



The possibility of additional flooding within and adjacent to the Tar Creek Superfund Site in Ottawa County, Oklahoma, is the basis of Local Environmental Action Demanded (LEAD) Agency's partnership with AGU's Thriving Earth Exchange.

Creating an interactive tool to build awareness

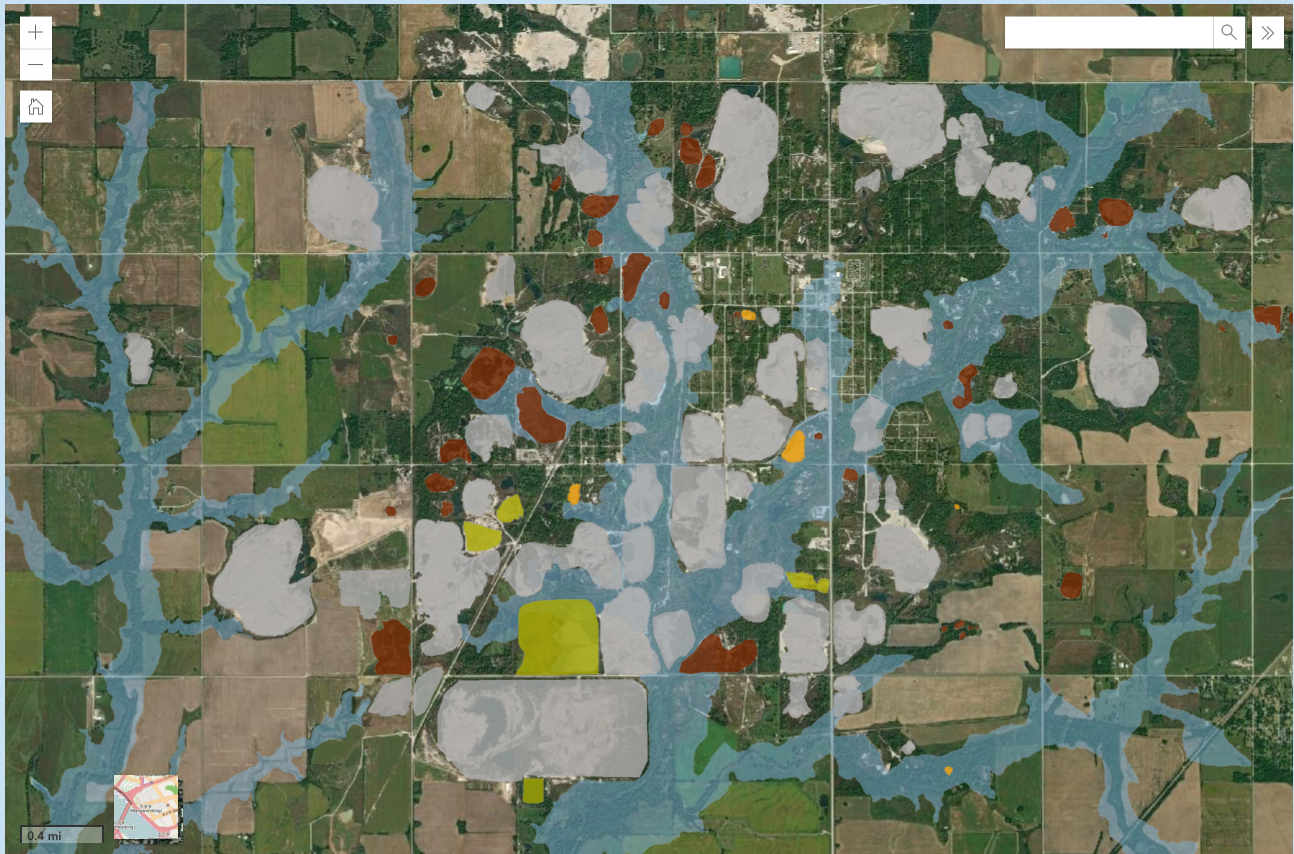
AGU's Thriving Earth Exchange maps the extent of the Tar Creek Superfund Site in Ottawa County, Oklahoma, to alert local authorities and residents of the risks of increased flooding

When Jessica Tran began working with Local Environmental Action Demanded (LEAD) in September 2020, she knew the community nonprofit needed a powerful tool to show a continuum of environmental degradation in Ottawa County, Oklahoma. More than 120 years of active mining and unremediated contamination within the Tar Creek Superfund Site had taken a tremendous toll on the flora, fauna, and water quality of the 1,188 square-mile basin within a county that's home to 31,200 residents and the Eastern Shawnee Tribe, Miami Nation, Modoc Tribe, Ottawa Tribe, Peoria Tribe, Quapaw Nation, Seneca-Cayuga Tribe, Shawnee Tribe, Cherokee Nation and the Wyandotte Tribe. Predictable cycles of flooding and undeniable cases of lead poisoning had pushed the community into a public health crisis that might soon be exacerbated by the Grand River Dam Authority's plan to raise the level of Grand Lake in neighboring Mayes County by two feet.

But, there were two things Tran didn't know: the extent to which Tar Creek and its tributaries had been compromised and the extent to which LEAD could alert the general public while also making a case to a dam authority.

"I spent a lot of time learning about Tar Creek and Ottawa County," says Tran, a doctoral candidate at the University of Minnesota studying Natural Resource Science and Management and a research fellow with the American Geophysical Union's Thriving Earth Exchange. "LEAD Agency was firm about its goals, which became my goals—to create a map to show flooding and to target the Grand River Dam Authority as its audience."

AGU's Thriving Earth Exchange serves as a connector and facilitator to bring together communities who have self-identified concerns, fellows (like Tran) who organize and administer community-based projects that address those concerns, and experts who can address the specific scientific issues that come to bear on the projects. The Thriving Earth Exchange trains and convenes fellows during the course of their projects, offers limited monetary support, and provides opportunities for fellows to create awareness of the scientific challenges that projects raise and, ideally, help solve, as well as opportunities for fellows to share their work.



The GIS map developed by AGU's Thriving Earth Exchange team in consultation with LEAD Agency includes 21 general layers and another 21 sublayers including the specific locations of chat piles, tailings, flood hazard zones, property lines, and other pieces of information that can provide a fresh perspective for dam authorities, as well as local residents, to examine the causes and consequences of flooding.

Tran worked directly with LEAD's Executive Director Rebecca Jim and Earl Hatley, who co-founded the environmental justice organization in 1997, to outline what a map of the Tar Creek area might look like when flooded at its current level and at future levels, the information the map might contain, and the visual argument the map might represent to the dam's authority to reconsider their actions.

"As the map evolved," she says, "so did our idea of who our audiences could be." Tran, Jim, and Hatley realized that greater public awareness seemed to be both possible and desirable with the map, too.

"This is an environmental justice issue," says Tran, "and it's an issue that's been going on for decades and nothing has been done about it. It's frustrating."

Defining environmental justice

Lead and zinc mining operations between 1891 and 1958 in the northern half of Ottawa County left behind excavated rock called tailings deposited into piles called chat, the tallest of which are approximately 200 feet. Any satellite view of the area from any distance will reveal the scope of what some have called an "alien landscape"

and others have likened to a lunar landscape. Since the early-1960s, 75 million tons of chat piles have remained visible above ground while groundwater has infiltrated the abandoned mines below ground to mix with oxidized minerals and create acidic water that has dissolved minerals within the mine, thereby increasing concentrations of iron, cadmium, lead, nickel, and zinc (among other impurities) in the creek and aquifers, according to the Environmental Protection Agency (EPA). Dust picked up by the wind off area chat piles also contains high concentrations of lead, zinc, and cadmium, according to one Harvard University Graduate School of Design study, and the color of Tar Creek, itself, has been variously described as dark brown, orange, and "electric" orange.

By the time Rebecca Jim and Earl Hatley founded LEAD Agency in 1997, Tar Creek had already been designated a EPA Superfund Site for 14 years—among the first two named in the state, which today comprises 15 active, delisted, and proposed sites in nine counties.

"Nobody knew [the problems] before and nobody saw before because nobody lives up where the problems are," says Rebecca Jim. "Even still, the chat piles continue to ooze heavy metals into the stream, and a million and a half

gallons of contaminated water go into the creek that has flooded this area every day for the last 44 years.”

Jim and Hatley inaugurated the National Environmental Conference at Tar Creek in 1998, which LEAD has hosted annually for the last 25 years, convening supporters, developing its knowledge base, creating awareness, and knitting together groups by inviting state, federal and local agencies, impacted community members, and all local tribal nations. Their mission is singular: make the clean-up of the Tar Creek Superfund Site a local, regional, and national priority.

Yet, the mid- to late-1990s were still early days for the term “environmental justice,” which had been codified only a few years earlier with an executive order signed by President Clinton directing federal agencies (including the EPA) to account for human and environmental health, particularly within low-income and minority populations, and protect communities that might otherwise be neglected for lack of a potent advocate.

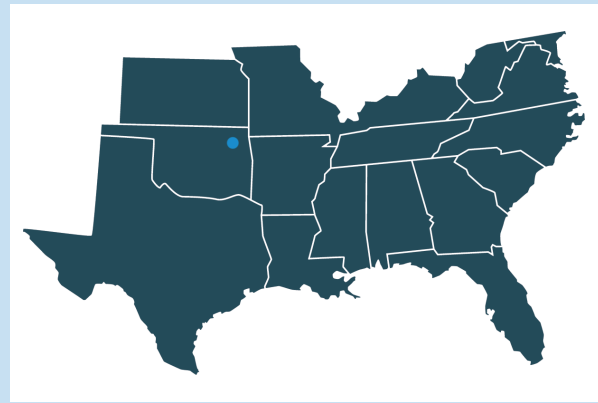
Since then, the EPA has refined its definition to focus on the justice aspect of the phrase. In enforcing environmental laws, regulations, and policies, the agency says, we must be equitable in ensuring better health for all and we must involve stakeholders in a “meaningful” way—participatory, representative, and, if not solicitous engagement by authorities, then a process by which, “decision makers will seek out and facilitate the involvement of those potentially affected.”

For Jim and LEAD Agency, the challenge has not been a lack of transparency on the point of environmental justice. It’s the coordination between and among siloed groups—from municipal, state, and federal actors to scientists and engineers to tribal authorities to communities across a vast swath of prairie.

“We already know the fish in the lake are contaminated with metal. You can’t ignore it,” she says, “so we need to gather all these groups including the Army Corps of Engineers, the Grand River Dam Authority, and the EPA to talk about what to do together—not individually.”

Establishing inclusive project tactics

Tran, Jim, and Hatley assembled for calls in late-2020 to establish the parameters of their work together. It became clear then that constructing a map meant determining its layers of information. As the core group around the project grew, Tran reports that it was imperative at each stage to ensure transparency and that each new member joining the group understood the group’s composition and dynamic. “I interviewed [new members]—and made sure they understood how we decentralize the authority for most everything, but left major directional steering up to Rebecca, Earl, and Martin Lively—Grand Riverkeeper and member of LEAD.”



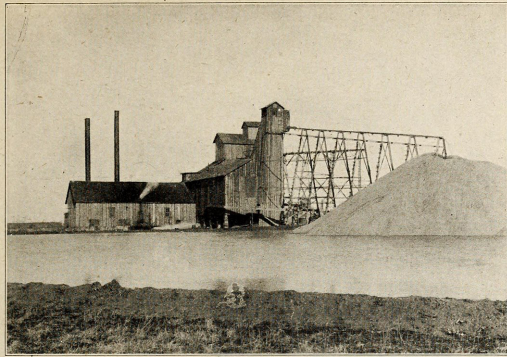
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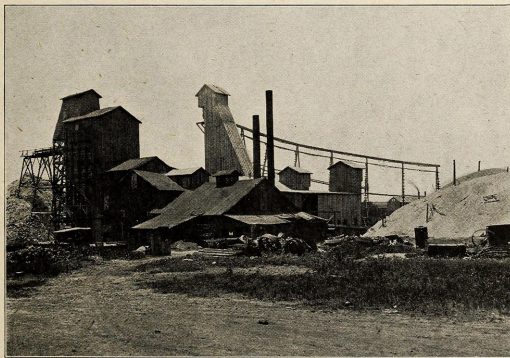
Lead and zinc mining operations between 1891 and 1958 in the northern half of Ottawa County left behind excavated rock called tailings deposited into piles called chat piles by the locals, the tallest of which are approximately 200 feet.



The color of Tar Creek has been variously described as dark brown, orange, and “electric” orange owing to concentrations of iron, cadmium, lead, nickel, and zinc (among other impurities). (Credit: EPA)



AN OTTAWA COUNTY MINE



A lead and zinc mine in Ottawa County (pictured here in a 1922 album) sits adjacent to a burgeoning chat pile. Since the early-1960s, 75 million tons of chat piles have remained visible above ground. Public domain.

To begin conceptualizing the map of the flood-prone area, Tran sought out Katherine Meierdiercks, Associate Professor and Chair of Environmental Studies and Sciences at Siena College in Loudonville NY, and an expert in watershed management, environmental field techniques, Geographic Information Systems (GIS), and soil, air, and water analysis techniques. Tran and Meierdiercks quickly realized that key data they needed to create their base map and its layers didn't exist. They conducted an inventory of the kinds of maps available—showing, for instance, a 100-year floodplain—and evaluated the accuracy of what was on those maps.

“Within Ottawa County, there are a lot of stakeholders,” says Tran, “and we wanted to make this useful to the community broadly, but also to specific communities that might not have been coordinated on a public health level. One map can't be a perfect fit for everyone.”

Tran says it is the only map that shows how everyone who lives within the affected area fares during routine flooding and will likely fare if the local dam's level is raised.

However, that sort of picture showing flood or no-flood isn't as straightforward as it might seem. Proximity in

feet to Tar Creek does not necessarily translate to a deluge for property owners because soil types and fault lines can play a role in how a creek swells and overflows in one direction but not another. Similarly, the expanding flood map has no regard for the hard geometries of the lands of no fewer than eight tribal nations that envelop the site, not to mention the patchwork of irregular plats that saturate the landscape on the digital map. In the end, Meierdiercks' and Tran's GIS map included 21 general layers, and another 21 sublayers—from the specific locations of chats, aquifers, and groundwater wells; to the capacious zones of the National Land Cover Database (showing land classifications, impervious surfaces, and canopy coverage); to the locations of Federal Emergency Management Agency (FEMA) assessed properties.

The map is billed by Tran and LEAD Agency as interactive, which means you can see the relationships between as many (or as few) layers as you want. This is a vital feature for, say, a dam authority or a municipal authority charged with considering environmental justice per the EPA's guidelines.

Its appeal to the general public is the map's ability to reveal locations at the scale of the individual house. Residents of Ottawa County, Oklahoma, can see precisely what a flood means to them and their neighbors—even if they are already well accustomed to its effects—as well as what a larger flood might mean to them in 10 years or to their children in 20 years, should they, say, inherit the properties.

Expanding the map's reach

As a flexible map that can be tailored to specific discussions or specific legal, geographical, or political purviews, Jim and Tran believe it will serve LEAD Agency well in the coming years.

“With this map, we hope to ask what can the agencies that control the water and quality of that water do for us? Can they sign an MOU to begin the conversation? Can we get them to the table?” reports Jim. “We didn't realize when we started this project how much bigger the wider world of people and agencies was—how many people we needed to reach.”

The reason, she says, is simple: for too many area residents, water quality is an invisible problem—even in spite of Tar Creek's revealing color—and a deeply troubling one.

To facilitate the kind of broad public awareness Jim and her colleagues hope to achieve, LEAD Agency plans to launch a campaign with two different versions of the map. The [interactive version](#) will be sent around through digital channels such as email and social media. A reasonably simple and static .PDF version of the map will be loaded onto flash drives and distributed to community members

that might not have regular or reliable Internet access (but have a computer at home).

Tran is also strategic in her outlook for the map, identifying levels of success that the project team can aim for and work towards.

“If we get people to look at the website and the map, I’ll be really happy,” she says. “If people look at their streets and understand their houses in the context of the floodplain, I’ll be really, really happy. But, if the map spurs curiosity for them to find out more, that will be the gold standard of success for me.”

The raw data sets on the back-end of the map are also invaluable for LEAD Agency, its partners, and its audiences. Jim, Hatley, Tran, and others can use that data to present their findings to their local EPA office for Region 6, which includes Oklahoma, Arkansas, Louisiana, Texas, and New Mexico, as well as demonstrate to the EPA why their conceptual models for future flooding might be faulty. Revised models means a reconsideration of the state of the Tar Creek Superfund Site and, ideally, immediate action to ameliorate flooding in a sensitive and ailing local ecology.

“Mapping the extent of the Tar Creek Superfund Site and other potential risks Ottawa County, Oklahoma,” is a project of AGU’s Thriving Earth Exchange (TEX), which advances community solutions to some of the most vexing environmental challenges. The Thriving Earth Exchange helps scientists, community leads and sponsors work together to conserve natural resources, mitigate climate change and create awareness of natural hazards and their impacts on communities.

Learn more at thrivingearthexchange.org.

This project was supported by the [Gordon and Betty Moore Foundation](#).