Issue 22: Summer 2019

BRIDGES

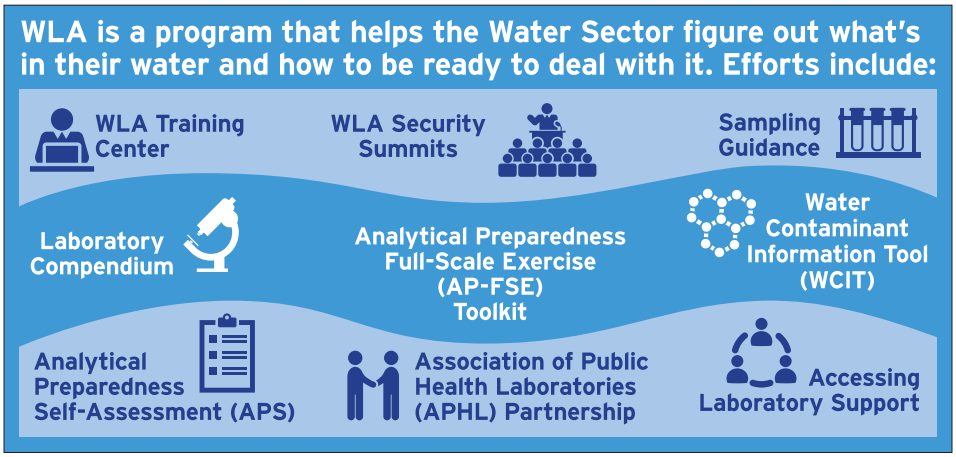
CONNECTING THE NATION'S ENVIRONMENTAL LABORATORIES

THE WATER LABORATORY ALLIANCE: A PREPAREDNESS AND RESPONSE PROGRAM

By Yasmin Termeh-Zonoozi, ORISE research participant, EPA, Office of Ground Water and Drinking Water, Water Laboratory Alliance

A drinking water contamination event can occur at any time. Therefore, emergency preparedness and rapid response remains a priority to ensure the water sector can effectively and efficiently address contamination incidents. This includes being prepared for unforeseen analytical challenges that may result from sample surges or unknown contaminants.

To assist with this need, the US Environmental Protection Agency's Water Laboratory Alliance (WLA) was formed. It consists of over 140 state, utility, public health, environmental and commercial laboratories with the capability and capacity to analyze water samples for chemical, biological or radiochemical contaminants. This nationwide network of laboratories supports the water sector in preparing for and responding to water contamination events that may require analytical needs beyond their capability or capacity.



Source: WLA

WLA Tools and Resources

The WLA program offers a variety of free tools and resources to increase water sector preparedness and decrease response times. Examples include:

Water Laboratory Response Plan (WLA-RP)

The WLA-RP is a comprehensive approach for responding to water contamination incidents of any scale, from multi-regional events to those involving a single laboratory. The WLA-RP provides laboratories with access to analytical best practices and lessons learned and helps facilitate communication amongst key stakeholders. For example, Appendix-C of the WLA-RP contains a checklist of items that should be discussed between the Analytical Services Requestor and supporting laboratories. Learn more.

IN THIS ISSUE

Extras

The Association of Public Health Laboratories (APHL) works to strengthen laboratory systems serving the public's health in the US and globally. APHL's member laboratories protect the public's health by monitoring and detecting infectious and foodborne diseases, environmental contaminants, terrorist agents, genetic disorders in newborns and other diverse health threats.

Funders
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Contacts
Julianne Nassif, director, Environmental Health Programs
julianne.nassif@aphl.org 240.485.2737

Sarah Wright, manager, Environmental Laboratories
sarah.wright@aphl.org 240.485.2730

APHL

8515 Georgia Avenue
Suite 700
Silver Spring, MD 20910

www.aphl.org

Analytical Preparedness Full Scale Exercise (AP-FSE) Toolkit

The AP-FSE is an interactive PDF that allows users to practice implementation of the WLA-RP and other response efforts as though an incident were occurring in real time. The Toolkit involves ten steps to guide users through planning and executing a full-scale exercise of their own and contains example scenarios as well as associated exercise documentation that can be used as-is or customized accordingly. Learn more.

Water Contaminant Information Tool (WCIT)

The WCIT is a secure, online database of information on over 800 priority contaminants of concern for drinking water and wastewater systems. It contains contaminant profiles with detailed information on fate and transport, physical properties, potential health effects and infrastructure decontamination. WCIT also contains more than 200 analytical methods and provides information on collecting field samples and analyses of unregulated contaminants. Learn more.

Compendium of Environmental Testing Laboratories

The Compendium is a secure, online database of environmental laboratories with the capacity to analyze chemical, biological and radiochemical contaminants. It allows users to search for laboratories based on criteria such as location, laboratory name or type, specific analytical capabilities and special sample handling. Learn more.

Training & Meetings

The WLA program also offers a variety of free webinars and training sessions on its tools and resources. The next major WLA meeting, the WLA Security Summit, will be held in November. This free Summit brings together a variety of water sector stakeholders to network and exchange best practices and lessons learned. Attendees will learn about WLA program elements, participate in a tabletop exercise and hear from state laboratories during a panel discussion on topics facing the water sector.

WLA Security Summit

November 13-14, 2019 | Atlanta, GA

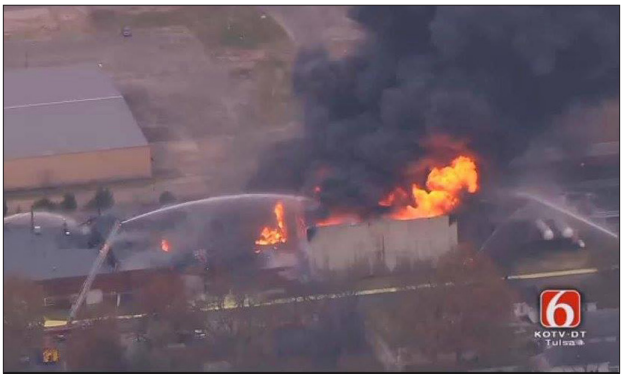
REGISTER

Learn more about other WLA resources and upcoming trainings on the WLA Training Center website.

SMALL TOWN, BIG RESPONSE: A THANKSGIVING EMERGENCY MAKES A DEEP IMPACT ON LAB, COMMUNITY

by Martha Pings, writer

This story originally appeared in the Summer 2019 issue of APHL's quarterly magazine, Lab Matters.



The Neodesha Fire Department responds to the plant explosion. (Photo: Neodesha Fire Department)

The call came on a Tuesday afternoon: "We're going to need your help with this issue."

It was the Tuesday before Thanksgiving, and a small town was completely without water. For N. Myron Gunsalus Jr., director of Kansas Health and Environmental Laboratories, the cascade of events that followed brought a clear sense of purpose and connection to the lab's work.

Neodesha, Kansas is a small town of about 2,500. Hours from both Topeka and Tulsa, it is nestled near the convergence of the Verdigris and Fall Rivers. The town motto, "Two rivers, no limits," makes it clear: there is a lot of pride in this natural resource. The Verdigris River serves as a drinking water source for Neodesha as well as

several communities downstream, including Independence and Coffeyville in Kansas and Delaware, Lenapah and Nowata in Oklahoma.

Earlier that Tuesday, November 22, 2016, a Neodesha chemical plant sustained an explosion. Flame and smoke billowed, visible for miles. As firefighters worked to put out the blaze, fire suppressants and other chemicals collected in ditches and made their way to the rivers.

Suddenly the town was without a reliable water source. Residents were warned not to use the water for any purpose—a complete shut-off. The community identified a retention pond that had been piped but not tested for use as drinking water.

"I called all of our environmental group together," Gunsalus remembers. "I told them a town in south Kansas wouldn't have any water for Thanksgiving weekend. We needed to test the river and also do a full screen of the new water source. Were they in?"

Some staff took the first overnight shift, returning to work later that day after a nap. The next few days were a flurry of activity: receive the samples at the airport, incubate, extract, analyze, repeat.

"We glutted the bottle supply to make sure staff had all the containers they'd need. Everything would change so quickly," Gunsalus says.

Microbial contaminants were of concern in the new water source. Acetone, diethylene glycol monobutyl ether, ethylene glycol, methanol, PCE and toluene were of concern in the rivers.

In the midst of all this, one testing instrument failed on Thanksgiving day. Since the vendor was unavailable, the lab and regulatory team worked Thanksgiving day to resolve the issue and approve the water source.

Neodesha and other towns drawing water from the Verdigris and Fall Rivers graduated from the initial "no water use" to "boil advisory" by Friday. The boil advisory was then lifted within a week of the explosion.

"This event made our testing very tangible," Gunalus says. "I've been in this work for 28 years and have never seen a team respond with such a sense of purpose as this team did. They stepped up and were awesome."

A lesson learned? "Communicate," Gunsalus says. "It's important to keep up on FEMA's command system. On the health side of the lab, many think of Incident Command System, but on the environmental side it's not so common."

In the end, Gunsalus says it's about restoring peace to a community. "We do tests all year 'round. We know it affects people, but it's not always tangible to us. We're not always able to connect that sample of water to somebody. But here it was very clear. The team stepped up and said, 'You know, I'll do that. I really feel good about helping these citizens. We're stepping up, not just working hard.'"

UPCOMING EVENTS

National Biomonitoring Meeting
October 22-24, 2019 | St. Paul, MN
Register by **October 8, 2019**

APHL 2020 Session Proposals
Submit proposals by **November 1, 2019**

US EPA WLA Security Summit
November 13-14, 2019 | Atlanta, GA

APHL 2020 Poster Abstracts
Submit abstracts by **January 17, 2020**

APHL Committee Applications
Submit Applications in March

APHL 2020
June 8-11, 2020 | Portland, OR

EPA CONTINUES TO UPDATE ITS ESAM PROGRAM

By Michaela Burns, communication specialist; Erin Silvestri, MPH, biologist; Emily Snyder, PhD, division director; Kathy Hall, MBA, health physicist; Sarah Taft, PhD, associate division director, US EPA National Homeland Security Research Center, Threat and Consequence Assessment Division

The US Environmental Protection Agency (EPA)'s continued development and re-evaluation of analytical methods and protocols provides an invaluable resource for laboratories faced with incident response. EPA's Homeland Security Research Program (HSRP) aims to increase the United States' capabilities to prepare for and respond to environmental disasters involving oil and hazardous substances such as chemical, biological, radiological and nuclear. As part of that effort, HSRP develops scientific data, methods and tools that can be used by various stakeholders, including laboratories and on-scene coordinators, to increase the effectiveness of response.

One of HSRP's most important efforts is the Environmental Sampling and Analytical Methods (ESAM) Program. Launched in 2018, the ESAM program and associated website is a one-stop resource for field-and-laboratory-ready documents and web-based tools, used to support characterization and post-decontamination sampling of sites following an intentional or accidental homeland security-related contamination incident. An ESAM overview was featured in *Bridges* Issue 20: Summer 2018. This article provides an update on current and upcoming changes to ESAM since that article.

ESAM Updates

ESAM has been improved through several major changes. The ESAM webpage has a new weblink and the webpage has been redesigned for easier navigation. In addition, three new topic areas have been added which support sample collection and analysis and provide links to other HSRP resources to create five distinct sections of resources that support the remediation of a contaminated site:

Sample Collection Procedures and Strategies

Contains links to the sample collection procedures and strategies, Pacific Northwest National Laboratory's Visual Sample Plan (VSP), and the Sample Collection Information Documents (SCID). The SCID documents and query tools provide general information for collection of samples.

Analytical Methods and Protocols

Contains links to collaborative analytical methods and protocols, which were developed by HSRP together with partnering laboratories and agencies, and the Selected Analytical Methods for Environmental Remediation and Recovery (SAM). The SAM document and query search identifies select processing and analytical methods for analyzing samples following an intentional or unintentional contamination incident involving biotoxin, chemical, biological, or radiochemical agents.

Homeland Security Research Tools and Resources (New)

Includes links to HSRP and Waste Management Tools, which can be used by partners to prevent, prepare for and recover from contamination incidents involving chemical, biotoxin, pathogen, and radiological agents.

Data Management (New)

Includes link to EPA's software tool, Scribe, which can assist with managing environmental sampling data, observational data, and monitoring field data.

Data Quality and Planning (New)

Includes links to HSRP-developed sampling and analysis plan resources for pathogens and resources to manage the quality of environmental data.

SAM Revision Process

In addition to the ESAM website changes, in 2020 HSRP will begin the next cycle of the SAM revision process by convening SAM workgroups. SAM methods will be reviewed and updated by discipline-specific SAM workgroups (i.e., chemicals, pathogens, biotoxins or radiological analytes), typically comprised of EPA, and other federal, state and local agency experts. Workgroups will evaluate and revise the selected methods listed for each analyte and matrix (e.g., air, water, soil, etc.) pair or, if necessary, replace them with more current methods. Workgroups will also advise on the applicability of the selected method for the matrix/analyte combination (i.e., the extent to which the analysis methods have been tested and applied for the specific analyte and sample type selected). The next version of SAM is due in mid-2022.

When the SAM document is updated, SAM companion documents and ESAM will be updated to include the analytes/matrices/methods revisions. SAM workgroups will help to review changes made to the SCID. In addition, EPA will publish one-page addendums that describe to readers new methods that become available in between SAM revisions. The ESAM website is revised on an ongoing basis as new research becomes available but will be updated by default when the SAM workgroups finish, and the latest version of SAM is released. ■

APHL labs members interested in participating in the next round of SAM revisions should contact Kathy Hall (Hall.Kathy@epa.gov) or Erin Silvestri (Silvestri.Erin@epa.gov) and indicate your discipline of interest. Workgroup members will participate in conference calls to discuss needed revisions and suggested method updates for their discipline-specific section. Workgroup members will also help review drafts of the document. Five APHL members contributed to this process during the last revision cycle.

MOBILIZING LABORATORIES TO PROTECT COMMUNITIES FROM PFAS

by Nancy Maddox, MPH, writer
This story originally appeared in the Winter 2019 issue of APHL's quarterly magazine, Lab Matters.

In the 1930s—when manufacturers began a frenzied period of product development creating vinyl, nylon and a host of other synthetic materials—scientists made a seminal discovery: bonding fluorine atoms to a simple carbon backbone yields compounds with amazing chemical properties, such as ultra-low friction, fierce water repellency and exceptionally long half-lives.

Collectively known as per- and polyfluoroalkyl substances, or PFAS, these compounds now pervade almost every aspect of modern life.

Polytetrafluoroethylene (PTFE), the first in this huge family of compounds, was the basis for Teflon® non-stick coatings. Other PFAS repel water, oil and stains in umbrellas, tents, Gore-Tex® outerwear, carpets and upholstery. They repel grease and moisture in pizza boxes, fast food wrappers, microwave popcorn bags and pet food bags. And they have been incorporated into everything

from cell phones to fabric softeners to Oral-B® Glide dental floss.

Beginning in the late 20th Century, they also began turning up in human blood, with the most heavily exposed populations located on or near industrial sites, such as chemical manufacturing plants, and the hundreds of airports, military facilities and fire departments that store and use PFAS-containing firefighting foams.

According to the US Centers for Disease Control and Prevention (CDC), in 2000, the average US resident had a blood perfluoroctane sulfonic acid (PFOS) level of 30 µg/L; 3M workers had roughly 500 µg/L.

Human exposure, in turn, has been associated with a long list of health problems, notably including kidney and testicular cancers, thyroid disease, pre-eclampsia, asthma diagnoses and decreased antibody response to vaccines, especially in children.

"People are scared," said Doug Farquhar, JD, who analyzes environmental health legislation for the National Conference of State Legislators. "That's putting a lot of pressure on [government] agencies to come up with some sort of response."

And that, in turn, has created a growing—as yet, unmet—demand for laboratory testing to detect and measure the chemicals in people and in the environment.

PFAS Testing: Costly, Complex

But laboratory testing for PFAS isn't cheap. Or easy. Patrick Parsons, PhD, head of environmental health sciences at New York's Wadsworth Center—the state public health laboratory—explained the hurdles. First is cost.

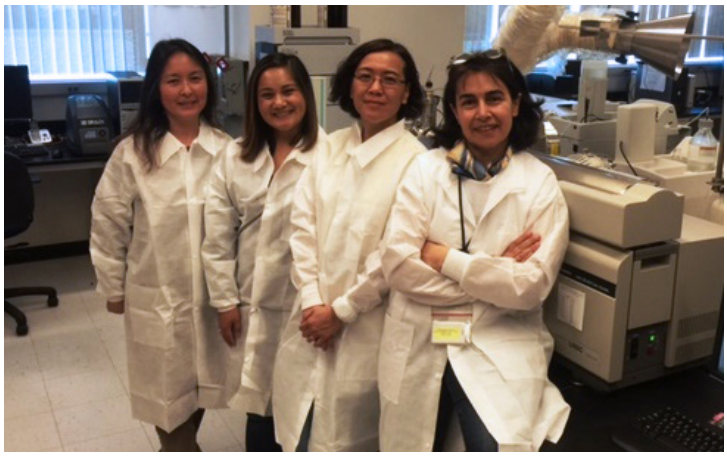
"Testing for PFAS in aqueous samples involves an extraction of the analytes using solid phase extraction (SPE) techniques and determination using liquid chromatography coupled to tandem mass spectrometry (LC/MS/MS)," he said. "The type of LC/MS/MS instrumentation for this analysis costs between $250-300K and a further $140K for the automated 96-well plate technologies for SPE for serum testing, and a further $40K for the automated SPE for water testing."

Older LC/MS/MS systems may be incapable of detecting PFAS at the low levels required, on the order of parts per trillion (ppt).

A second problem is contamination from PFAS already in the laboratory. Thus, sample introduction systems have to be stripped of Teflon® degassers, Teflon® SPE cartridges, PTFE vial caps and all other PFAS-containing components.

Of course, laboratories must also have staff experienced in mass spectrometry and assure additional, specialized training in trace analysis of the compounds.

And because there are few standardized test methods for these unregulated chemicals—and literally thousands of possible analytical targets in a variety of test matrices—scientists must often develop and validate their own testing protocols.



Biomonitoring California laboratory staff analyze samples for many different chemicals, including PFAS. From left to right: Qi Gavin, Josephine DeGuzman, Yu-Chen Chang and Rana Zahedi. (Photo: CA PHL)

After all these tasks have been accomplished, laboratories still need approval from the US Centers for Medicare and Medicaid Services before clinical test results can be reported to patients. "This requires a substantial amount of work to document the validation studies performed and to develop the protocols that meet clinical quality standards," said Parsons.

Analyzing drinking water for PFAS, he said, "also requires a substantial effort to document validation and to develop the detailed

protocols that meet environmental quality standards."

State laboratories in at least ten jurisdictions—CA, IA, MI, MN, NH, NJ, NY, RI, UT, WI—have tested or currently test for select PFAS in human blood, drinking water or both. At least three of these states also test other matrices, such as groundwater, wastewater and surface water. Michigan has tested deer and fish.

Wadsworth, a leader in PFAS analytics, can measure up to 11 PFAS targets in human serum and up to 16 PFAS compounds and eight perfluoroalkyl ether carboxylic acids (a newer class of PFAS chemicals) in drinking water. Additionally, Wadsworth scientists have developed more than ten novel methods for PFAS measurement in a variety of matrices, including newborn screening dried blood spots. The laboratory serves as resource to neighboring states and contributes to a number of federal biomonitoring studies.

The California Department of Toxic Substances Control uses two test methods to detect PFAS in serum. One targets 12 long carbon chain perfluorochemicals—the most persistent, bioaccumulative and toxic compounds within the PFAS class (the same test panel historically used for CDC's population-based PFAS surveillance). The other targets some of the newer, short carbon chain PFAS and precursor compounds.

But even with these state resources, Julianne Nassif, MS, director of APHL's environmental health program, said national capacity for PFAS testing falls well short of demand, especially as the potential dangers of PFAS exposure become more publicized and as the chemicals turn up in more and more sites.

The newly launched National Biomonitoring Network (NBN) is preparing to offer training and technical assistance to states seeking to institute clinical PFAS testing programs, but there is no comparable entity to boost capacity for environmental PFAS testing.

"NBN funding comes from CDC, so it's limited in how it can be used," said Nassif. "We'd love to have a similar structure to build capability and capacity for PFAS water testing in the state laboratories," perhaps supported by the US Environmental Protection Agency (EPA) and US Department of Defense.

APHL RESOURCES

Webinars
Take advantage of APHL's free webinars and other training materials

Quality Improvement Forum Call: Iowa Private Well Survey
Recorded call from July 2019

Past Issues of *Bridges*
Now you can access all previous issues of *Bridges* on aphl.org

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Access APHL's complete collection of publications

APHL Blog
Find all the blog's environmental health stories in one place

***Lab Culture* Podcast**
Find the complete collection of APHL's podcast, *Lab Culture*, on the blog

APHL 2019 Presentations
Access many presentations from APHL's annual conference.

At present, much of this environmental work has been handed off to commercial laboratories. While "expedient," Nassif said, "I don't think [reliance on contractors] is a good long term solution. … States should have capability to perform that testing. It would be prioritized; it would be high quality testing." Moreover, a state "primacy" laboratory for environmental PFAS testing could be responsible for quality oversight in the commercial sector and for confirmatory testing in cases where contract labs report differing results.

"The Public is Just Up in Arms"

While laboratory data are critical to inform PFAS investigations and response, the utility of the data is limited by serious scientific gaps. For example, since 1999 CDC has been measuring serum levels of select PFAS chemicals as part of its National Health and Nutrition Examination Survey (NHANES), but there is no national standard for human PFAS exposure to explain what those findings mean.

Eden Wells, MD, MPH, FACPM, former chief medical officer for the state of Michigan, said, "There is no blood level that can advise

clinical response, because there's so little known about PFAS clinically. We don't know what a level in the blood may mean in terms of past exposure, current risks or future health outcomes."

NHANES data are, however, critical for establishing national background levels—against which local test data can be compared to identify cases of elevated exposure—and for monitoring exposure trends. For example, after manufacturers began voluntarily phasing out use of PFOS around 2000, average US blood concentrations fell by more than 80% over the next 14 years.

Yet CDC tracks only a small handful of the thousands of PFAS compounds in existence.

The California Department of Public Health (CDPH)—the first state to begin population-wide PFAS biomonitoring—noted in an e-mail the challenges associated with this broad class of chemicals:

"Developing methods to identify and measure new compounds is difficult and time consuming, all the more so because we usually do not know what compounds are being used commercially. There are also many analytical complications. Analytical standards (needed for method development) are not readily available. Some of the newer replacement PFAS, such as shorter chain and ether-based compounds, require specialized analytical methods to detect, and there isn't a consensus yet about how to interpret and report results. These issues are difficult to resolve, and new chemicals are being used in products and released into the environment every day."

The environmental side of the issue is similarly fraught. In 2016, EPA lowered its drinking water health advisory limit for PFOS and perfluorooctanoic acid (PFOA)—two of the best studied PFAS legacy compounds—from 200 ppt PFOS and 400 ppt PFOA down to 70 ppt for both chemicals combined. But this is a nonbinding limit. (A draft CDC toxicology report released last June suggests a much lower lifetime exposure limit for the same compounds.) While the agency is evaluating the need for a Safe Drinking Water Act maximum contaminant level for PFOA and PFOS, a final determination and enforceable regulation are likely years away.

In the meantime, EPA is also developing draft toxicity values for the PFOS/PFOA replacement chemicals GenX (HFPO dimer acid) and perfluorobutane sulfonic acid.

In the absence of stronger federal action, states have begun their own PFAS monitoring and interventions. Last June, for example, the North Carolina Department of Environmental Quality filed a court order requiring Chemours Company—a DuPont spinoff—to drastically reduce its release of GenX and other PFAS into the air and into the Cape Fear River watershed, where they had contaminated drinking water supplies and alarmed residents. Local communities blame GenX for a cluster of unexplained pediatric cancer cases there.

NCSL's Farquhar said, "People are very, very concerned. They want a solution. North Carolina is not known as a very environmentally rigorous state, which is probably part of the reason [Chemours] built there. Now [the issue has] come back to the

CONTRIBUTE TO THE MEMBER RESOURCE CENTER

The APHL Member Resource Center (MRC) provides an extensive range of resource materials designed to provide technical assistance within the public health and environmental laboratory sector. Created by and for the APHL member community, the MRC provides a virtual clearinghouse of documents designed to exchange practices, communications, protocols, state newsletters and more. The MRC assists APHL members in accessing timely, peer-contributed, public and environmental health information—rapidly and easily. These resources are not necessarily endorsed by APHL.

The APHL MRC is a vital instrument for the environmental laboratory community to remain knowledgeable in meeting today's challenges. Visit the MRC site to learn more and submit a resource. Please send feedback to memberresources@aphl.org.

Examples of MRC resources:

- Promising laboratory practices
- Lab testing protocols and guidelines
- Media relations procedures
- Local fact sheets
- Laboratory newsletters
- Energy management practices
- Human relations processes

state. The public is just up in arms."

Last February, 3M agreed to pay the state of Minnesota $850 million to settle a lawsuit related to PFAS drinking water contamination in the area surrounding the company's Cottage Grove manufacturing plant, just ten miles south of St. Paul.

A notable feature of the policy environment, said Farquhar, is that PFAS are a "very bipartisan" issue, as "reflective of public opinion." He said, "The state legislatures are not waiting for the federal government. It's not that they don't trust the government, they're just moving ahead."

During 2017-2018, at least ten states (CA, MI, MN, NC, NH, NY, PA, RI, VT, WA) enacted PFAS-related laws. Washington, for example, passed legislation banning the use of certain PFAS-containing food packaging and severely restricting the sale and use of PFAS-containing firefighting foam, beginning in 2022 and 2020, respectively.

Other states have instituted drinking water standards more stringent than EPA's 70 ppt health advisory level for PFOS and PFOA. For example, California requires public drinking water systems to notify residents when PFOA exceeds 14 ppt or PFOS exceeds 13 ppt. Vermont allows no more than 20 ppt for the sum of five PFAS, including PFOS and PFOA. New Jersey has a 13 ppt limit for perfluorononanoic acid, a particularly toxic PFAS discharged into the southern Delaware River area by a specialty polymers plant.

"Everyone Carries a Body Burden of These Persistent Chemicals"

Michigan began detecting PFAS in sites around the state as early as 2012, beginning with the area around the Wurtsmith Air Force Base (WAFB) in Oscoda and the Army & Air National Guard Training Center at Camp Grayling.

"We learned the military, right about that time, had begun to test their bases for PFAS, because firefighting foams carry these 'forever' chemicals, and they have to do a lot of training and put out a lot of fires," said Wells. "After that, we had citizen concerns."

Today, Wells serves on the Michigan PFAS Action Response Team (MPART), the first multi-agency, state PFAS working group in the country. Launched in 2017 at the behest of Governor Rick Snyder, MPART has statehouse support and funding. One indication of the group's stature is its initial leader, a former deputy attorney general of Michigan.

One of team's first actions was to convene a scientific panel to advise the state on response, mitigation and recovery activities.

So far, the state has proactively tested every public water utility in Michigan for select PFAS. It is in the process of testing drinking water from all schools, childcare providers and Head Start programs using well water, with results posted online.

After finding combined PFAS levels as high as 1,828 ppt in treated drinking water from the tiny town of Parchment (population 3,174), officials acted swiftly, directing the digging of a tunnel to service Parchment with drinking water from nearby Kalamazoo.

COMMUNICATION TOOLKITS

APHL Environmental Health Laboratory Toolkit

APHL is in the process of producing a set of materials to help laboratory directors and communications officers better convey the environmental work their labs do. More promotional materials are planned for the coming year, but two resources are available now:

Key Messages
Three talking points and supporting facts.

Questions & Answers
Basic questions about environmental labs with answers in layman's terms.

Increasing Private Well Testing Toolkit

APHL members, in collaboration with the Minnesota Department of Health and the Private Well Class, developed a new communications toolkit to help water testing laboratories protect private well water user health and promote well water testing. Tools include recommendations for strengthening communications with private well users, suggested social media posts and a postcard template to remind private well users to get their well water tested.

"We had a municipal water hook-up in about a month's time between when we got the test results back and when there was basically a permanent solution in place," said Wells. "The key is that a lot of that came about because of MPART; leadership could quickly grasp what needed to be done."

The MPART website includes a map showing 36 sites under investigation for PFAS contamination, including military facilities, tanneries (which often apply PFAS-containing ScotchguardTM to leather goods), the site of a tanker spill, metal plating facilities, a commercial laundry, a Superfund site, landfills and other locations. A separate webpage identifies lakes and streams affected by PFAS.

Wells said authorities are also investigating possible PFAS contamination in deer and fish consumed in this "hunting state," and are considering testing wild birds. Another concern, she said, is waste that is converted into biosolids and added to agricultural fertilizers.

Half a continent away, California has been focused on PFAS for over a decade via a state biomonitoring program established by law in 2006. Historically, the program has received baseline state funding of $2.2 million per year, supplemented in most years with CDC funding ranging from $1 million to $2.5 million. Individual biomonitoring studies measure PFAS in maternal and infant populations, firefighters and Asian/Pacific Islanders. And a separate statewide surveillance project assesses the PFAS exposure of the general California population.

According to CDPH, "What we find, in every study, is that just about every person has been exposed to PFAS. Regardless of where you live or what kind of work you do, everyone carries a body burden of these persistent chemicals."

More heavily exposed groups in the California studies include firefighters—found to have significantly elevated levels of perfluorodecanoic acid relative to NHANES adults—and Asians, found to have higher levels of PFOS than Asians in NHANES. Overall, California men were found to have higher levels of PFOS and PFOA than California women, although levels of these two legacy compounds are decreasing.

As PFAS exposure routes become better understood and the public health response evolves, state laboratories will continue to play a vital role. Andy Gillespie, PhD, executive lead for EPA's PFAS research and development, said laboratory testing to assess human exposure "is key to understanding risk and to understanding risk management options," such as carbon filtration or ion exchange to remove the chemicals from drinking water.

Gillespie expects LC/MS/MS testing technology to become less costly and more accessible over time, with improved tools to support data analysis. The laboratory response, he said, must progress "not only in terms of bandwidth—greater testing capacity—but also pushing the science to more advanced capability."

Currently, Gillespie said, EPA is doing considerable research into non-targeted PFAS testing, using high-resolution mass spectrometry (HRMS). Whereas targeted analysis measures "maybe 18 to 24 analytes and that's all the method can see," he said non-targeted analysis detects "everything that's in a sample," followed by "a lot of detective work … to figure out what you're seeing." The technology is mostly used in research laboratories today.

Asked if he had any message for state laboratories, Gillespie responded with three. First, he said, "PFAS are likely to be contaminants of concern for a long time to come," due to the persistence of legacy compounds and the ongoing production of new ones. Second, he said, "Increased analytical capacity for analyzing samples will be needed and welcome." And lastly, he encouraged scientists to follow HRMS advances: "Follow that science and be ready to move in that direction." ■

PROTECTING ENVIRONMENTAL RESOURCES IN THE SOONER STATE

by Gynene Sullivan, MA, manager, Communications, APHL
This story originally appeared in the Summer 2019 issue of APHL's quarterly magazine, Lab Matters.

The name "Oklahoma" comes from the Choctaw phrase okla humma, literally meaning "red people." Equivalent to the English word Indian, okla humma described Native American people as a whole. But it's also known by its more common nickname, "The Sooner State" in reference to the non-Native settlers who staked their claims on land before the official opening of lands in the western Oklahoma territory.

A major producer of natural gas, oil and agricultural products, the state relies on an economic base of aviation (generates $11 billion annually), energy (third largest producer of natural gas and fifth largest producer of crude oil), telecommunications and, more recently, biotechnology. It also boasts more than 10 distinct ecological regions within its borders – more per square mile than any other state. With four separate mountain ranges—the Ouachitas, the Arbuckles, the Wichitas and the Ozarks—more than 500 named creeks and 200 lakes created by dams, there is a critical need for environmental testing for Oklahoma's 3.9 million plus residents.

Chris Armstrong, director of the Oklahoma Department of Environmental Quality State Environmental Laboratory (DEQ SEL) has been at the forefront of environmental public health in Oklahoma for over four decades. "It's been gratifying to see the effects our laboratory has had on the environment in the state."

Facility

DEQ SEL was previously under the umbrella of the Oklahoma State Department of Health, but separated from it in May 1998. The 48,000 square-foot laboratory resides in what used to be the Bell Telephone Building, a Brutalist-style building situated directly north of the Oklahoma City National Memorial Museum in what has become a bustling, vibrant downtown. Its BSL-2-rated facility occupies the ninth and tenth floors, and there are specialized areas in the basement for radiochemistry instrumentation, on the third floor for storage, and on the first floor for receiving.

Oklahoma Department of Environmental Quality laboratory staff. (Photo: SELS)

Director

A lifelong Oklahoma resident, Armstrong received his bachelor's in microbiology with a chemistry minor from Oklahoma State University. But he worked construction for over a decade before joining a local medical research foundation, performing tissue culture and working on animal immunotherapeutic protocols. "Organic extraction labs have very specialized HVAC needs, and I was the only one who had a really good understanding of that when I first started," Armstrong said. He loved research, but he soon found himself with a family of five, so he became a clinical microbiologist doing STD microscopy cultures and zoology. He made the jump to environmental science after participating in Oklahoma's first wasteland allocation study, and has served as a supervisor to both a clinical laboratory and an environmental laboratory.

Staff

DEQ SEL has 57 full time employees. More than 90 percent of the staff have an undergraduate degree in chemistry, biology or microbiology and have a minimum of 11 years of experience. Two staff members also serve as laboratory accreditation assessors. "We're currently three positions down, but we hope to replace those folks soon."

Revenue

DEQ SEL has a budget of $7.2 million, of which approximately 47% is fee revenue, 33% is appropriation and 20% is federal grants. While fees for testing are fixed, Armstrong says, "We had the foresight to include a Consumer Price Index (CPI) clause into our budget," so fees would have an automatic increase based on the CPI of the previous year.

Testing

The laboratory provides technical and analytical support for the air quality, well water quality, land protection, and environmental compliance and local services divisions of the Department of Environmental Quality. It is also involved with four different EPA programs: Safe Drinking Water, Clean Water Act, CERCLA and FRPA. "We are the only laboratory that tests drinking water in the state of Oklahoma," says Armstrong, which encompasses over 1,700 public water supply systems. "We also have a lot of small communities, with very little means, that rely on us for water testing." In fact, requests for private water issues have quadrupled over the past five years, with the laboratory responding to over 12,000 requests in 2018.

DEQ SEL provides fish testing for 97 lakes across the state, testing for Cryptosporidium girardi and mercury levels, and is responsible for issuing consumption advisories as needed. In 2011, the state found itself involved in its first large harmful algal bloom on Grand Lake, but DEQ SEL was able to respond because of its existing sample identification, numeration and toxin testing program.

The laboratory also runs an accreditation program to insure the quality of analytical data received by the DEQ Water Quality Division and other state agencies for compliance and decision making purposes. The overarching goal is to provide standards for accreditation of privately and publicly owned laboratories for performance of analyses of water, wastewater and sludge. DEQ SEL is in the process of implementing qPCR for surface water and source water monitoring to assist with these efforts.

Through a state legislative requirement, DEQ SEL has the responsibility of investigating all environmental complaints anywhere in the state. From an unknown yellow power on the highway to a hazardous waste spill, the laboratory is required to respond. The laboratory is also required to respond to any HAZMAT incidents, providing anything from sampling assistance to risk management, and assist with management of all Superfund sites.

Successes

- Being one of the first businesses to return to downtown Oklahoma City after the 1995 bombing: "We were right around the corner from the Murrah building and we were among the first responders doing air quality testing after the explosion."
- Actively improving the air, water and lands of Oklahoma. "I've been working here for over 40 years, and I've seen the results first-hand."
- Data quality and reproducibility: "We've implemented a very good quality system and, through the accreditation program, we've forced the private labs to do that as well."
- Bolstering the radiochemistry program: "We've really expanded the program over the last 12 years, and with the implementation of a new LIMS, we're able to actually interface instrumentation and quality control."

Challenges

- An understanding of public health and, more specifically, of environmental public health. "Sometimes it's difficult to convey the scope of the work that we do, and its effect on the public."
- Funding: "We've had funding cuts every year for the past 12 years. But I'm thankful that our director has really made an effort to pay our staff market value. Couple that with increases in instrumentation expenses and training requirements, and we're sometimes straining to cover all divisions."
- Succession planning: "We've been staff stable for a good period of time, but over the last two years we've seen some turnover. As folks leave and new staff come on board, we need to plan for those transitions now."
- Centralized systems: "Invoicing and IT support have been challenging under a centralized state system. A laboratory has very specialized systems needs that are sometimes hard to convey in a memo or purchase order."
- The possibility of moving the laboratory to another building: the Oklahoma City Center is a thriving area of commercial and residential spaces. Condos downtown are currently valued at over $500,000, so there's a lot of interest in the current building. "The only thing that is preventing the sale of the building is the laboratory. And I've already moved a laboratory once."

UNIVERSITY IN MALAWI INVESTIGATES FOOD AND WATER SAFETY AT LOCAL INFORMAL MARKETS

By Rochelle Holm, PhD, PMP, Centre of Excellence in Water and Sanitation, Mzuzu University

In sub-Saharan Africa, more than 80% of household food purchases are made at informal markets[1] which are often in open-air public spaces, and, in Malawi, fish is a major protein source commonly purchased from such individual vendors. Despite this, much of the environmental research around water, sanitation and hygiene focuses on schools, health centers and households rather than more public spaces such as food markets. To fill this gap, investigators from Mzuzu University, a government university in Malawi, Africa, decided to focus their environmental laboratory investigation efforts on food safety policies and practices in public food markets.

Both photos above show fresh fish sold from individual vendors at an informal market in Mzuzu, Malawi. (Photos: Rochelle Holm)

The study—led by a senior level student from the Department of Fisheries and Aquatic Science, Jazimoni Lazaro—aimed to review national acts and policies and local regulations focused on fresh fish sold at open-air markets or by mobile bike vendors, and to further examine a case study of the water, sanitation and hygiene environment that may impact food safety in Mzuzu City, Malawi. Lazaro gathered data via interviews, observational checklists, and sampling of water and fish skin.

In general, it was found that there was limited food safety-related oversight, and inadequate monitoring guidance. While three of the four markets had access to water, in only two was there safe water (0 cfu/100 ml for *Escherichia coli*). All fish skin samples were positive for the presence of *Salmonella* spp., and most had high *E. coli* levels. Toilets were available for vendors and customers in two of the four markets, but the use was limited. No handwashing stations with soap were available for any of the vendors to use in the studied areas.

To improve public health outcomes associated with selling fish at these markets, Lazaro and his colleagues suggest three key opportunities for reform:

- National acts and policies and local regulations must consider informal food markets and mobile vendors
- Safe water, clean and functional toilets, and handwashing stations with soap accessible for all food vendors
- Education for food vendors on foodborne disease.

The findings of this study have been published in the journal *Food Science & Nutrition*.

1 Roesel, K, and Grace, D. (Eds.) (2014). *Food safety and informal markets, animal products in Sub-Saharan Africa*. New York, NY: Routledge.