



*Many Voices Working for the Community*

# Oak Ridge Site Specific Advisory Board

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## *Monthly Meeting of the Oak Ridge Site Specific Advisory Board*

### **APPROVED March 13, 2019, Meeting Minutes**

The Oak Ridge Site Specific Advisory Board (ORSSAB) held its monthly meeting on Wednesday, March 13, 2019 at the DOE Information Center, 1 Science.gov Way, Oak Ridge, TN, beginning at 6 p.m.

Copies of referenced meeting materials are attached to these minutes. A video of the meeting was made and is available on the board's YouTube site at [www.youtube.com/user/ORSSAB/videos](http://www.youtube.com/user/ORSSAB/videos).

#### **Members Present**

David Branch  
Richard Burroughs, Secretary  
Bill Clark  
Martha Deaderick  
Sarah Eastburn

Eddie Holden  
Shell Lohmann, Vice Chair  
Harriett McCurdy  
Marite Perez  
Leon Shields (call-in)

Bonnie Shoemaker  
Fred Swindler  
John Tapp  
Dennis Wilson, Chair

#### **Members Absent**

Leon Baker  
Nannan Jiang

Brooke Pitchers<sup>1</sup>  
Belinda Price

Ed Trujillo<sup>1</sup>  
Rudy Weigle

<sup>1</sup>Second consecutive absence

#### **Liaisons, Deputy Designated Federal Officer, and Alternates Present**

Dave Adler, ORSSAB Deputy Federal Designated Officer, Department of Energy, Oak Ridge Office of Environmental Management (DOE-OREM)

Melyssa Noe, ORSSAB Alternate Deputy Designated Federal Officer (DDFO), OREM

Kristof Czartoryski, Tennessee Department of Environment and Conservation (TDEC)

#### **Others Present**

Mark Peterson, Oak Ridge National Laboratory (ORNL)

Elizabeth Phillips, OREM

Roger Petrie, UCOR

Shelley Kimel, ORSSAB Support Office

Sara McManamy-Johnson, ORSSAB Support Office

14 members of the public were present.

### **Liaison Comments**

**Mr. Adler** – Mr. Adler told board members OREM began tearing down one of the last remaining buildings at East Tennessee Technology Park (ETTP) – Building 1037, which was the building where the gaseous processing equipment used at K-25 was produced, maintained, and serviced. He told members it would be done very quickly, and when it was done, there would only be one other large building left. He said the main message is that OREM is nearly finished with the buildings at ETTP, then some soil work will be done, “then we’ll be closing in on, hopefully, being done at the ETTP site.”

Mr. Adler also told board members that a large group of people from OREM recently attended the 2019 Waste Management Symposia in Phoenix, Arizona. He said that while there, OREM Manager Jay Mullis met TDEC’s new commissioner, and the two had a productive meeting.

**Mr. Czartoryski** – None

### **Presentation**

Ms. Lohmann introduced board members to Mark Peterson, presenter for the evening’s topic, Aquatic Ecology Research and Technology Development in East Fork Poplar Creek.

Mr. Peterson told board members he would first talk about the mercury problem in general before going into more details about East Fork Poplar Creek and the work his research team has been doing. A key characteristic of mercury (Hg) is its density. Mr. Peterson said an example is images of mercury and lead with lead blocks floating on top of mercury, illustrating just how dense it is. Mr. Peterson said mercury’s physical properties make remediation difficult. If you dig a hole with elemental mercury in the soil, the mercury beads end up at the bottom of the hole. As you dig more, the mercury becomes more embedded into the environment, and closer to the subsurface flow paths in the groundwater. He said when mercury is in buildings, it will invariably end up in basements, where there is an interchange between the building and the surrounding soil. When storm drains are involved, mercury travels into cracks and crevices at the bottom of the storm drains, and it gets into the footers of the storm drains, where subsurface flow paths are located.

Other than elemental mercury (Hg (0)) there are forms of the main types of inorganic mercury, mercury 1 (Hg (I)) and mercury 2 (Hg (II)). He said one that most people are familiar with is mercuric sulfide, commonly called cinnabar, which is the form normally found in the environment and is a very stable form. However, mercury 2-plus (Hg (II)), a dissolved ionic form found at Y-12 National Security Complex (Y-12), is normally rare in the environment, but at Y-12 chlorine interacts with elemental mercury and oxidizes into mercury 2, which then is more mobile and potentially more bioavailable in the downstream environment.

In addition to the chemistry and the complex physical aspects to it, mercury can also be methylated by microorganisms. The resulting methylmercury is the most highly toxic form, said Mr. Peterson, and can cause neurological and reproductive harm. It accumulates in muscle tissue, and concentrates as it moves up the food chain. He said the primary risk relative to bioaccumulation of methyl mercury is typically through fish that are ingested by wildlife and/or humans.

Next, he gave board members an overview of how East Fork Poplar Creek is geographically situated. He said Y-12 is at the headwaters of East Fork, which flows east-northeast, goes through Pine Ridge, then bends to go west into the City of Oak Ridge. He said Y-12 has released a total of about 700,000 pounds of mercury into the environment, mainly during the 1950s and 1960s when mercury was used in industrial processes. To provide perspective, he said that quantity is equivalent to the volume of a 15-foot moving truck and a 5-by-8-foot cargo trailer, relatively small in size compared to volume, again due to its density. This has resulted in 15 miles of East Fork and 5 miles of Poplar Creek exceeding ambient water quality criteria for mercury concentrations. He said a

lot of work has been done in Oak Ridge, and specifically at Y-12, to address mercury issues, and he showed board members a timeline of actions that have affected mercury in the environment and mercury concentration data coinciding with those actions. He said some activities targeted mercury sources and some targeted mercury concentrations in the creek.

Next, he highlighted the disconnect between total mercury in water and total mercury in fish. In East Fork site and Lower East Fork Poplar Creek, mercury in water measures about a thousand parts per trillion (ppt) near the headwaters and this decreases by distance downstream so there is a 10-fold decrease between upstream East Fork and downstream East Fork. This is consistent with a point source, where you expect dilution and declining concentrations in water as you go downstream. He said all of the mercury concentrations in East Fork Poplar Creek, regardless of where they were collected, are below drinking water standards.

Mr. Peterson said fish in the Upper East Fork have mercury concentrations of 0.6 parts per million (ppm) and in the Lower East Fork, it's twice as high. The EPA's recommended criterion is 0.3 ppm. He said that although you would expect with declining total mercury in the water that with distance you would expect a similar decline in fish concentrations, concentrations in fish instead have gone up. The reason is that there's not a linear relationship between total mercury in water and the fish. He said it goes back to the methylating environment and the other factors. If you have a methylating environment, you can get a lot of methyl mercury in water, then that can be an issue with bioaccumulation in fish. Many variable conditions, including pH, dissolved organic carbon, and the amount of wetlands in the system can impact mercury concentrations in fish. He said that's a real challenge when thinking about remediation and just focusing on source reduction. It's not enough ultimately to deal with the source, we have to think about other kinds of solutions to address the mercury issues.

Mr. Peterson next detailed the strategy DOE is using to address mercury issues in Oak Ridge. He said the primary mercury remediation strategy for DOE is a phased adaptive management approach, and the first priority is to get the Mercury Treatment Facility (MTF) online, which is currently scheduled for 2024. The facility will reduce the mercury flux from the most contaminated outfall in Y-12 into the creek and to provide a control mechanism as buildings start coming down to try to control mercury releases during the demolition. After MTF becomes operational, the creek environment will be monitored to see what effects the facility has.

In the meantime, said Mr. Peterson, the Aquatic Ecology Group at ORNL has been working to develop interim technology solutions for the downstream environment, anticipating multiple approaches will need to be combined with MTF to reach target concentration levels, especially in the downstream environment. He said the researchers' strategy includes three main tasks: Addressing the soil and groundwater sources in the downstream environment; trying to develop water chemistry or sediment manipulation options and technologies; and to evaluate potential ecological manipulations.

He said there are three key factors determining the level of mercury contamination in fish: The amount of inorganic mercury available in ecosystems (the source); the conversion of that inorganic mercury to methylmercury (the more toxic form of mercury); and then the bioaccumulation within the food chain. Researchers' goal with technology development is to try to develop strategies for all three of those issues.

Mr. Peterson told board members that the primary study locations include Y-12 at the East Fork headwaters, where there is a gauging station for flow and water chemistry that UCOR and Y-12 maintain; there's a gauge at the Wiltshire Drive area; there is another gauge at the Horizon Center; and there are various biological monitoring sites as well as groundwater sites along the stream. Mr. Peterson showed attendees a video from a kayak survey that was done of East Fork Poplar Creek from the headwaters to the mouth to investigate bank soil and sediments characteristics in the stream, especially relative to bank erosion. It can be found at <https://www.energy.gov/ore/download/orssab-meeting-march-13-2019>.

He next detailed how researchers have approached the project. He said they have used erosion information to focus in on small zones where there is high mercury and high erosion. He said researchers want to target those areas for potential technology deployment to reduce mercury flux into the system. They've been looking at various sorbent technologies to see if they can prevent mercury from getting into the creek.

As far as the source identification and bank erosion issues, Mr. Peterson said researchers believe there is the most potential to reduce mercury flux to the stream within two zones, identified as the NOAA and the Bruners sites, for making a significant reduction in mercury flux.

He said researchers have been studying the effectiveness of sorbents with dissolved organic matter and how it affects methyl mercury. A lot of the work to-date has largely been done on mercuric chloride and mercury in water and effectiveness of sorbents in water, but it hadn't been tested much for use in bank soils, a very different environment. He said they've seen some promise using activated carbon fiber materials. One option being studied is to create some bank stabilization areas by applying sorbents and also stabilize through mat application to keep mercury in the soil from getting in the creek.

For the sediment and water chemistry task, the goal has been to reduce total mercury, but especially methylmercury concentrations in the water, he said. Researchers have various gauges through the creek to study seasonal and annual changes, to get a better spatial and temporal resolution of the concentration of the flux, and to do some various sediment source investigations. Additionally, he said, researchers have looked at using alternative chemicals, such as ascorbic acid (Vitamin C) at Y-12 that may help with the mercury issue. He said researchers have seen promise with using ascorbic acid to lower chlorine, and although longer-term testing is needed, it indicates that process adjustments inside the site at Y-12 could make a difference.

He said about 75 percent of the total mercury flux per day comes from the section between Station 17 and the outflow of Y-12 at Wiltshire Road, which is part of the upper section. However, the lower section seems to be the biggest concern in terms of methylmercury.. Researchers have also seen concentrations of mercury and methylmercury vary between night and day, with higher levels at night. They believe this variance is related to bioturbation – animals like crayfish and fish digging through mud – causing higher concentrations in the water.

Next, Mr. Peterson discussed the ecological manipulations that have been studied. He said that previously assumptions had been that most total mercury in fish fillets was methylmercury, by they've shown that is not the case. Now researchers are studying the organism populations in East Fork Poplar Creek to learn more about those that are present and whether they can be adjusted in any way. He said that within the last five years, they've found that periphyton – algae on rocks – is a place for methylation, so things like nitrates and nutrients, light, and shade can affect algae, which could then affect mercury methylation.

He also discussed the effects of food chains on mercury concentrations in fish. He explained that longer food chains cause higher biomagnification, and each organism has a different bioaccumulation potential. He said the greatest biomagnification step is between water and periphyton, which is a step of hundreds of thousands to a million-times higher in mercury. He said that after that, it becomes two-fold or three-fold. If adjustments could be made in the step between water and periphyton, there could potentially be adjustments all the way up the food chain. He said predators have a relatively high percentage of methylmercury because they are higher in the food chain; conversely, collectors/filterers, like clams and mussels, have very little methylmercury. If the number of organisms with low methylmercury can be increased in the system, the risk paradigm could potentially change for the community downstream.

Additionally, he said researchers have been looking at mussels and clams as a way to possibly reduce mercury in the water column. He said bivalve organisms – mussels, clams, and oysters – are highly effective at removing particles from the water, and he cited cases elsewhere where bivalves have been planted and cleaned the water. He

said if they can take a lot of the particles out of the water, that's potentially less particle-associated mercury available to periphyton and the fish food-chain pathway of exposure. He added that East Fork had a lot of mussels many years ago, and researchers know the species that were collected there. The Aquatic Ecology Laboratory has been working with the Tennessee Wildlife Resource Agency to obtain mussels that are native to the area. To illustrate the potential of this method, Mr. Peterson showed a fast-motion video demonstrating mussels' filtering capabilities. This video can be found at <https://www.energy.gov/orem/downloads/orssab-meeting-march-13-2019>.

Mr. Peterson said researchers have been studying filtration rates in the lab under various environmental conditions and examining substrate from the kayak surveys to find out where there is appropriate habitat. He said they've identified about a dozen species they think will be suitable for East Fork, and they're researching the available carrying capacity of East Fork for mussels. Additionally, he said they plan to do controlled studies in the Aquatic Ecology Lab evaluating how mussel filtering can affect mercury concentrations in water and fish.

In summary, he said, potential future strategies for decreasing mercury flux into the system starts with a mercury treatment facility. MTF will hopefully reduce a lot of mercury flux coming into East Fork, and although it hasn't been quantified yet, it may further reduce mercury flux from the soil banks. He explained that MTF will also have large storage tanks to collect some storm flow, and with that flow being released more slowly into the creek over time, it may potentially reduce bank erosion. Additionally, he said, they're exploring possible bank stabilization sorbent solutions for high-mercury streambanks. He said mercury removal from the banks is not an effective strategy at a large scale. Considering the physical and chemical aspects of mercury it's very hard and expensive to remove enough of the soil – he said targeted actions at the most contaminated sites for bank-stabilization and sorbent technologies might be the most effective.

He said researchers have a goal of developing watershed scale recommendations and potential strategies to employ that could provide benefits in reducing mercury flux or bioaccumulation. For example, he said, actions that decrease flashy flows to the creek, such as the use of pervious pavement in the upstream industrial and urban areas of the watershed. They know nutrients, algae, and light all affect mercury processing, methylation, and bioaccumulation, so developing a strategy for modifying these key environmental factors may be effective. Lastly, he said, the strategies involving the food chain could be effective. He said they could look at introducing mussels, and possibly fish management actions. In East Fork there are rock bass, redbreast, and bluegill, which vary a lot in their mercury content. The bluegill largely eat terrestrial insects that are low in mercury. By overstocking with bluegill and outcompeting these other species, there could be a two-fold reduction in the mercury concentrations in the fish.

Mr. Peterson told board members there are modifications planned for the Aquatic Ecology Laboratory to do flow-through testing of East Fork water in stream-like conditions in a controlled setting, so researchers can start scaling up and applying these technologies.

After the presentation board members asked the following questions:

- Mr. Clark asked if there have there been any studies on plants that absorb mercury or for erosion control.
  - Mr. Peterson said phytoremediation has been looked at, but the thought is to look at it for soil stabilization for areas where you might not be able to do more aggressive kinds of actions. He said that, as far as pulling mercury out of the soil and into the plant and then harvesting it, that raises cost issues and disposal issues. Where it's been applied previously is in flat wetland areas; when there's mercury in the soil, it's hard to get it out of there with plants, it becomes perpetual. He said, though, that plants can be a good solution for erosion control in some places, depending on the characteristics of the banks.

- Ms. Shoemaker asked if chlorine discharges from Y-12 have been eliminated and whether wetlands are beneficial.
  - Mr. Peterson said they are more looking at de-chlorination at the exit point of the storm drains. Regarding wetlands, he said wetlands are not beneficial in terms of mercury; they are generally methylating environments.
- Mr. Tapp asked what the situation is in Poplar Creek below the confluence with East Fork.
  - Mr. Peterson said in Poplar Creek, the concentrations go down, consistent with what you'd expect with increased flow and dilution, but they're still elevated.
- Mr. Tapp asked where the mercury goes when a mussel filters water and removes mercury.
  - Mr. Peterson said it goes into the mussel. They're picking up inorganic mercury, but they're very low in methylmercury. He said they wouldn't generally expect toxicity in the mussels, especially in the downstream section.
- Mr. Tapp asked if they have done any studies on what the releases need to be from the MTF storage tanks to maintain a flow that would not lead to bank erosion.
  - Mr. Peterson they've just recently obtained some specifications for MTF that can be used to run calculations. He said any capture of storm water is likely to help with the mercury because of decreases to erosion, but the benefits not been quantified.
- Mr. Clark asked if mussels are planted in East Fork Poplar Creek if there is any plan to collect those mussels later. He also asked whether the mercury goes into the shell or the flesh.
  - Mr. Peterson they plan to look at what happens to the mercury after the mussels die, but they don't plan to remove the mussels later. He said the mercury primarily stays in the flesh.
- Ms. McCurdy asked if any test have been done on what eats the fish.
  - Mr. Peterson said there's been some work associated with the Lower East Fork floodplain, largely for ecological risk assessment, evaluating prey. He said most toxicity benchmarks are based on prey. Therefore to model toxins in a hawk and what those risks are, you look to controlled laboratory studies on what that hawk's been fed to be able to evaluate the toxicity. He added that just because a receptor has mercury in a feather or tissue does not mean that it's negatively affected. You do studies to evaluate toxicity (smaller egg size, etc.) by how much mercury it's been exposed to through the food chain. He said largely the fish concentrations provide the measure for evaluating blue heron, mink, kingfishers, and all those have been modelled in various risk assessments on the reservation through the years.
- Mr. Czartoryski asked if the researchers had any information on Bear Creek.
  - Mr. Peterson said there are fish issues in Bear Creek, but not water concentration issues. He said a lot of the work in Bear Creek has focused on concerns with beaver dams because they flood the floodplains and create a methylating wetland environment.
- Mr. Tapp asked if the mercury would eventually kill the mussels.
  - Mr. Peterson said they want to do more scaled-up studies in the laboratory to evaluate those kinds of issues, but he suspects not because inorganic mercury – which is what the mussels would be filtering – has not been known to be a major toxic actor in the concentrations in Lower East Fork.
- Ms. Deaderick asked how they are going to clean up around the Bruners area.
  - Mr. Peterson said ORNL is trying to develop some technologies or remedial solutions for the

creek. Based on what they've seen so far, they think some very small areas within the Bruner or NOAA areas are where they would target as having an opportunity with somewhat smaller actions or technology deployment making a real difference in overall flux. He said whether that is some technology that they develop by some sorbent or not, that'll be evaluated as part of the CERCLA process. He said ORNL is developing the science and technologies, and after MTF is in operations for two years, there will be a formal evaluation of interim actions – not a final solution, but an interim actions – and that's where a lot of their information will inform the decision-makers on what they may or may not do in East Fork.

- Ms. Deaderick asked what a sorbent coupon is.
  - Mr. Peterson said a sorbent coupon is just a way to be able to place the sorbent so it doesn't just dissolve or fall apart, when it mixes in with the soil. The sorbent is put in a mesh packet, which is then tagged with the original location and material.
- Ms. Eastburn asked if there is any kind of timeframe on implementing the carbon-fiber mats and bank stabilization.
  - Mr. Peterson said ORNL's timeframe for getting information of value to DOE is in the mid-2020s timeframe.
- Ms. Shoemaker commented that she wished MTF could be operational before 2024.
  - Mr. Adler said DOE is working with the contractor to see if some schedule compression is possible. He said it's largely driven by how soon the money is budgeted.
- Ms. Lohmann said the recent permit approvals for MTF from TDEC included statements that it would be 2021-2022, so she was curious what pushed the timeline back.
  - Mr. Adler said he thought there were some components to the procurement process that slid out, but he'd have to ask Brian Henry, the federal project director, to provide detailed answers. He said he would get Mr. Henry to answer the board's questions.
- Mr. Wilson said that during the floodplain remediation, there was an actual vote from the city on whether to remediate any further. He asked for additional background on that.
  - Mr. Adler said there was discussion on how aggressively to dig up soils. He said some conservative risk assessments done suggested one concentration, and other less conservative assessments suggested a different concentration. He said they realized that if they dug to the very low concentration, there would also be ecological impacts; they would actually be destroying the floodplain to go after a hypothetical risk. He said they weighed the various considerations and in the end, largely through the input of the community and concerns from some scientists at the lab, elected not to go for the most conservative level, but to go for a level that was deemed to be protective of current uses of the land and people but that didn't require removing so much of the landscape.
- Mr. Wilson how researchers came up with using vitamin c (ascorbic acid).
  - Mr. Peterson studies have been done previously on ascorbic acid, and it's a very effective de-chlorinator that has been used to help fish in the aquarium industry.

### **Public Comment**

There were no public comments.

**Motions –**

**3/13/19.1 Motion to approve the agenda**

The motion carried unanimously.

**3/13/19.2**

Mr. Burroughs reported on the meeting minutes from the November meeting. Mr. Branch moved to approve, and Ms. Eastburn seconded. The motion carried.

**3/13/19.3**

Mr. Burroughs reported on the meeting minutes from the February meeting. Mr. Holder moved to approve, and Ms. Shoemaker seconded. The motion carried.

**Responses to Recommendations & Alternate DDFO Report**

Ms. Noe said there are no open recommendations to report on, but she had an update on the ORSSAB new member package. She said the package is at headquarters in draft form, and they are waiting for headquarters to give preliminary approval to submit it.

**Committee Reports**

EM & Stewardship – Mr. Swindler said the committee had an extensive discussion on OREM’s groundwater program.

Executive – Mr. Wilson said the committee reviewed some of the changes to the bylaws and reviewed options for the annual meeting and details about the presentations for the next two board meetings.

**Additions to the Agenda & Open Discussion**

Mr. Wilson told board members the executive committee is proposing changes to the bylaws. He directed members to the list of proposed changes in the meeting packet and asked them to review those changes before the next full board meeting for a vote on them. He said the proposed changes are not drastic, but they are necessary.,

**Action Items**

1. DOE will provide additional information on construction schedule changes for the Mercury Treatment Facility.

The meeting adjourned at 7:40 p.m.

I certify that these minutes are an accurate account of the March 13, 2019, meeting of the Oak Ridge Site Specific Advisory Board.



Dennis Wilson, Chair

Richard Burroughs, Secretary

April 10, 2019

Oak Ridge Site Specific Advisory Board  
DW/sbm