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Development, Evaluation, and Long-Term Outcomes of Environmental Health and Land Reuse Training—Part 1: Developing Environmental Health and Land Reuse Trainings for the Environmental Health Workforce and Their Community Partners

Laurel Berman, PhD,
Agency for Toxic Substances and Disease Registry

Sharon Unkart, PhD,
National Environmental Health Association

Michael Lewin, MS,
Agency for Toxic Substances and Disease Registry

Rebecca Labbo, MA,
National Environmental Health Association

Gina Bare, RN,
National Environmental Health Association

Alyssa Wooden, MPH,
National Environmental Health Association

Serap Erdal, PhD,
University of Illinois at Chicago

Leann Bing,
Agency for Toxic Substances and Disease Registry

Sue Casteel, MS,
Agency for Toxic Substances and Disease Registry

Onongoo Amar, MPH,
University of Illinois at Chicago

Corresponding Author: Laurel Berman, Agency for Toxic Substances and Disease Registry, 77 West Jackson Boulevard, Suite 433, ATSD-4J, Chicago, IL 60604. laberman@cdc.gov.

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Editor's Note: This article is the first in a series of three that describe the development, launch, and evaluation of the EHLR Certificate Training content. ATSDR and NEHA collaboratively developed the EHLR Certificate Training program. The training program consists of 1) the EHLR Basic Training, which is a 5-module short course and 2) the EHLR Immersion Training, which is an expansion of the first three modules of EHLR Basic.

This first article described the development and delivery of the EHLR Basic Training and the pilot of the EHLR Immersion Training. The second article will describe the evaluation of EHLR Basic content, focusing on training effectiveness, training modalities, and participant feedback. The third article will describe the evaluation of participant feedback from the EHLR Basic Training up to 12 months post-training.

Tracie Jones,
Diné College

Leorenda Begay
Diné College

Abstract

This article is the first in a series of three that describes the development and delivery of the Environmental Health and Land Reuse (EHLR) Basic Training and the first pilot of the EHLR Immersion Training. The EHLR Basic Training is based on the 5-step Land Reuse Model from the Agency for Toxic Substances and Disease Registry (ATSDR). Through a collaboration with the National Environmental Health Association (NEHA), we developed the EHLR Basic Training in two modalities: virtual/live (maintained by ATSDR) and online/asynchronous (maintained by NEHA). The modules include: 1) Engaging With Your Community, 2) Evaluating Environmental and Health Risks, 3) Communicating Environmental and Health Risks, 4) Redesigning With Health in Mind, and 5) Measuring Success: Evaluating Environmental and Health Change.

From June 2019–August 2022, ATSDR and NEHA delivered 10 EHLR Classroom Basic Trainings, launched the EHLR Online Basic Training, and developed the EHLR Immersion Training. We piloted the EHLR Immersion Training in July 2022, March 2023, and July 2023. Our participants included science, technology, engineering, and mathematics (STEM) students from Diné College who were in a Summer Intern Program; tribal environmental professionals; NEHA members in environmental health careers; and environmental professionals, students, and community members who were engaged in environmental work or environmental justice.

We have learned that individual training modules can be used for specific learning needs among our participants. Perhaps more importantly, we have learned that undergraduate students and community members can and should be engaged in EHLR Training. The results of the evaluation and long-term follow-up of the EHLR Training will be presented in the second and third articles in this series.

Keywords

brownfields; Navajo Nation; environmental health; land reuse; environmental training; tribal ecosystem knowledge

Background

The definition of brownfields from the U.S. Congress (2002) refers to property of which the expansion, redevelopment, or reuse can be complicated by the presence or potential presence of a hazardous substance, pollutant, or contaminant. The National Land Reuse Health Program (Land Reuse Program) within the Agency for Toxic Substances and Disease Registry (ATSDR) considers land reuse sites to be those sites that are slated for redevelopment but might have chemical contamination. Such sites are commonly blighted, underused, or vacant properties that could be contaminated due to prior industrial uses

or hazardous building materials, such as asbestos-containing materials or lead-based paint. ATSDR includes brownfield sites as a type of land reuse site.

Because of the potential contamination of land reuse sites and brownfield sites, it is important to include health considerations in their remediation and redevelopment. Environmental health professionals are uniquely qualified to address community concerns about contamination and the negative health effects associated with land reuse sites. Environmental health professionals, however, might need specialized training to evaluate, communicate, and mitigate risks related to land reuse. According to the National Association of County and City Health Officials (2017), 17% of local health departments report working on land use issues, but only 3% report working on land remediation.

To assess the baseline capacity for local environmental health professionals to address environmental and land reuse issues, the National Environmental Health Association (NEHA) surveyed its members over 6 weeks beginning in May and extending into June 2016. Based on 92 responses, NEHA concluded that “among local health department (LHD) respondents who indicated working on land reuse/brownfields issues, almost 75% indicated having either no formal education (e.g., college-level classes) or only continuing education courses related to land reuse/brownfields” (Berman et al., 2019).

In 2018, ATSDR and NEHA began to draw on their extensive environmental health training capabilities to fill gaps for environmental health professionals to work on land reuse. This effort resulted in the Environmental Health and Land Reuse (EHLR) Certificate Trainings, which currently are the EHLR Basic Training (10-hr short course) and the EHLR Immersion Training (three longer, immersive courses).

EHLR Training Development

To launch the training collaboration with NEHA, ATSDR developed an EHLR training concept based on its 5-step Land Reuse Model:

1. Engaging With Your Community
2. Evaluating Environmental and Health Risks
3. Communicating Environmental and Health Risks
4. Redesigning With Health in Mind
5. Measuring Success: Evaluating Environmental and Health Change

In early 2019, ATSDR and NEHA co-created two modalities of the EHLR Basic Training consisting of a classroom (live or virtual live) training and an asynchronous online training. These two courses were designed for environmental and health professionals, planners, and students in environmental science, public health, and planning. The course modalities are maintained by ATSDR (www.atsdr.cdc.gov/sites/brownfields/classroom_training.html) and by NEHA (www.neha.org/ehlr-certificate).

A participant is eligible for a certificate of completion from NEHA after completing any of the five training modules. To become fully certified in EHLR, however, the participant

must complete all five modules. ATSDR and NEHA supplemented the training with a free textbook/community resource written by the Brownfields & Reuse Opportunity Working Network (BROWN) called *Land Reuse and Redevelopment: Creating Healthy Communities* (Agency for Toxic Substances and Disease Registry [ATSDR], 2020; Berman, 2020).

EHLR Basic Training: Classroom and Online Modalities

In 2019, ATSDR conducted two in-person pilots of the EHLR Classroom Basic Training. Participants included environmental professionals, environmental health professionals, and university students at undergraduate and graduate levels. The same year, a small cohort of environmental professionals piloted the asynchronous online course to provide completion times that informed the amount of continuing education units issued. Trainees provided feedback on both courses regarding content, cogency, and flow. ATSDR and NEHA revised and finalized the EHLR Basic Training in both the classroom and asynchronous online modalities. NEHA then launched the asynchronous online course in fall 2020.

The COVID-19 pandemic necessitated virtual delivery of the EHLR Basic Training. This change meant overcoming the challenges of shifting from in-person to virtual delivery. For example, participants in the EHLR classroom setting engaged in a variety of interactive exercises, such as using community engagement tools and roleplaying to identify activities involved in Phase I (information gathering on past uses of brownfields) and Phase II (determination of presence of contamination) environmental site assessments. In addition, the ATSDR and NEHA teams were working from home offices full-time for the first training, which was an adjustment. Regardless, we continued to provide opportunities for environmental health professionals to meet their continuing education requirements and increase their land reuse expertise.

EHLR Basic Training Evaluation: Classroom and Conference Face-to-Face Learning

ATSDR and NEHA evaluated both modalities of the EHLR Basic Training, which will be discussed in detail in our second article in this series. Essentially, the evaluation of participant feedback, knowledge assessments, and a long-term follow-up survey indicated that participants wanted more hands-on practice with the tools presented in the first three modules. In response, by early 2022 we developed the EHLR Immersion Training, which provides expanded instruction and hands-on practice in:

1. Community Engagement: 8 hr/8 continuing education units (CEUs)
2. Evaluating Environmental and Health Risks: 8 hr/8 CEUs
3. Communicating Environmental and Health Risks (Risk Communication): 4 hr/4 CEUs

Training Summary

As shown in Figure 1, from June 2019 to August 2022, ATSDR and NEHA delivered 10 EHLR Classroom Basic Trainings, launched the EHLR Online Basic Training, and piloted two different EHLR Immersion Trainings. Not shown are two additional EHLR Immersion pilots launched in March and July 2023, which occurred after we drafted this article. Our participants included science, technology, engineering, and math

(STEM) students from Diné College who were in a Summer Intern Program (SIP); tribal environmental professionals; NEHA members in environmental health careers; and environmental professionals, students, and community members who were engaged in environmental work or environmental justice.

The EHLR Basic Trainings were virtual and live and also asynchronous and online. The EHLR Immersion Training was designed for live, in-person delivery. Pandemic disruptions necessitated some hybrid instruction during the first pilot of EHLR Immersion, but the class was able to come together for much of the training in person. The subsequent pilots were in-person iterations.

Diné College STEM Summer Intern Trainings

The pandemic disrupted the normal 2020 and 2021 Diné College SIP fieldwork courses. To compensate, we expanded the 10-hr EHLR Classroom Basic Training into a 6-week virtual program in which Diné College faculty supervised environmental health research based on each of the five EHLR modules. In addition, 20 partners from BROWN provided instruction. This approach was highly creative and kept the students engaged in Zoom classrooms for 40 hr a week. We published a commentary with our Diné College faculty partners to document the experience of converting a field-based, in-person learning program into a virtual learning experience (Berman et al., 2021). As a result of our training successes, in 2022 NEHA and Diné College sponsored 6 SIP interns to attend the NEHA 2022 Annual Educational Conference (AEC) & Exhibition in Spokane, Washington, to participate in a 2-day, in-person EHLR Basic Training. In addition, 14 environmental health professionals attended this training.

Tribal Environmental Professionals Trainings

From 2019 through August 2023, ATSDR and NEHA trained >250 tribal environmental professionals in both EHLR Classroom Basic and Immersion Trainings through the annual Tribal Lands & Environment Forum. The Institute for Tribal Environmental Professionals hosted these trainings.

Fall 2020 Cohorts of the EHLR Basic Trainings

In 2020, 63 participants attended a virtual classroom training and 200 enrolled in the online training. ATSDR and NEHA conducted follow-up focused discussions with six classroom participants and five online participants. We will present the results of the focused discussions in the second article in this series.

NEHA AEC Trainings

ATSDR and NEHA provided the EHLR Basic Training to >20 participants virtually in July 2021 and to >20 participants in person in June 2022. We intend to continue offering annual EHLR Basic and Immersion Trainings at the AEC.

Specialty Trainings

We have learned that the 5-module EHLR Basic Training or its individual training modules can be used for specific learning needs among our participants. For example, in spring

2021, several undergraduate public health students from Andrews University in Berrien Springs, Michigan, completed the EHLR Basic Training online as part of their required environmental seminar. In October 2022, a class of >40 undergraduate public health students at the University of Illinois Chicago completed the first module of EHLR Basic Training: Engaging With Your Community. The students received certificates of completion for this module. In October and November 2022, NEHA hosted adapted portions of the EHLR Basic Training for its Environmental Health Leadership Academy, which involved 30 environmental health professionals who were primarily from local and state health agencies.

EHLR Immersion Training Development

In summer 2022, ATSDR and NEHA piloted the full three modules of EHLR Immersion with a cohort of six Diné College SIP interns, described previously, the students and one faculty member completed the prerequisite EHLR Basic Training at the 2022 NEHA AEC. We combined additional fieldwork exercises to supplement the EHLR Immersion Training, including mock Phase I environmental site assessments and a community event that included a Soil Screening, Health, Outreach, and Partnership (soilSHOP) event in Navajo, New Mexico.

During the soilSHOP event, ATSDR and partners used an X-ray fluorescence (XRF) handheld spectrometer to detect metals in soils (ATSDR, 2022a). The soilSHOP event provided hands-on practice with the XRF and with health education. The students also toured brownfields in Chinle and Holbrook, Arizona. For each of the three independent EHLR Immersion modules, the students completed voluntary knowledge assessments, which NEHA used for evaluation. We will discuss the evaluation in the second article of this series.

During the Tribal Lands & Environment Forum in August 2022, ATSDR provided a full-day EHLR Immersion Training for the Evaluating Environmental and Health Risks course. In total, 45 tribal environmental specialists attended the training, of which 20 opted for the certificate of completion in this module.

In March 2023, ATSDR and NEHA trained 31 participants from community nonprofits, planning agencies, the U.S. Environmental Protection Agency, the state environmental agency, and Andrews University (public health undergraduate students and faculty). The training was hosted by three community nonprofits that focus on building community capacity through community revitalization projects.

Long-Term Follow-Up for EHLR Basic

During spring 2022, ATSDR hosted a 9-question survey using the REDCap survey system (per the Paperwork Reduction Act Control Number 0923–0060) to assess the effectiveness of the 2020–2021 EHLR Online Basic Training up to 12 months post-training. The results of this survey will be discussed in the third article in this series.

Outcomes of the EHLR Basic and Immersion Trainings

From October 2020 to June 2023, the EHLR Online Basic Training hosted 2,500 participants. The EHLR Basic Training continues to be popular in live and virtual

conference venues. Further, we provided classroom training at least 2–3 times per year from August 2019 to June 2023. Thus far, we have trained >500 tribal professionals, environmental health professionals, students, and community members.

We have learned that individual training modules can be used for specific learning needs among our participants. As discussed previously, university partners have incorporated the EHLR Online Basic Training into an environmental seminar and incorporated module 1 of the EHLR Basic Training to supplement public health learning about community engagement. Community nonprofits in Benton Harbor, Michigan, requested to pilot the Communicating Environmental and Health Risks course from the EHLR Immersion Training. This training has a focus on building the capacity of community members to understand and communicate about environmental risks and health risks.

Moreover, NEHA evaluated the EHLR Immersion pilot at Diné College. Based on this evaluation, combined with ongoing training evaluation, we made further revisions to the EHLR Immersion Training. For example, we decided to include the prerequisite EHLR Basic Training module as a classroom exercise prior to the EHLR Immersion Training. In addition, we are developing case examples for use during interactive exercises that are culturally appropriate for specific audiences.

Evaluations from the EHLR Basic and Immersion pilots provided valuable information about the overall effectiveness of the training and participants' self-perceived increase in skills and confidence to work in land reuse and general environmental health arenas. As part of the evaluation, ATSDR completed a long-term follow-up survey in August 2022, which indicated that the EHLR Basic Training, primarily in the asynchronous online modality, remained an effective tool months after completion. Of 100 EHLR online Basic Training participants, 22 completed the survey, as did 5 classroom participants. The results of the evaluation and of the long-term follow-up of the EHLR Trainings will be presented in the second and third articles in this series.

Diné College Summer Intern Program 2022: EHLR Immersion Training Pilot

After earning their certificates in the EHLR Basic Training at the NEHA 2022 AEC, the Diné SIP students completed a 3-day EHLR Immersion Training led by ATSDR and NEHA instructors at Tsaile Campus in Tsaile, Arizona. ATSDR and Diné College SIP faculty tailored the immersive training to incorporate tribal ecosystem knowledge, environmental research, brownfield site visits, a community health education fair and soilSHOP event, and a research project. Two students shared their research projects, inspired by the SIP and EHLR Immersion Training, summarized below.

- **Health Impacts of Uranium Mines on the Navajo Nation:** Leorenda Begay researched health impacts of uranium mines on her Navajo community. Begay's research question focused on uranium studies that have been planned but not yet conducted on the Navajo Nation. Begay emphasized that some people are concerned about exposure from the mine in her community and want to be tested as part of studies on uranium health effects (Figure 2). She said others are concerned that their land rights will be affected by a study of uranium

mining exposures. Begay suggested using the ATSDR Action Model (2019) for community engagement to identify ways to address these issues, prevent more exposures, and lower the negative health impacts from the uranium mining.

- **Brownfields and the Long-Lasting Effects They Can Have on Local Neighborhoods**: Tracie Jones noted that brownfields frequently are not represented in federal environmental tools, such as My Environment (U.S. Environmental Protection Agency, 2022). Drawing on a 2-week training on GIS and geospatial data science through the SIP at the University of New Mexico, Jones conducted surveillance of known brownfields in Chinle, Nazlini, and Holbrook, Arizona. She superimposed and highlighted the locations of brownfields that have 1) not yet been identified by the Navajo Nation Environmental Protection Agency or 2) received funding for assessment, which would tag them on My Environment or other federal maps. The map of brownfields in Chinle is shown in Figure 3. These maps could contribute to health professional and environmental professional knowledge of contaminated land on or near the Navajo Nation that could cause adverse health effects among community members.

Another important learning experience for the students was the soilSHOP event that took place at a community health fair in Navajo, New Mexico (Photo 1). Students were able to use an XRF spectrometer and get hands-on experience in testing soil samples from their community areas. They measured lead and arsenic levels in soil samples brought in by Navajo residents. Under the guidance of an ATSDR health education specialist, the students were able to practice risk communication to community members based on soil sampling results. With the help of a graduate student peer mentor, the students learned to create a chart that described the sample results (Figure 4).

NEHA conducted a full evaluation of the EHLR Immersion Training pilot. Most dents indicated that the modules in a) Community Engagement, b) Evaluating Environmental and Health Risks, and c) Risk Communication increased their knowledge and self-perceived new skills to a great, good, or moderate extent. The full evaluation will be described in the second article of this series.

Discussion and Conclusion

During our collaboration, we were battling a global COVID-19 pandemic while learning how to shift from a face-to-face to a virtual learning environment. We had to learn how to work from home and how to keep people engaged in virtual learning. Despite these challenges, we trained >3,000 people, evaluated the EHLR Basic Training, and created and launched the EHLR Immersion Training.

We learned many lessons during the pandemic, which were transformative personally and professionally. For example, we drew on the BROWN partner group to provide instruction during the 2021 Diné College SIP. In total, 20 members of BROWN donated their time and expertise to provide the SIP students with exceptional instruction and unique opportunities to engage with people all over the country from a variety of disciplines (e.g.,

environmental health, geology, environmental and occupational health, pediatric medicine, risk assessment).

This approach would not have happened were it not for the pandemic, which necessitated the switch to a virtual classroom. In 2022, we incorporated the Navajo Nation mask mandate and brought the students into a professional conference (NEHA AEC) and a community environmental health education event. These experiences provided the students with additional opportunities for professional networking and environmental health practice. As a result, one student might have an opportunity for an internship in aerospace engineering and another is considering a graduate program in public health.

Regardless of training modality or delivery, our training evaluation illuminated the value of environmental health and land reuse training as a means to increase skills and capabilities among the current and future environmental health workforce. Moreover, we realized that it could be equally important to promote this training to community members. Community members offer valuable expertise about their communities and demonstrate leadership skills that can build capacity to negotiate and communicate with diverse redevelopment partners, which could lead to funding and additional resources to address environmental concerns.

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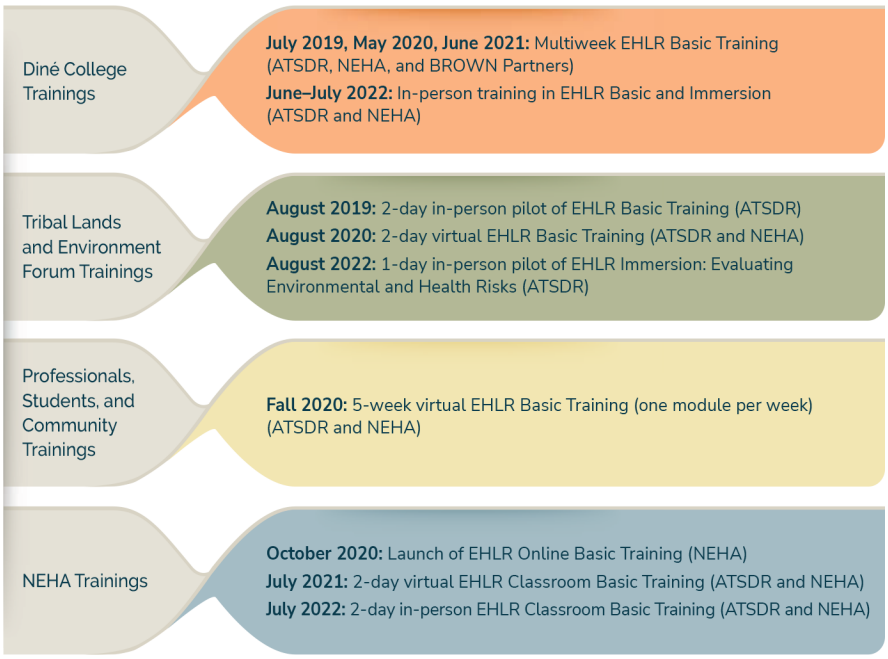

FIGURE 1. Environmental Health and Land Reuse (EHLR) Training Summary From 2019–2022

Note. ATSDR = Agency for Toxic Substances and Disease Registry; BROWN = Brownfields & Reuse Opportunity Working Network; NEHA = National Environmental Health Association.

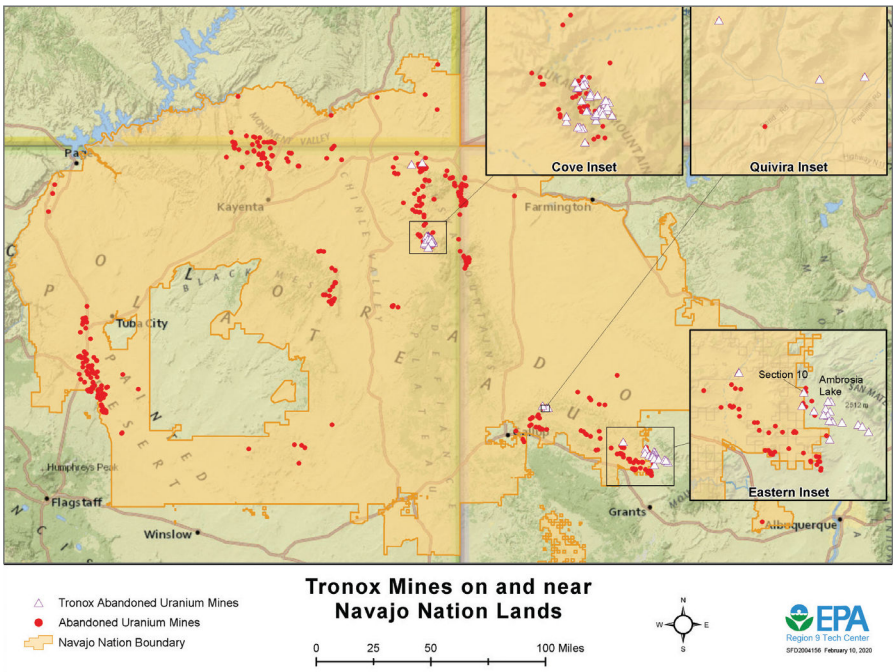

FIGURE 2. Abandoned Uranium Mines On and Near the Navajo Nation

Note. The red dots represent abandoned uranium mines on and near the Navajo Nation (U.S. Environmental Protection Agency, 2024).

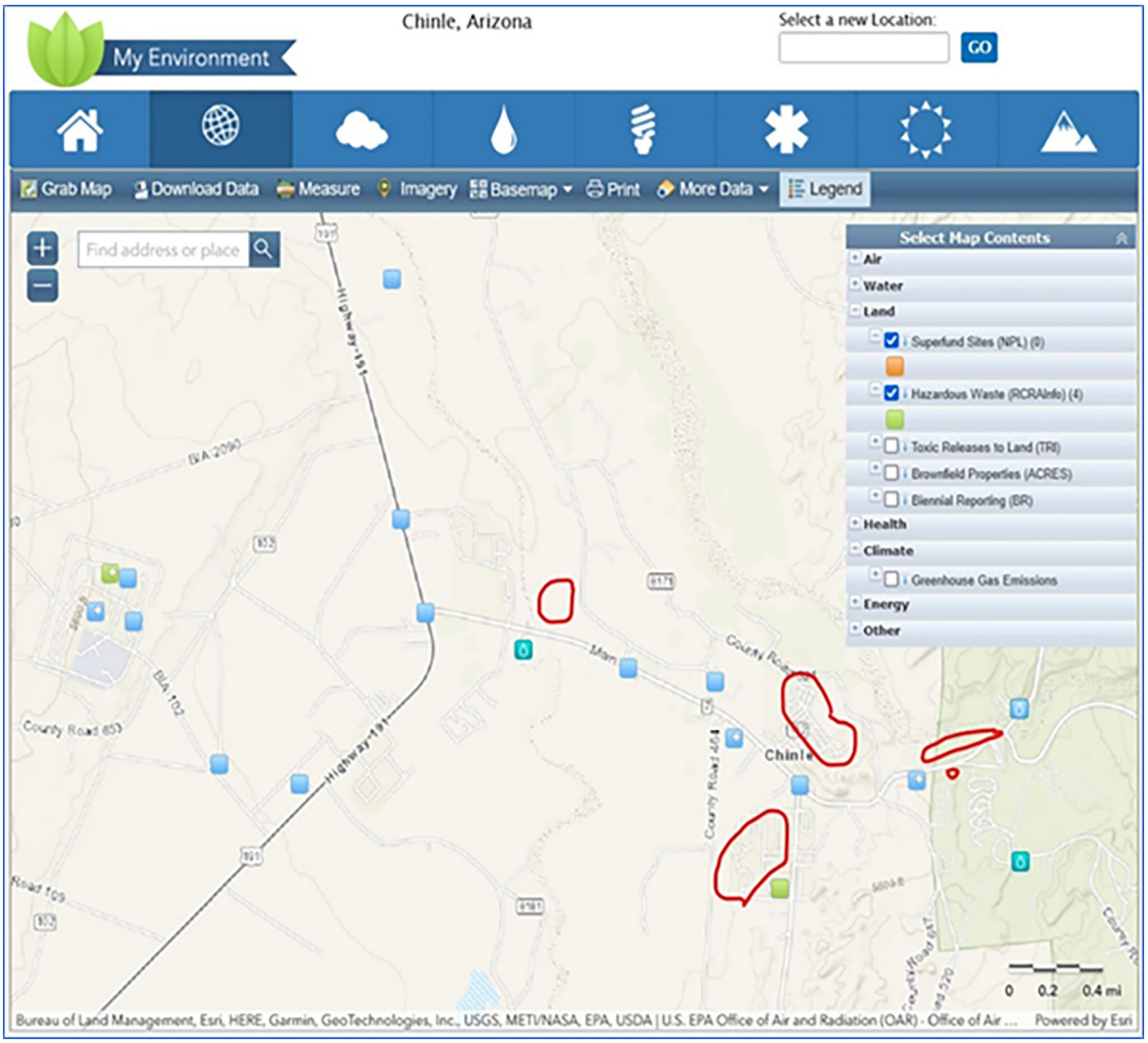

FIGURE 3. Map of Chinle Brownfield Sites

Note. The map shows the Chinle brownfield sites (red circles) that were previously not indicated in federal environmental maps (U.S. Environmental Protection Agency, 2022).

Photo 1.
Students of the Diné College Summer Intern Program participate in a SoilSHOP (Soil Screening, Health Outreach, and Partnerships) event offered by the Agency for Toxic Substances and Disease Registry (ATSDR, 2022b). Photo courtesy of ATSDR.

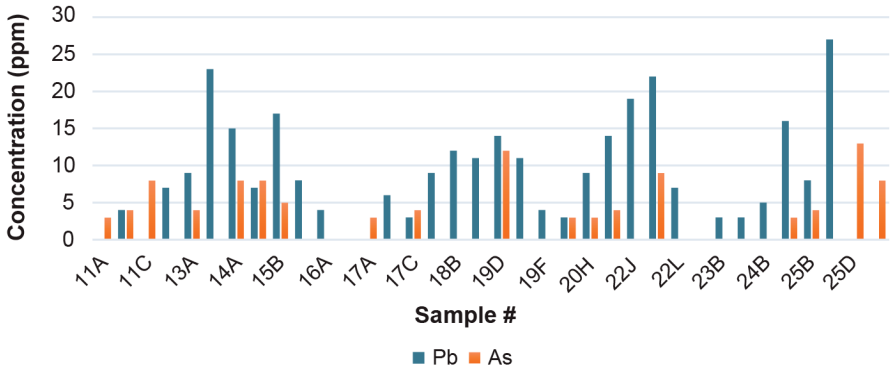

FIGURE 4.

Results of a SoilSHOP (Soil Screening, Health Outreach, and Partnerships) Event Held at a Navajo Community Health Fair in New Mexico