasing the frequency of testing of these devices is advisable. While annual testing of these devices is the current industry recommended practice, a more frequent testing schedule helps insure that these devices will function as intended when they are needed.

Another approach currently being evaluated for dealing with diesel corrosion is to maintain a nitrogen atmosphere within the tank ullage. Because many microbes that produce acid require oxygen to thrive, maintaining a nitrogen atmosphere could prevent the growth of microbial colonies that require oxygen.

Additional research to determine the causative factors responsible for diesel corrosion is planned, so stay tuned for further developments.

## Change Brings Change

Tinkering with our fuel composition has produced changes in UST systems that in some cases bear watching and in other cases may require modifications to our UST management strategies. While the old external corrosion issues that plagued our bare steel USTs have now largely receded, new corrosion issues have arisen. It took many decades for twentieth century fuel marketers to come to terms with external corrosion on underground tanks, even though the causes and cures for that type of corrosion were pretty well understood. Let's hope that today's corrosion issues will be dealt with in a shorter timeframe. ■

## Endnotes


1. "E15 Retailer Handbook," Renewable Fuels Association, 2012, p. 26.
2. "Ibid.
3. "Brian T. Knapp, New-Fuels Challenges for Petroleum Marketers," *LUSTline* Bulletin 61, May 2009, p. 8
4. John Wilson, et al., "Corrosion in USTs: What Causes It and What Can Be Done About It?" EPA/ORD, Poster Session Presentation at 2013 OUST UST Conference.
5. "Investigation of Corrosion-Influencing Factors in Underground Storage Tanks With Diesel Service," U.S. Environmental Protection Agency, Office of Underground Storage Tanks, EPA-510-R-16-001, July 2016, p. 5.
6. Ibid, pg 2.
7. Ibid, pg 1.
8. "EPA Releases Corrosion Report," Steel Tank Institute/Steel Plate Fabricators Association, Tank Talk, July 22, 2016, p. 2.
9. "Investigation of Internal Corrosion of Steel Fuel Storage Tanks," The Hinchman Company, August 31, 1970.
10. "Leaks Induced by Internal Corrosion in Steel Tanks—Executive Sumary," Warren Rogers Associates, Inc.

11 "Tank Corrosion Study," U.S. Environmental Protection Agency, EPA-510-K-92-802, November, 1988.

12. Ibid, pg 11.
13. Ibid, pg 33.

14 "Investigation of Corrosion-Influencing Factors in Underground Storage Tanks With Diesel Service," U.S. Environmental Protection Agency, Office of Underground Storage Tanks, EPA-510-R-16-001, July 2016, p. 56.

15. "Microbes and Fuel Systems—The Overlooked Corrosion Problem," Fred Passman, *LUSTline* Bulletin #39, November 2001, pp. 14–17.

L.U.S.T.LINE
New England Interstate Water
Pollution Control Commission
Wannalancit Mills
650 Suffolk Street, Suite 410
Lowell, MA 01854

Non-Profit Org.
U.S. Postage
**PAID**
Wilmington, MA
Permit No.
200

## New From NEIWPCC......................

### NEIWPCC Welcomes New Tanks Program Project Officer!

We are pleased to announce the addition of Andrew Youngs to the NEIWPCC staff. Drew will work on UST/LUST issues and be the Project Officer for the *LUSTLine* bulletin.

Drew was recently a graduate research fellow with the Rhode Island Sea Grant. During his master's program, he was a graduate research assistant with the University of Rhode Island's (URI) Department of Natural Resources where he wrote a technical report detailing the distribution of soils, vegetation, and hydrologic factors in the wetlands of southern New England. Following his undergraduate work, he worked as Director of Community Outreach for Clean Water Action, a national citizens' organization working for clean, safe, and affordable water, and prevention of health-threatening pollution.

Drew recently received his master's of Environmental Science and Management, with a graduate certificate in GIS and remote sensing, from URI. He holds a B.S. in Environmental Policy and Planning from Virginia Tech. ■

### Don't Forget About the CA Forum!

NEIWPCC hosts an Internet forum for Corrective Action discussions. The site can be found at: *http://www.neiwpcc.org/ust/caforum/index.php*. The forum is monitored by NEIWPCC and provides a variety of discussion topics for industry professionals. Topics include Innovative Clean-Up Technologies, PVI Screening, Soil Gas Analysis, Institutional Controls, and Cleanup News. If you are not a member of the forum, please visit the site and register today. ■

**NEW L.U.S.T.Line Index**

**August 1985/Bulletin #1 – October 2016/Bulletin #81**

**To download the index, go to *www.neiwpcc.org/lustline/* then click on *LUSTLine* Index.**

## SNAPSHOTS FROM THE FIELD

*Would you put your patio dining on top of a tank pad?*

Courtesy of Ben Thomas

Addendum to Bulletin 81

L.U.S.T.LINE

A Report On Federal & State Programs To Control Leaking Underground Storage Tanks

October 2016
neiwpcc.org/lustline

# Reply to Roger Brewer and Iris van der Zander letter, "Clarification of Hawaii's Use of Silica Gel Cleanup"

We appreciate the opportunity to respond to the letter authored by R. Brewer and I. van der Zander [see page 20], both senior environmental scientists at Hawaii Department of Health (HDOH), in response to our article, "What Are You Really Measuring Using an Extractable TPH Analysis at LUST Sites?," in the *LUSTLine* #80, June 2016 bulletin. We thank them for their thoughtful comments. We agree with the authors' statements that the collection of TPH silica gel cleanup (SGC) data should be encouraged. As we stated in our article, HDOH recommends the use of SGC to distinguish between the petroleum hydrocarbon compounds and polar portions of the total dissolved organics plume to focus remedial efforts or to support closure decisions (HDOH, 2014).

We want to clarify a few points made in their letter:

1. We did not state or mean to imply in our article that HDOH supports the stand-alone use of SGC for risk assessment or for direct comparison to drinking water or ecological-based screening levels. We concur that the metabolites and hydrocarbons portions of a plume should be assessed separately in a risk-based context.

2. We disagree with the HDOH letter's statement that *"For initial screening purposes, we consider heavily degraded, petroleum-contaminated groundwater to be as equally toxic as the parent petroleum compounds."* The nature and toxicity of metabolites has been in question for many years, which is why our article discussed the results of our research study conducted at 21 biodegrading fuel release sites where GCxGC testing identified thousands of metabolites in groundwater samples. Our study results indicate that the vast majority of biodegradation metabolites actually identified in groundwater (primarily organic acids/esters, with fewer alcohols, and very few ketones), are less toxic than the parent petroleum hydrocarbon compounds typically assumed to be present in groundwater (i.e., aromatic hydrocarbons) Mohler et al., 2013; Zemo et al., 2013; Zemo et al., 2016).

3. The HDOH letter states: *"While we agree in principle that TPH-related metabolites are likely to be less "toxic" than parent compounds, in part due to reduced volatility, we do not concur with the conclusion stated later in the article that…metabolites pose low risk to human (and ecological) health"* and the subsequent inference that they can thus be ignored. We want to clarify that we did not imply in our article that the polar metabolites in a plume should be ignored. We encourage the use of a risk-based decision making framework to evaluate sites with metabolite plumes and the use of appropriate toxicity data and exposure scenarios to evaluate the risk of these plumes. For example, in our recent paper, we present a risk evaluation for a potential drinking water scenario in which we compared average plume concentrations from our study sites to simple Tap Water Equivalent Concentrations calculated using oral reference doses for the identified metabolites, and the result of that exercise indicates that these plumes pose low risk to human health via groundwater ingestion (Zemo et al., 2016). ■

*Catalina Espino Devine*
*Dawn A. Zemo*
*Kirk T. O'Reilly*
*Rachel E. Mohler*
*Renae I. Magaw*
*Asheesh K. Tiwary*

## References

Espino Devine C, Zemo DA, O'Reilly KT, Mohler RE, Magaw RI, Tiwary AK. 2016. What Are You Really Measuring Using an Extractable TPH Analysis at LUST Sites? *LUSTLine* Bulletin 80.

[HDOH] Hawaii Department of Health. 2014. Technical guidance manual - Section 9: Supplemental guidance for select chemicals of concern. Office of Hazard Evaluation and Emergency Response. July final. Retrieved from: http://www.hawaiidoh.org/

Mohler RE, O'Reilly KT, Zemo DA, Tiwary AK, Magaw RI, Synowiec KA. 2013. Non-targeted analysis of petroleum metabolites in groundwater using GC×GC–TOFMS. Environ Sci Technol 47:10471–10476.

Zemo DA, O'Reilly KT, Mohler RE, Tiwary AK, Magaw RI, Synowiec KA. 2013. Nature and estimated human toxicity of polar metabolite mixtures in groundwater quantified as TPHd/DRO at biodegrading fuel release sites. Groundwater Monit Remed 33(4):44–56.

Zemo DA, O'Reilly KT, Mohler RE, Magaw RI, Espino Devine C, Ahn S, Tiwary AK. 2016. Life Cycle of Petroleum Biodegradation Metabolite Plumes, and Implications for Risk Management at Fuel Release Sites. Integrated Environmental Assessment and Management. SETAC Journal. DOI 10.1002/ieam.1848.