ATSDR
Health Consultation

Former Fort McClellan

Calhoun County, Alabama

Public Health Implications of Servicemembers' Past Exposures to Environmental Contaminants (Chemical or Radiological) in Non-Occupational Areas or While Engaging in Non-Occupational Activities at Fort McClellan

January 14, 2025

U.S. Department of Health and Human Services
Agency for Toxic Substances and Disease Registry

Health Consultation: A Note of Explanation

An ATSDR health consultation is a verbal or written response from ATSDR to a specific request for information about health risks related to a specific site, a chemical release, or the presence of hazardous material. In order to prevent or mitigate exposures, a consultation may lead to specific actions, such as restricting use of or replacing water supplies; intensifying environmental sampling; restricting site access; or removing the contaminated material.

In addition, consultations may recommend additional public health actions, such as conducting health surveillance activities to evaluate exposure or trends in adverse health outcomes; conducting biological indicators of exposure studies to assess exposure; and providing health education for health care providers and community members. This concludes the health consultation process for this site, unless additional information is obtained by ATSDR which, in the Agency's opinion, indicates a need to revise or append the conclusions previously issued.

About ATSDR

The Agency for Toxic Substances and Disease Registry (ATSDR) is a federal public health agency of the U.S. Department of Health and Human Services (HHS). ATSDR works with other agencies and tribal, state, and local governments to study possible health risks in communities where people could come in contact with dangerous chemicals. For more information about ATSDR, visit the ATSDR website, ATSDR website.

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List of Acronyms

ALM EPA's Adult Lead Methodology

BaPE benzo(a)pyrene equivalent

BEC benzo(a)pyrene concentration

BLL blood lead level

BLRV blood lead reference value

BRAC base realignment and closure

CREG cancer risk evaluation guide

CV comparison value

EMEG environmental media evaluation guide

HC health consultation

HQ hazard quotient

IEUBK EPA's Integrated Exposure Uptake Biokinetic model

µg/dL micrograms per deciliter

$\mu g/ft^2$ micrograms per square foot

mg/kg milligrams per kilogram

MCL maximum contaminant level

MRL minimal risk level

N/A not available

pCi/L picocuries per liter

PEF potency equivalency factor

PHAST ATSDR's Public Health Assessment Site Tool

ppb parts per billion

ppm parts per million

RfD reference dose

RMEG reference dose media evaluation guide

RSL regional screening level

VI vapor intrusion

Summary

Introduction

On June 11, 2021, ATSDR received a petition request submitted by a citizen on behalf of the Fort McClellan Veterans Stakeholders Group (hereafter referred to as the "petitioner"). The request was for ATSDR to conduct a cumulative health risk assessment for veterans stationed at Fort McClellan, Alabama from 1945 until closure around 1999. (In 1995, the Base Realignment and Closure Commission selected Fort McClellan for closure, with official closure occurring in 1999.) The petitioner reports that veterans are experiencing adverse health effects from multiple environmental exposures that occurred while they were stationed at Fort McClellan.

According to the petitioner, the servicemembers of Fort McClellan may have been exposed to hazardous or chemical sources while at one or more the following locations or while engaging in the following activities:

- A variety of sites at Pelham Range,
- A variety of sites at Fort McClellan,
- Commuter soldiers who were assigned to Anniston Army Depot as a duty station while residing at the Fort McClellan base, and
- Transient soldiers who frequented the downtown retail district and public transportation venues as designated "commercial visitors" while out on an authorized military Gate Pass from the Fort. The areas visited include Amtrak, Greyhound Bus, the Anniston Airport, indoor or outdoor movie theaters, hotels, indoor or outdoor eateries, auto or motorcycle dealerships, and grocery or clothing shopping stores.

The petitioner also requested ATSDR to evaluate data from a Tumor Health Registry established by the base hospital (Noble Army Hospital) at Fort McClellan. The request was for ATSDR to determine whether the registry data can be used to define and analyze health outcome data for servicemembers that were stationed at Fort McClellan and the Anniston Army Depot.

This health consultation (HC) report documents ATSDR's evaluation and conclusions regarding potential public health implications for servicemembers' non-occupational exposure to environmental contaminants (chemical or radiological) at the former Fort McClellan site.

Environmental sampling data evaluated in this HC are from historical records maintained by the United States Army (Army) in the Administrative Records and from information provided by the petitioner. This HC also includes our conclusions regarding our evaluation of the Tumor Health Registry information.

ATSDR's HC evaluation included ingestion, inhalation, and dermal (skin) exposures to hazardous substances – chemical or radiological – that were released to the surface soil, surface waters, groundwater, air, or biota in non-occupational settings, including on-base buildings. This HC evaluation does not evaluate exposures during military work-related duties or training, including exposures related to military field maneuvers or to gases or agents (bacterial, radiological, or chemical) used for training or warfare.

Since ATSDR or a state partner agency has already conducted public health evaluations for the off-base areas of concern (e.g., Anniston Army Depot we did not re-evaluate those areas or draw new public health conclusions in this HC.

CONCLUSIONS

Based on the evaluation of environmental contaminant concentrations and using the specific exposure assumptions detailed in this report, ATSDR reached the following seven conclusions for the former Fort McClellan site:

Conclusion 1

ATSDR concludes that servicemembers' past exposure to environmental contaminants while engaging in non-occupational activities at certain locations (see below) at Fort McClellan is not expected to harm their health.

Basis for Conclusion 1

ATSDR evaluated the environmental sampling data collected at the following non-occupational areas on Fort McClellan to determine if past exposures could have been harmful to people's health:

- Landfills
- Golf course
- Athletic field
- Reilly Lake
- Lake Yahou
- Cane Lake
- Mock Village

For each exposure area, we used the maximum detected concentration of each contaminant in environmental media to calculate exposure doses and lifetime excess cancer risks, when appropriate. Based on these risk calculations, ATSDR concluded that exposure to contaminants in these non-occupational areas is not likely to harm people's health because the estimated exposures are below levels of health concern.

ATSDR did not evaluate work-related exposures of service members as they performed military duties or training specific for their military occupational specialties. We did not evaluate exposures related to military field maneuvers or to (bacterial, radiological, or chemical) gases or agents used for training or warfare.

Conclusion 2

ATSDR concludes that servicemembers are not at risk for harmful health effects from exposure to contaminated groundwater at Fort McClellan since no exposures occurred because the groundwater was not used for potable purposes.

Basis for Conclusion 2

ATSDR evaluated whether servicemembers were exposed to contaminated groundwater while stationed at Fort McClellan. Exposure to contaminated groundwater can occur via human consumption, dermal contact, or inhalation. We determined that groundwater at Fort McClellan was not used for potable purposes, such as drinking or other household uses. Since construction, Fort McClellan received its drinking water supply from the Anniston Water Works and Sewer Board (Army, 2021). When in operation, Fort McClellan personnel conducted routine monitoring of the drinking water. Based on a 1997 records review and 1994 environmental compliance assessment, "the system has operated in compliance with state and federal drinking water standards" (Environmental Science & Engineering, 1998).

Conclusion 3

ATSDR reached the following conclusions regarding exposures to lead in soil:

<u>Housing</u>: ATSDR concludes that past touching or accidentally swallowing lead in soil near at least one housing building at Fort McClellan could have harmed a child's health. However, missing data prevented site-specific estimates of blood lead levels (BLLs).

<u>Non-housing buildings</u>: ATSDR cannot conclude whether past touching or accidentally swallowing lead in soil near non-housing buildings at Fort McClellan could harm a person's health due to insufficient information on soil lead concentrations and frequency, duration, and nature of exposures.

Basis for Conclusion 3

One or more concentrations of lead greater than the Army's action level of 400 ppm were detected in soil near five Ft McClellan buildings, but average concentrations (required for site-specific exposure modeling) are unknown. ATSDR used modeling to describe potential BLLs that would be of concern if sensitive populations were exposed in the past to various soil concentrations near Fort McClellan housing and non-housing buildings. The modeled soil concentrations are used to help understand potential for health effects from various levels of exposure. Lead based paint (discussed separately) may also contribute to BLLs for past Fort McClellan building occupants.

Housing

Average soil lead levels in past Fort McClellan housing are unknown because the quantitative soil lead sampling results are missing from the administrative records. A family housing building (Building 2242) had at least one soil concentration greater than 400 ppm.

ATSDR ran the EPA Integrated Exposure Uptake Biokinetic (IEUBK) model using all default parameters and a soil lead concentration of 400 ppm, which was the action level used by the Army at that time.[1] At 400 ppm of lead in soil, our analysis showed a 22% probability that child's BLL will exceed 5 µg/dL; that number increases to a 50% probability when the BLL is lowered to 3.5 µg/dL.[2] These levels in the past would have been a health concern for children at a residence. However, many details about how and where the samples were collected as well as the frequency and duration of exposures creates too much uncertainty in the data. Therefore, ATSDR cannot determine whether past touching or accidentally swallowing lead in soil in housing at Fort McClellan could harm people's health.

In 2024, EPA lowered the screening level for lead in soil at residential properties from 400 ppm to 200 ppm, or 100 ppm if multiple sources of lead are identified [EPA 2024]. During sampling events at Fort McClellan, lead concentrations in surface soil and dust wipe samples exceeded applicable standards that were established for use at that time. Exposure to indoor and outdoor sources of lead may have resulted in elevating BLLs even further.

Non-residential buildings

Average soil lead levels in non-housing buildings at Fort McClellan are unknown because the soil lead sampling results are missing from the

[1] ATSDR used the Army's action level of 400 ppm lead in the IEUBK model because the specific lead concentrations were missing from the Administrative Record. It is likely that the lead levels in soil at the five buildings (housing and non-residential) above the action level were higher than 400 ppm.

[2] In 2021, CDC lowered its blood reference value from 5 to 3.5 µg/dL. However, EPA has not evaluated the IEUBK below 5 µg/dL, so uncertainties may exist when modeling at levels below 5 µg/dL [EPA 2024].

administrative records. Four buildings, i.e., the workshop (Building 129), chapel (Building 893), soldier's chapel (Building 1740), and WAC chapel (Building 2293) buildings, had at least one soil concentration greater than 400 ppm.

Exposures at non-residential buildings are usually less frequent than at housing, though areas with intense soil exposure, such as playgrounds, may result in higher soil intake rates (see additional uncertainties below). Information about frequency, duration, and nature of exposures is not available.

The ALM model calculates non-residential exposure from lead in soil and predicts the risk of elevated blood lead levels in the fetus of an exposed pregnant person. At 400 ppm of lead in soil, our analysis showed a 0.4% probability that child’s blood lead level (BLL) will exceed 5 µg/dL; that number increases to a 2.1% probability when the BLL is lowered to 3.5 µg/dL. The geometric mean BLL of an adult worker is estimated to be 1.2 µg/dL.

ATSDR cannot reasonably estimate whether average soil exposures at non-residential buildings at Fort McClellan would cause harmful health effects because the data set is not available. Therefore, ATSDR cannot conclude whether past exposures may have been harmful to health at the four non-housing buildings with one or more soil lead concentrations exceeding the past screening level of 400 ppm.

<u>Uncertainties</u>
Many factors affect exposure estimates, lead uptake into the body, and potential for health effects:

- Soil sample depth (e.g., accessible surface soil), location (e.g., playground, dripline, whole yard), number, type (e.g., discrete, composite), size fraction, pH, moisture, treatment (e.g., grinding)
- ground cover
- bioavailability of lead in the soil or dust
- nutritional status, genetics, and other exposures (e.g., hobbies)
- frequency and duration of exposures

Without access to the soil analytical data and other factors, ATSDR cannot estimate average soil exposure point concentrations at Fort McClellan, the quality of the data for representing exposures, or personal factors that affect potential for health effects from soil lead exposures. Measured soil concentrations at buildings other than the five listed in this conclusion were less than 400 ppm but the actual concentrations are unknown. Residential exposure to levels less than 400 ppm may be a health concern also but cannot be evaluated without the sampling results.

Estimating BLLs from exposure at non-housing sites would be most accurate when site-specific information is available on the frequency and duration of exposures, when the nature of exposures is understood (e.g., outdoor activities), and when exposure at alternate locations is also understood (e.g., also spends time at home or a school/day-care with lead-based paint).

In 2024, EPA lowered the screening level for lead in soil at residential properties from 400 ppm to 200 ppm, or 100 ppm if multiple sources of lead are identified (EPA, 2024). During sampling events at Fort McClellan, lead concentrations in surface soil and dust wipe samples exceeded applicable standards that were established for use at that time. Exposure to indoor and outdoor sources of lead may have resulted in elevating BLLs even further.

Conclusion 4

ATSDR cannot conclude whether past touching or accidentally swallowing lead in dust from buildings sampled at Fort McClellan could harm people's health. The reasons for this include (1) the full data results are not available for review, and (2) the samples are not representative of potential past exposures as the buildings were vacated before the sampling was performed with no normal/regular cleanings or filtered ventilation systems running.

Basis for Conclusion 4

Lead based paint and/or dust wipe sampling was conducted at Fort McClellan in 1994 and 2000. In 2000, dust wipe lead loadings in 13 buildings exceeded the Army lead dust standards in use at the time of sampling. The standards used by the Army for leaded dust clearance levels by wipe sampling were: interior floors – 40 $\mu g/ft^2$; interior window sills – 250 $\mu g/ft^2$; and windows troughs – 800 $\mu g/ft^2$. The EPA/HUD post-cleanup clearance standards have been lowered since 2000 to 10 $\mu g/ft^2$ for floors and 100 $\mu g/ft^2$ for windowsills.

The new lower standards further reduce children's BLLs and the risk of adverse cognitive and developmental effects in children from lead exposures.[3] No safe level of lead in blood has been identified in children, and past exposures to lead in dust at Fort McClellan may have resulted in health effects to children.

Current models do not predict adult BLLs from exposure to lead dust loadings in mass per square foot (µg/ft^2). There is too much uncertainty in converting µg/ft^2 to concentration (ppm) to use the data in the IEUBK model. Therefore, ATSDR cannot estimate blood lead levels that may have resulted from the dust exposures at Fort McClellan.

Another limitation to the dust wipe sampling data is that sampling was performed in 2000 after the base closed in 1999. Unoccupied buildings that do not have regular cleanings and operational HVAC systems with air filters may differ from occupied buildings. Therefore, the dust sample results may not be representative of the past exposure to residents.

Conclusion 5

ATSDR concludes that servicemembers and families who live in or visited some on-base housing units and buildings may have been exposed to radon at levels above recommended action levels (currently 4 picocuries per liter) that may have increased their risk for harmful health effects.

Basis for Conclusion 5

Beginning in 1989, the U.S. Army's Radon Reduction Program began testing on-base buildings for radon. The radon sampling program detected radon levels above 4 picocuries per liter (pCi/L) in six on-base buildings. The EPA recommends that people take remedial actions in their homes if the radon levels are above 4 pCi/L (EPA, 2022). Radon levels above 4 pCi/L are not protective of human health and should be mitigated to reduce radon levels. ATSDR was not able to determine the levels of radon in buildings before 1989.

Conclusion 6

Because of lack of data ATSDR cannot conclude whether servicemembers were exposed to asbestos in some on-site buildings and whether these exposures might have harmed their health. Critical information – such as condition, location, size, shape, and chemical make-up of the fibers – is lacking to support a determination of the level of public health hazard.

Basis for Conclusion 6

Based on surveys conducted by the Army, some on-site buildings were

[3] https://www.federalregister.gov/documents/2021/01/07/2020-28565/review-of-dust-lead-post-abatement-clearance-levels

found to contain both friable and non-friable asbestos-containing materials. The results of these surveys are summarized in a report that only identified the presence or absence of asbestos-containing materials and did not contain other relevant information ATSDR would need to conduct a public health evaluation.

Conclusion 7

ATSDR determined that the notes by the Tumor Health Registry (specifically, the Tumor Board Cancer Committee and the Tissue and Transfusion Committee) are too limited to be used for public health assessment purposes and are not suitable for determining causal associations in environmental exposure investigations.

Basis for Conclusion 7

ATSDR evaluated information provided by the petitioner from the National Archives files. Individual cancer cases were reported in the Tumor Board Cancer Committee and the Tissue and Transfusion Committee notes. The data contained in the files were limited to treatment plan, age, and sex; race and military status were included in some, but not all, case reports. The data reported from each meeting were de-identified; therefore, some notes may contain reports of duplicate cases. Additionally, some cases may have had multiple cancers. Upon review of the files, we abstracted 306 reports of cancer cases that were reported between 1979-1983. The majority, 52%, of these cases were skin (31%) and breast (21%) cancers. Exposure to environmental hazards was not noted for any of the cases. Overall, these data are not suitable for conducting a health outcome data evaluation or for determining causal associations or links between exposures and harmful health outcomes in environmental exposure investigations.

Next Steps

ATSDR does not have any health protective recommendations considering the exposures were so far in the past. Individuals may consult their personal physician if they have concerns related to their health.

Further characterization of lead in soil and dust and taking appropriate remedial actions, if warranted, are recommended if the area and buildings are reused in the future.

For More Information

For further information about this health consultation, please call ATSDR at 1-800-CDC-INFO and ask for information about the Former Fort McClellan Site. If you have concerns about your health, please contact your health care provider.

Background

Statement of Purpose

On June 11, 2021, ATSDR received a petition request submitted by a citizen on behalf of the Fort McClellan Veterans Stakeholders Group (hereafter referred to as the "petitioner"). The request was for ATSDR to conduct a cumulative health risk assessment for veterans stationed at Fort McClellan, Alabama from 1945 to closure around 1999. (In 1995, the Base Realignment and Closure Commission selected Fort McClellan for closure, with official closure occurring in 1999.) The petitioner reports that veterans are experiencing adverse health effects from multiple environmental exposures that occurred while they were stationed at Fort McClellan.

Overview of the Petition Request

This section summarizes the major components of the petition request. Where possible, we used the original text as submitted by the petitioner. However, in some instances, we revised text for brevity and/or clarity.

According to the petitioner, the servicemembers of Fort McClellan may have been exposed to hazardous sources while at one or more the following locations or while engaging in the following activities:

- A variety of sites at Pelham Range
- A variety of sites at Fort McClellan
- Commuter soldiers who were assigned to Anniston Army Depot as a duty station while residing at the Fort McClellan base, and
- Transient soldiers who frequented the downtown retail district and public transportation venues as designated "commercial visitors" while out on an authorized military Gate Pass from the Fort. The areas visited include Amtrak, Greyhound Bus, the Anniston Airport, indoor or outdoor movie theaters, hotels, indoor or outdoor eateries, auto or motorcycle dealerships, and grocery or clothing shopping stores.

The petitioner identified the following contaminants of concern and potential exposure settings for servicemembers:

- Indoor and friable asbestos contamination was found in certain buildings including residential barracks buildings and high-traffic buildings such as the former non-commissioned officers (NCO) club

- Fog oil smoke generators that were used for outdoors field maneuvers
- Herbicides and pesticides were all used during the same set of years including (with certainty) the ingredients for making Agent Orange
- The Aroclor PCB air pathway of pollution stemming from the former Monsanto Chemical Factory of downtown Anniston, Alabama
- CS Riot Control Gas which may have involved the use of both the diluted training simulant version of the gas, as well as the live-agent version in some cases
- The former trichloroethylene (TCE) contamination site plus other contaminants of concern that was declared as an EPA Superfund site at the Anniston Army Depot
- The atomic and radiological sites across the Fort McClellan base and Pelham Range, including a significant list of certain isotopes, cesium-137, cobalt-60, lead, and a naturally occurring uranium site that was found in the shale bedrock near the cleanup site for an atomic burial mound
- The base-wide spraying of Bacillus germ spore bacteria in the pursuit of Fort Detrick military experiments
- Four landfill sites that underwent remedial cleanup actions at Fort McClellan, contaminants of concern from these sites have included TCE, tetrachloroethylene (PERC or PCE), and metallic lead
- Chemical, biological, radiological, nuclear, and explosives (CBRNE), chemical weapons air releases and related burn pits, including HD mustard gas, VX, Sarin, and GB warfare gases

The petitioner also requested for ATSDR to evaluate whether the Tumor Health Registry established by the base hospital at Fort McClellan (Noble Army Hospital) included patients from the medical clinic that was previously located at the Anniston Army Depot. The intended purpose is to determine whether the registry can be used to define and analyze health outcome data for servicemembers that were stationed at Fort McClellan (and Anniston Army Depot).

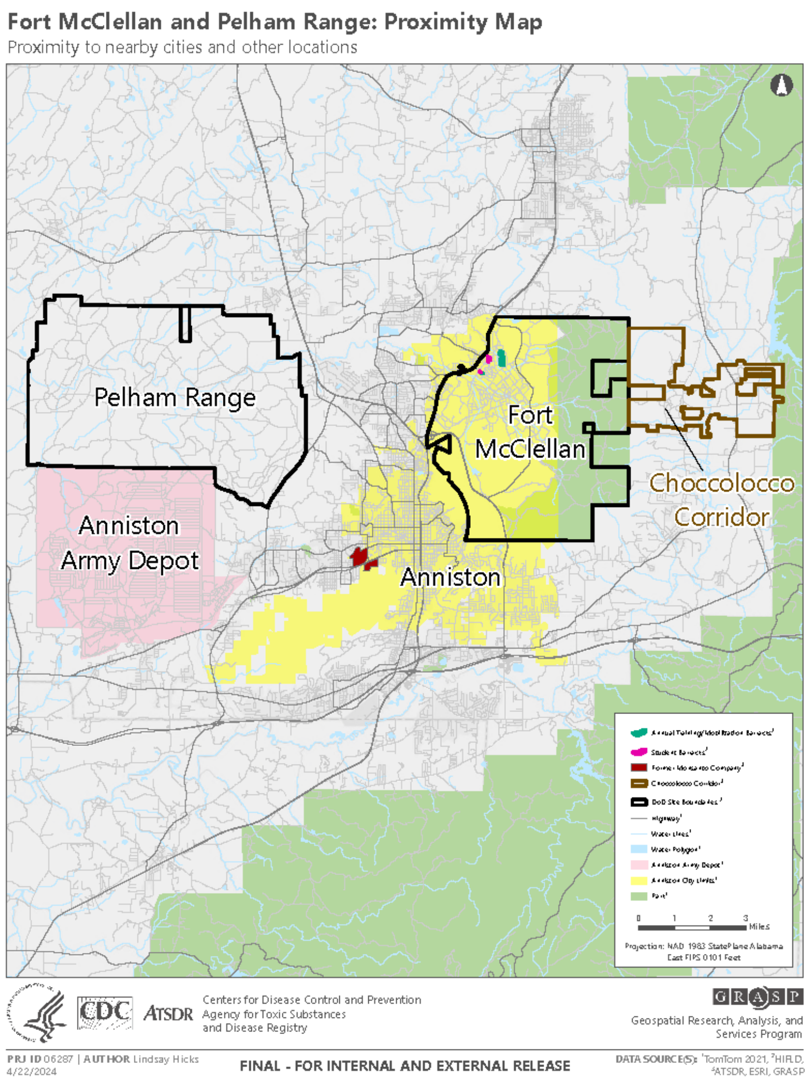
This health consultation (HC) includes ATSDR's evaluation and conclusions regarding potential public health implications for servicemembers' non-occupational exposure to environmental contaminants (chemical or radiological) at the former Fort McClellan site. ATSDR evaluated the information and environmental sampling data from the Base Realignment and Closure (BRAC) Environmental Restoration Program investigations and cleanup reports on areas and buildings at Fort McClellan where hazardous substances were known or suspected of being stored, released, or disposed of at some point in the facility's history.

We also reviewed information provided by the petitioner. This HC also includes our conclusions regarding the analysis of the Tumor Health Registry information. Since ATSDR or a state partner agency has already conducted public health evaluations for the off-base areas of concern (e.g., [Anniston Army Depot](), we did not re-evaluate those areas or draw new public health conclusions in this HC.

Site Description

Fort McClellan, originally called Camp McClellan, is a decommissioned U.S. Army facility located near Anniston, Alabama, in Calhoun County (Figure 1). Fort McClellan is comprised of three parts totaling approximately 45,679 acres. The three parts are the Main Post, the Choccolocco Corridor, and Pelham Range. The Main Post occupies 19,000 acres and contains most of the facilities and buildings. The Choccolocco Corridor occupies 4,500 acres and connects the Main Post to the Talladega National Forest to the east. Pelham Range, located west of the Main Post, consists of approximately 22,000 acres used for training.

Figure 1. Fort McClellan: Main Post, Choccolocco Corridor, and Pelham Range



Fort McClellan was a training facility for thousands of men and women since the early 1900s. During different points in its history, Fort McClellan was home to the U.S. Army Military Police School, the Advanced Individual Training Infantry Brigade, the Women's Army Corps School, and the U.S. Army Chemical School.

In 1941, the U.S. Army acquired Pelham Range. Pelham Range was used for training grounds for a wide range of activities, including small arms, tank artillery, chemical decontamination, and radiological training.

In 1995, the BRAC Commission selected Fort McClellan for closure, with official closure occurring in 1999. The BRAC Environmental Restoration Program is required to investigate and clean up contamination at closed or realigned federal properties prior to transferring properties to the public domain. As part of the BRAC process, the BRAC Environmental Restoration Program conducted environmental investigations and cleanups of areas and buildings at Fort McClellan where hazardous substances were known or suspected of being stored, released, or disposed of at some point in the facility's history. The reports generated from these BRAC-related investigations provided relevant environmental information and sampling data that were used in ATSDR's evaluation.

Environmental Sampling Data

ATSDR gathers and reviews environmental sampling data as a critical part of the public health assessment (PHA) process. (See Appendix A for a brief summary of ATSDR's PHA process.) Generally, ATSDR reviews information collected by other federal or state governmental agencies or their contractors, potentially responsible parties, or other third parties. ATSDR typically does not collect environmental sampling data.

For this HC evaluation on Fort McClellan, ATSDR used the historical sampling data from the environmental reports in the Administrative Record maintained by the U.S. Army. The Department of Defense (DoD) developed and implemented the Defense Environmental Restoration Program (DERP) to provide for the identification, investigation, and cleanup of contamination associated with past activities at DoD facilities to ensure that potential threats to public health and the environment are eliminated. Most environmental studies/sampling were conducted pursuant to activities by the BRAC Environmental Restoration Program. ATSDR used pertinent information and environmental sampling data from these investigations to understand the nature, magnitude, and extent of contamination in the non-occupational areas at Fort McClellan. Environmental sampling data prior to the mid-1990s are limited.

The petitioner also provided pertinent data and information to ATSDR, including information on tumor records from the National Archives.

Scientific Evaluation

Exposure Pathway Evaluation

Another critical step in our evaluation process is identifying exposure pathways. An exposure pathway is the link between the environmental release and the people that may be exposed to the environmental contaminants. Contaminants released into the environment have the potential to cause harmful health effects only if people contact the contamination. If no one comes into contact with a contaminant, no exposure occurs, and no harmful health effects occur.

ATSDR considers these five elements in the evaluation of exposure pathways:

1. **Contaminant source:** Where did the contaminants come from?
2. **Environmental fate and transport:** How contaminants released to the environment move through and across different media, as well as how they degrade or transform in the environment.
3. **Exposure point:** The specific location(s) where people might come into contact with a contaminated medium.
4. **Exposure route:** The path by which contaminants enter the body (dermal, inhalation, ingestion).
5. **Potentially exposed population:** The people who potentially have, do, or could come in contact with environmental contaminants.

ATSDR uses three exposure categories for the past, present, and future site-specific situations:

1. **Completed exposure pathways:** All five elements of a pathway are present.
2. **Potential exposure pathways:** One (or more) element of a pathway is missing, but information is not sufficient to eliminate or exclude the element.
3. **Eliminated exposure pathways:** One (or more) element of a pathway is not present for the timeframe of interest.

To develop the most complete understanding of the exposure pathways and areas associated with Fort McClellan, ATSDR conducted an extensive review of available files, records, and reports. We also spoke with the petitioner and with staff at other federal and state agencies. Based on this information, ATSDR identified several non-occupational exposure areas (Table 1). The following non-occupational areas at Fort McClellan were determined to 1) have been an area or medium for potential storage or release of hazardous substances, 2) have available environmental sampling data, and 3) have been a potential exposure point for servicemembers stationed at Fort McClellan:

- Housing and other community-based buildings
- Groundwater

- Landfills
- Golf course
- Athletic field
- Reilly Lake
- Lake Yahou
- Cane Lake
- Mock Village

ATDR acknowledges that land uses and building locations may have changed over time at Fort McClellan. We are unable to document and account for most land use changes that may have impacted potential exposures over time.

The identification of a completed or potential exposure point/pathway **does not mean** that the exposure will result in harmful health effects. The likelihood of health effects depends on specific exposure conditions such as the exposure duration, contaminant toxicity and concentration, and exposure frequency. Therefore, even if exposure has occurred, is now occurring, or likely will occur in the future, human health might not be affected. To determine whether health effects are possible, ATSDR further evaluates the completed and potential exposure pathways in the next scientific evaluation – the **Screening Analysis**.

Table 1. Fort McClellan Exposure Pathways & Contaminants with Maximum Concentrations Greater than Applicable Comparison Values (CVs)

Pathway or Area	Contaminant Source	Fate and Transport	Exposure Point	Exposure Route	Potentially Exposed Population	Notes	Contaminants with Max Concentrations Greater than CVs (Require Further Evaluation)	Contaminants without CVs (Require Further Evaluation)
Groundwater	Activities at the base	Base activities can release contaminants to the groundwater	None	None	None	Incomplete pathway; groundwater not used for drinking or other potable purposes.	Not applicable.	**Not applicable.**
Landfills	Landfill waste and debris	Contaminants released from waste and debris to the soil and groundwater	▪ Surface soil ▪ Vapor Intrusion (VI)	▪ Dermal contact ▪ Incidental ingestion ▪ Inhalation	Military personnel living on base near Landfills (Landfill 1)	Complete pathway	*Surface Soil* ▪ Iron *VI* ▪ None	***Surface Soil*** ▪ **Phenanthrene** ***VI*** ▪ **Acetone** ▪ **Di-n-butyl phthalate** ▪ **1,3-dinitrobenzene**
Golf course	Pesticide and herbicide application	Residual pesticides and herbicides can remain in soil, surface water, and sediment	▪ Surface soil ▪ Sediment ▪ Surface water	▪ Dermal contact ▪ Incidental ingestion	Military personnel who golf	Complete pathway	*Surface Soil* ▪ Benzo(a)pyrene *Sediment* ▪ None *Surface Water* ▪ Thallium	***Surface Soil*** ▪ **Benzo(g,h,i)perylene** ▪ **Phenanthrene** ***Sediment*** ▪ **None** ***Surface Water*** ▪ **None**
Athletic field	An adjacent former motor pool	Vehicle & fleet maintenance can contaminate the soil	▪ Surface soil	▪ Dermal contact ▪ Incidental ingestion	Military personnel playing ball/recreating	Complete pathway	*Surface Soil* ▪ Benzo(a)pyrene ▪ Dibenz(a,h)anthracene ▪ Indeno(1,2,3-cd)pyrene	***Surface Soil*** ▪ **Benzo(g,h,i)perylene** ▪ **Carbazole** ▪ **Phenanthrene**
Reilly Lake	Nearby fill area and former post garbage dump	Waste and debris can contaminate the surface water, sediment, and fish	▪ Sediment ▪ Surface water ▪ Fish	▪ Dermal contact ▪ Ingestion	Military personnel fishing, wading, or swimming	Complete pathway	*Sediment* ▪ Iron ▪ Manganese *Surface Water* ▪ Arsenic	***Sediment*** ▪ **None** ***Surface Water*** ▪ **None** ***Fish***

							Fish ▪ Hexavalent Chromium	▪ **Iron** ▪ **Manganese** ▪ **Thallium**
Lake Yahou	Training exercises at the Mock Village	Residual chemicals can contaminate the environment	▪ Sediment ▪ Surface water ▪ Fish	▪ Dermal contact ▪ Ingestion	Military personnel fishing, wading, or swimming	Complete pathway	*Sediment* ▪ None *Surface Water* ▪ None *Fish* ▪ Not available	***Sediment*** ▪ **None** ***Surface Water*** ▪ **None** ***Fish*** ▪ **Not available**
Cane Creek	Activities at Pelham Range and Fort McClellan	Base activities can contaminate the surface water, sediment, and fish in the creek	▪ Sediment ▪ Surface water ▪ Fish	▪ Dermal contact ▪ Ingestion	Military personnel fishing, wading, or swimming	Complete pathway	*Sediment* ▪ Benzo(a)pyrene *Surface Water* ▪ Di(2-ethylhexyl)phthalate ▪ Trichloroethylene ▪ Thallium *Fish* ▪ Not available	***Sediment*** ▪ **Benzo(g,h,i)perylene** ▪ **Phenanthrene** ***Surface Water*** ▪ **None** ***Fish*** ▪ **Not available**
Mock Village	Training exercises	Residual chemicals can contaminate the soil	▪ Surface soil	▪ Dermal contact ▪ Incidental ingestion	Military personnel	Complete pathway	*Surface Soil* ▪ None	***Surface Soil*** ▪ **None**
Housing and other buildings	Building materials with lead-based paint or asbestos; radon from the environment	Flaking paint or asbestos; radon seeping into the buildings from the ground and collecting in buildings	▪ Buildings	▪ Incidental ingestion ▪ Inhalation	Military personnel & Families living in the housing or occupying other buildings	Complete pathway	Not applicable.	**Not applicable.**

Screening Analysis

During our petition evaluation, ATSDR typically reviews a large amount of sampling data. We use a screening process to sort through the environmental data to identify contaminants in potential or completed exposure pathways that require further evaluation.

For completed and potential exposure pathways, ATSDR conducts a screening analysis – a quick, easy way for identifying contaminants that do and do not require further evaluation at a site. Conducting the screening analysis involves comparing contaminant concentrations to media-specific screening levels (ATSDR comparison values [CVs] and non-ATSDR screening levels) to identify those that meet or exceed screening levels. It also involves pinpointing contaminants with no available screening levels and evaluating other factors (e.g., a community concern) that warrant closer examination.

> **Important**: If a contaminant level exceeds an ATSDR CV or non-ATSDR screening level, it does not mean that health effects will occur, just that more evaluation is necessary.

ATSDR Comparison Values (CVs)

CVs developed by ATSDR are contaminant concentrations in a particular medium – such as air, soil, or water – to which humans might be exposed without the likelihood of experiencing harmful health effects. Each CV is specific to a particular contaminant and environmental medium. CVs help us make consistent decisions about what contaminant concentrations associated with site exposures might require a closer look. Exceeding a CV does not mean harmful health effects are likely; it means that a more detailed evaluation is needed to determine the potential for harm.

ATSDR develops its CVs assuming that exposures occur through contact to a single medium and to a single contaminant for a specified exposure period: acute (14 days or less), intermediate (15 to 364 days), or chronic (365 days and longer). CVs are based on a default exposure scenario (i.e., they do not reflect site-specific exposures), assuming daily exposure to the chemical and a standard amount of media (e.g., air, water, soil) that a person might inhale or ingest each day. CVs are generated to be conservative and to protect the health of children and adults. CVs are not intended as environmental cleanup levels and are not indicators that health effects occur above the CV concentrations.

ATSDR develops different CVs for *noncancer* and *cancer* health effects. When developing noncancer CVs, ATSDR assumes that only noncancer health effects will occur. When developing cancer CVs, ATSDR assumes that only cancer health effects will occur. When a contaminant has both a cancer and noncancer CV, health assessors use the lowest of the two CVs for screening (except for arsenic because the CV for cancer is below background concentrations).

ATSDR develops noncancer CVs using appropriate noncancer health guidelines and standard default exposure assumptions. Health guidelines consist of oral doses (ATSDR's oral minimal risk levels [MRLs], EPA's reference doses [RfDs]) and air concentrations (ATSDR's inhalation MRLs, EPA's reference concentrations [RfCs]) developed from toxicology or epidemiology studies. These health guidelines are developed with safety factors and are protective of human health. For cancer effects, ATSDR develops cancer CVs using EPA's cancer risk values to identify estimated concentrations of cancer-causing contaminants that would be predicted to cause no more than one excess cancer in a million persons exposed during their lifetime (78 years). Cancer risk values consist of EPA's oral cancer slope factors (CSFs) and inhalation unit risks (IURs).

In addition to ATSDR CVs, ATSDR may use non-ATSDR screening levels when ATSDR CVs are not available, or when lower (i.e., more health protective) than ATSDR CVs.

CVs Used in This Document

The following ATSDR and non-ATSDR CVs were used in preparing this document:

- *Cancer Risk Evaluation Guides (CREGs)* are ATSDR CVs that represent estimated contaminant concentrations that are not expected to result in no more than one excess cancer in a million persons exposure during their lifetime (78 years). CREGs for media, like water and soil, are derived using EPA's oral CSFs and default exposure assumptions. CREGs for air are derived using EPA's IURs. CREGs are calculated using age-group specific formula exposure assumptions for body weight and ingestion of soil or water. Age-dependent adjustment factors (ADAFs) are included for carcinogens with a mutagenic mode of action.

- *Environmental Media Evaluation Guides (EMEGs)* are ATSDR CVs. EMEGs are concentrations of contaminants in a specific medium (e.g., water, soil) that represent estimated contaminant concentrations below which humans exposed during a specific timeframe (acute, intermediate, or chronic) are not expected to experience noncancer health effects. EMEGs are based on ATSDR's oral and inhalation MRLs.

- *Reference Media Evaluation Guides (RMEGs)* are ATSDR CVs. RMEGs represent the concentration in a specific medium (e.g., water, soil) at which daily human exposure for a chronic duration is unlikely to result in noncarcinogenic effects. RMEGs are derived from EPA's oral RfDs for ingestion and RfCs for inhalation.

- *Maximum Contaminant Levels (MCLs)* are established by EPA to indicate the highest level of a contaminant in water which is delivered to any user of a public water system.

- *Regional Screening Levels (RSLs)* are concentrations of chemical contaminants used by EPA as risk-based screening levels at hazardous waste sites. RSLs are calculated using the latest toxicity values, default exposure assumptions, and physical and chemical properties.

To conduct the screening analysis, we compare maximum contaminant concentrations in environmental media to CVs to determine which contaminants need to be further evaluated.

To conduct the screening for the Fort McClellan site, we compared the maximum detected contaminant concentration in each medium to the appropriate CV (Appendix B). The maximum concentrations are used in the screening process as a protective measure even though we know that people were likely exposed to a range of concentrations and not just to the maximum detected levels. The screening process allows us to identify

- contaminants whose concentrations are below screening levels and therefore pose no health hazard (these contaminants are not evaluated further),
- contaminants whose concentrations meet or exceed screening levels and require further evaluation, and
- contaminants without readily available screening levels.

For contaminants with concentrations at or above CVs, or that have no CVs available, we proceeded with a further toxicological evaluation of that contaminant. We performed exposure calculations to estimate exposure doses that were then used to evaluate non-cancer and cancer risks. In doing these calculations, ATSDR used the maximum detected concentration and considered site-specific conditions (e.g., the duration, frequency, and magnitude of exposure) that are unique to the site. When site-specific information was not available, ATSDR used protective assumptions to estimate exposures (Appendix C, Table C1). Where appropriate, specifically related to housing, we considered families with children as part of the potentially exposed population at Fort McClellan. Estimated exposure doses that are less than health guideline values pose no public health hazard.

Eliminated or Incomplete Exposure Pathways, Areas, or Contaminants

Based on our exposure pathway evaluation and screening analysis, we eliminated the following exposure pathways from further evaluation because 1) the pathway is incomplete so no exposures would have occurred *OR* 2) all contaminant concentrations in the completed pathway are below CVs and therefore pose no health hazard:

GROUNDWATER: ATSDR evaluated whether servicemembers were exposed to contaminated drinking water while stationed at Fort McClellan. Exposure to contaminated groundwater can occur via human consumption, dermal contact, or inhalation. We determined that groundwater at Fort McClellan was not used for potable purposes such as drinking and other household uses. Since construction, Fort McClellan received its drinking water supply from the Anniston Water Works and Sewer Board (Army, 2021). When in operation, Fort McClellan personnel conducted routine monitoring of the drinking water. Based on a 1997 records review and 1994 environmental compliance assessment, "the system has operated in compliance with state and federal drinking water standards" (Environmental Science & Engineering, 1998). Therefore, the exposure pathway to contaminated groundwater is eliminated from further evaluation because no exposures occurred and therefore no public health hazard exists.

LAKE YAHOU: ATSDR evaluated whether people who fished or recreated (including swimming and wading) in Lake Yahou could have been exposed to contaminants in sediment and surface water in Lake Yahou. Fish data from Lake Yahou were not available, so we were unable to evaluate the fish exposure pathway. We determined that no contaminants in sediment or surface water in Lake Yahou exceeded applicable CVs. (Tables B1 and B2, respectively.) Therefore, no harmful health effects are expected for servicemembers who recreated at Lake Yahou.

MOCK VILLAGE: ATSDR learned from the petitioner that some servicemembers spent leisure time at the Mock Village. The Mock Village was located in the southwestern portion of the Fort McClellan Main Post and covered approximately 5 acres. ATSDR evaluated whether servicemembers could have been exposed to contaminants in surface soil while recreating or spending leisure time at the Mock Village. No contaminants in surface soil exceeded applicable CVs (Table B3). Therefore, no harmful health effects are expected for servicemembers who contacted the surface soil at the Mock Village.

AGENT ORANGE: Because the petitioner specifically mentioned concerns about Agent Orange exposures, ATSDR searched the sampling data for Agent Orange or Agent Orange chemical components in the aforementioned non-occupational areas at Fort McClellan. The major components of Agent Orange are two herbicides: 2,4,5-T (2,4,5-trichlorophenxoyacetic acid) and 2,4-D (2,4-diclorophenoxyacetic acid). We did not find samples in any environmental media that tested for Agent Orange or the chemical components 2,4,5-T or 2,4-D. However, we did find some samples that were tested for 2,4,5-trichlorophenol and 2,4-dichlorophenol, which can be used as precursors to the manufacture of 2,4,5-T and 2,4-D, respectively. Reilly Lake and Lake Yahoo sediment and surface water samples were tested for 2,4,5-trichlorophenol and 2,4-dichlorophenol, but neither compound was detected. The Mock Village soil samples were tested for 2,4-dichlorophenol and 2,4,5-trichlorophenol, but neither compound was detected.

Polychlorinated biphenyls (PCBs): ATSDR did not find samples that were tested for PCBs in environmental media in the non-occupational areas evaluated.

Completed Exposure Pathways/Areas

ATSDR conducted further evaluation for completed exposure pathways where contaminant concentrations exceeded a CV. Contaminants whose concentrations are below CVs, even for completed exposure pathways, do not pose a health hazard and are not evaluated further.

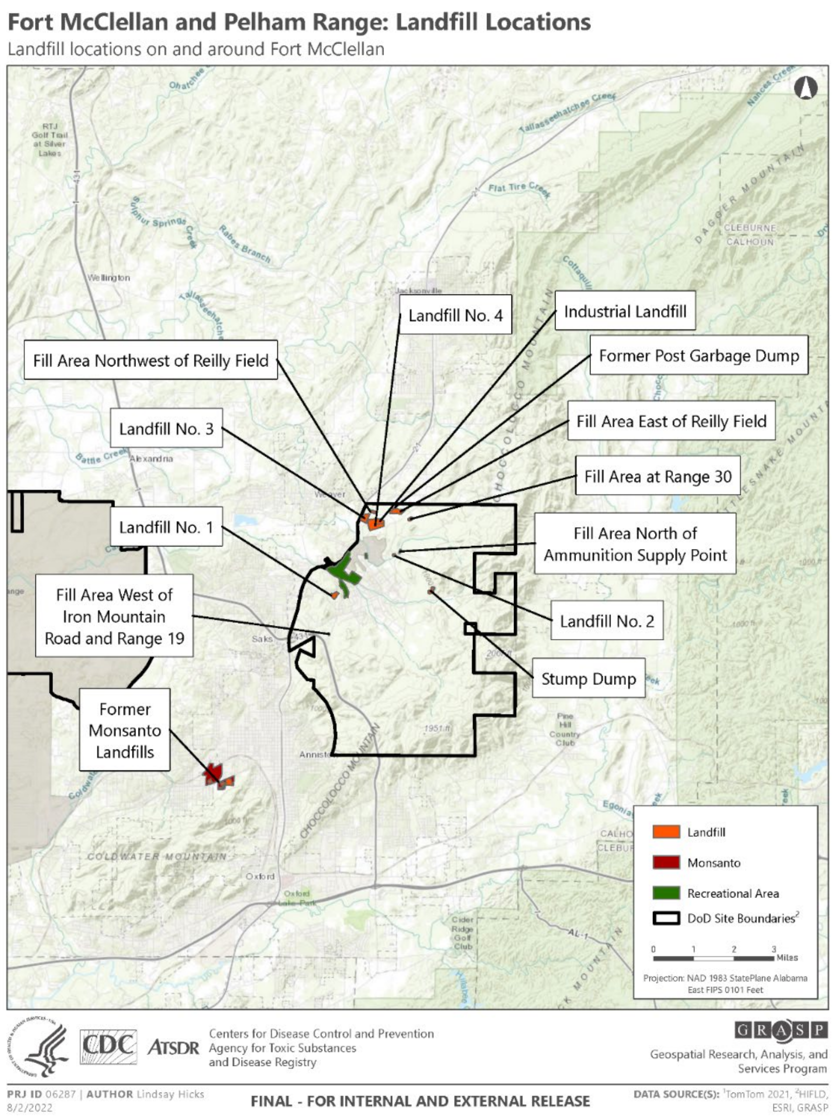
The remaining completed exposure pathways were evaluated further because 1) the pathways represented a likely exposure point in the past for servicemembers and 2) at least one contaminant concentration exceeds the applicable CV or no CV was available. A detailed explanation of ATSDR's health effects evaluation process – including how to calculate exposure doses, hazard quotients (HQs) and lifetime excess cancer risks – is included in Appendix C. We used the exposure parameters shown in Table C1 to calculate exposure doses.

The non-occupational exposure pathways/areas we evaluated and the public health conclusions we reached are summarized below.

LANDFILLS: Landfilling or waste disposal activities have been documented at 4 landfills and 8 other fill areas (Figure 2) at Fort McClellan. ATSDR only evaluated Landfill 1 because this landfill bordered housing and, therefore, had the potential for servicemembers or their family members to be exposed to the surface soil on the landfill and for possible vapor intrusion into the nearby buildings. Landfill No. 1 was a sanitary landfill between 1945 and 1947. Aerial photos from 1944 through 1969 indicate that portions of the landfill may have been trenched, cleared, and partially filled to accommodate military housing. Other landfills are in remote areas of the base and were not evaluated further because of the lack of exposure potential for non-occupational activities.

We evaluated the following environmental media associated with Landfill 1: surface soil and indoor air (via vapor intrusion).

Figure 2. Landfill Locations on and near Fort McClellan



Landfill Surface Soil: Servicemembers and their family members could have come into dermal contact with or incidentally ingested the surface soil at Landfill 1 while playing or engaging in outdoor activities near the landfill area. Based on the screening analysis of surface soil from Landfill 1, only iron and phenanthrene were selected for further evaluation because iron exceeded its CV and no CV exists for phenanthrene (Table B4).

Iron

The maximum detected concentration of iron is surface soil at Landfill 1 is 80,000 ppm, which exceeds the CV of 55,000 ppm for iron. Iron, an essential nutrient, is typically not harmful in the environment under most environmental exposure scenarios. Therefore, exposure to iron in the surface soil at Landfill 1 is not likely to cause harmful health effects to children or adults.

PAHs

Phenanthrene is one of a group of compounds referred to as polycyclic aromatic hydrocarbons (PAHs) (See Appendix D for additional information on PAHs). PAHs are a group of over 100 different compounds that are formed during the incomplete burning of coal, oil and gas, garbage, or other organic substances like tobacco or charbroiled meat. PAHs can either be synthetic or occur naturally. PAHs generally occur as complex mixtures – for example, as part of combustion products such as soot – not as single compounds (ATSDR, 1995).

Five PAHs were detected in surface soil at Landfill 1 – fluoranthene, pyrene, benz(a)anthracene, chrysene, and phenanthrene. For Landfill 1, all PAHs are below their respective CVs except for phenanthrene because no CV exists for phenanthrene.[4] Therefore, we used ATSDR's benzo(a)pyrene equivalent (BaPE) value to screen all PAHs at Landfill 1 for cancer risk. The BaPE value is the sum of the different PAHs detected in the soil sample adjusted for their toxicity relative to BaP; that is, the BaPE equals the sum of the individual PAH concentrations multiplied by their respective potency equivalency factor (PEF) (ATSDR, 2022a). (See Appendix E for a detailed description of how ATSDR calculates BaPEs and evaluates lifetime cancer risks for PAHs.)

Using ATSDR guidance, we calculated the BaPE concentration for the sample from Landfill 1 with the highest detected PAHs. Five PAHs were analyzed for in each of the surface soil samples collected from Landfill 1. Of the five PAHs, only two had PEFs. The other PAHs congeners do not have PEFs because there is not sufficient evidence demonstrating their carcinogenicity. These PAHs are not included in BaPE calculations.

[4] ATSDR has not derived health-based guidelines for all PAHs because there are no adequate human or animal dose- response data available that identify threshold levels for noncancer health effects. Most of the available information on the health effects of PAHs in humans must be inferred from studies that reported the effects of exposure to complex mixtures that contain PAHs.

It would be inappropriate to consider them in cancer risk evaluations, and therefore, they are not discussed further.

The BaPE calculation and results are in Table 2.

Table 2. BaPE Equivalent Calculation: Landfill 1 Surface Soils			
PAH Congener	**Potency Equivalency Factor – PEF (unitless)**	**Max Sample Concentration or Detection limit (ppm)**	**BaP Equivalent Concentration – BEC (ppm)**
Benz(a)anthracene	0.1	0.17	0.017
Chrysene	0.01	0.17	0.0017
BaP Equivalent (ppm)	--	--	0.019

The calculated BaP equivalent concentration (0.019 parts per million or ppm) was then compared to the current CV of 0.065 ppm for carcinogenic PAHs. The calculated BaPE is below the CV concentration. Therefore, ATSDR concludes that touching or incidentally ingesting PAHs in soil at Landfill 1 is not expected to harm people's health because the estimated exposures are below levels of health concern.

Environmental Medium	Calculated BaPE (ppm)	BaP Equivalent Comparison Value (CV) (ppm)	CV Exceeded?
Surface Soil – Landfill 1	0.019	0.065	No

Landfill 1 Indoor Air (via vapor intrusion): We also evaluated the potential for contaminants in groundwater to cause vapor intrusion (air) exposures for people in buildings near Landfill 1. Vapor intrusion (VI) can occur when chemical vapors migrate from contaminated groundwater through the soil into the basements or foundations of buildings. Breathing indoor air contaminants in buildings due to vapor intrusion is a potential pathway for exposure to shallow groundwater contaminants.

Based on the screening analysis, the maximum concentrations of acetone, di-n-butyl phthalate, and 1,3-dinitrobenzene exceeded their applicable CV or had no VI CV (Table B5).

Acetone

Acetone was selected for further evaluation because it is a volatile chemical and has no chronic vapor intrusion CV. The acute air CV for acetone is 19,000 µg/m^3. Applying the EPA groundwater VI screening attenuation factor of 0.001 to the acute air CV yields a groundwater value of approximately 14,000,000 ppb.[5] The intermediate and chronic

[5] {air CV [µg/m^3] x UCF [0.001 m^3/L]} / {H' [unitless] x AF [0.001]} = screening value [µg/L]
(19,000 x 0.001) / (1.4e-3 x 0.001) = 13,571,429 µg/L

where UCF = unit conversion factor, H' = unitless Henry's law constant, and AF = EPA's screening attenuation factor exposure studies in the ATSDR tox profile do not identify effects at any lower exposure concentrations than the study for the acute air CV. Considering that the groundwater concentration is 1,000,000 times less than the groundwater value derived from the acute air CV, ATSDR does not consider the maximum concentration of acetone in groundwater to be of concern for harmful health effects from the VI pathway.

Di-n-butyl phthalate and 1,3 dinitrobenzene

Di-n-butyl phthalate and 1,3-dinitrobenzene do not meet the EPA's volatility criteria of (Henry's law constant) H' >= 1e-5 atm-m^3/mol and (molecular weight) MW<200 g/mol requiring VI assessment. Therefore, ATSDR does not consider di-n-butyl phthalate and 1,3-dinitrobenzene to sufficiently volatile to pose a VI concern. However, if groundwater is very shallow and seeps directly into basements, direct off-gassing from the water into indoor air may indicate further evaluation is needed. Groundwater seepage into building basements was not documented in any of the reports examined, so additional evaluation of di-n-butyl phthalate and 1,3-dinitrobenzene is not needed.

GOLF COURSE: The golf course at Fort McClellan is in the northwest area of the Main Post and covers approximately 146 acres. Servicemembers and others who golfed at the golf course could have been exposed to surface soils, sediments, and surface waters via incidental ingestion and dermal touch while golfing. ATSDR evaluated each of these potential exposure scenarios. We evaluated the following environmental media associated with the golf course: surface soil, surface water, and sediments.

Golf Course Surface Soil: Based on the screening analysis of surface soil at the golf course, the maximum concentrations of benzo(a)pyrene, benzo(g,h,i)perylene, and phenanthrene either exceeded their applicable CV or had no CV (Table B6).

PAHs

Since each chemical is a PAH compound, we evaluated the PAHs for potential carcinogenic health effects. Twelve PAHs were analyzed for in each of the surface soil samples collected from the golf course. Of the 12 PAHs analyzed, six had PEFs that could be used for calculating the BaPE concentration. Using ATSDR guidance, we calculated the BaPE concentration for the golf course sample with the highest detected PAHs. The BaPE calculation and results are in Table 3.

Table 3. BaPE Equivalent Calculation: Golf Course Surface Soil			
PAH Congener	**Potency Equivalency Factor – PEF (unitless)**	**Max Sample Concentration (ppm)**	**BaP Equivalent Concentration – BEC (ppm)**
Benzo(a)pyrene	1	0.069	0.069
Benz(a)anthracene	0.1	0.052	0.0052
Benzo(b)fluoranthene	0.1	0.093	0.0093
Benzo(k)fluoranthene	0.1	0.062	0.0062
Chrysene	0.01	0.075	0.00075
Indeno(1,2,3-cd)pyrene	0.1	0.044	0.0044
BaP Equivalent (ppm)	--	--	0.095

The BaPE concentration of 0.095 ppm is greater than the current CV of 0.065 ppm for carcinogenic PAHs.

Environmental Medium	Calculated BaPE (ppm)	BaP Equivalent Comparison Value (CV) (ppm)	CV Exceeded?
Surface Soil – Golf Course	**0.095**	0.065	**Yes**

Therefore, we calculated an exposure dose and cancer risk using the calculated BaPE concentration (Table F1). The cancer risks ranged from 1.3E-09 to 4.3E-09, which is not considered by ATSDR to be an elevated lifetime cancer risk. Based on these lifetime cancer risk calculations, ATSDR concludes that touching or incidentally ingesting PAHs in soil on the golf course is not expected to harm people's health because the estimated exposures are below levels of health concern. Note that this is a theoretical estimate of lifetime cancer risk that ATSDR uses as a tool for deciding whether public health actions are needed to protect health—it is not an actual estimate of cancer cases in a community.

Golf Course Surface Water. Based on the screening analysis of surface water from the golf course, only the maximum concentration of thallium in exceeded the drinking water CV (Table B7).

Thallium

Thallium is a metal that is a by-product from smelting other metals; however, thallium has not been produced in the United States since 1984. Thallium also has limited use in the manufacture of special glass and for certain medical procedures (ATSDR, 1992). The maximum concentration of thallium in surface water (5.8 ppb) on the golf course slightly exceeds the drinking water CV (2 ppb), so no harmful health effects are expected from people's infrequent contact with surface water on the golf course. A CV based on drinking approximately 2 liters of water per day would likely be protective for the intermittent, incidental ingestion exposures associated with the golf course surface water pathway. ATSDR concludes that exposure to the maximum concentration of thallium in surface water on the golf course is not expected to harm people's health.

Golf Course Sediments: No contaminants in sediments on the golf course exceeded applicable CVs (Table B8); therefore, no harmful health effects are likely from incidental ingestion of and dermal contact with sediments at the golf course.

ATHLETIC FIELD: An area on Fort McClellan identified as the Former Motor Pool area was used as a softball/baseball field. People who played ball at the ballfield could have been exposed via incidental ingestion of and dermal contact with contaminants in surface soil while on the field.

We evaluated the following environmental medium associated with the athletic field: surface soil.

Athletic Field Surface Soil: Based on the initial screen of surface soil from the ballfield, the maximum concentrations of benzo(a)pyrene, benzo(g,h,i)perylene, carbazole, dibenz(a,h)anthracene, indeno(1,2,3-cd)pyrene and phenanthrene either exceeded their applicable CV or had no CV (Table B9).

PAHs

Since each compound is a PAH, ATSDR evaluated the PAHs for potential carcinogenic effects. Ten PAH compounds were analyzed for in each of the surface soil samples collected from the athletic field. Of the ten PAHs analyzed, six had PEFs that could be used for calculating the BaPE concentration. Using ATSDR guidance, we calculated the BaPE concentration for the athletic field sample with the highest detected PAHs. The BaPE calculation and results are in Table 4.

Table 4. BaPE Equivalent Calculation: Athletic Field Surface Soil

PAH Congener	Potency Equivalency Factor – PEF (unitless)	Max Sample Concentration (ppm)	BaP Equivalent Concentration – BEC (ppm)
Benzo(a)pyrene	1	0.1	0.1
Benz(a)anthracene	0.1	0.76	0.0076
Benzo(b)fluoranthene	0.1	0.1	0.01
Benzo(k)fluoranthene	0.1	0.15	0.015
Chrysene	0.01	0.098	0.00098
Indeno(1,2,3-cd)pyrene	0.1	0.061	0.0061
BaP Equivalent (ppm)	--	--	0.14

The BaPE concentration of 0.14 ppm is greater than the current CV of 0.065 ppm for carcinogenic PAHs.

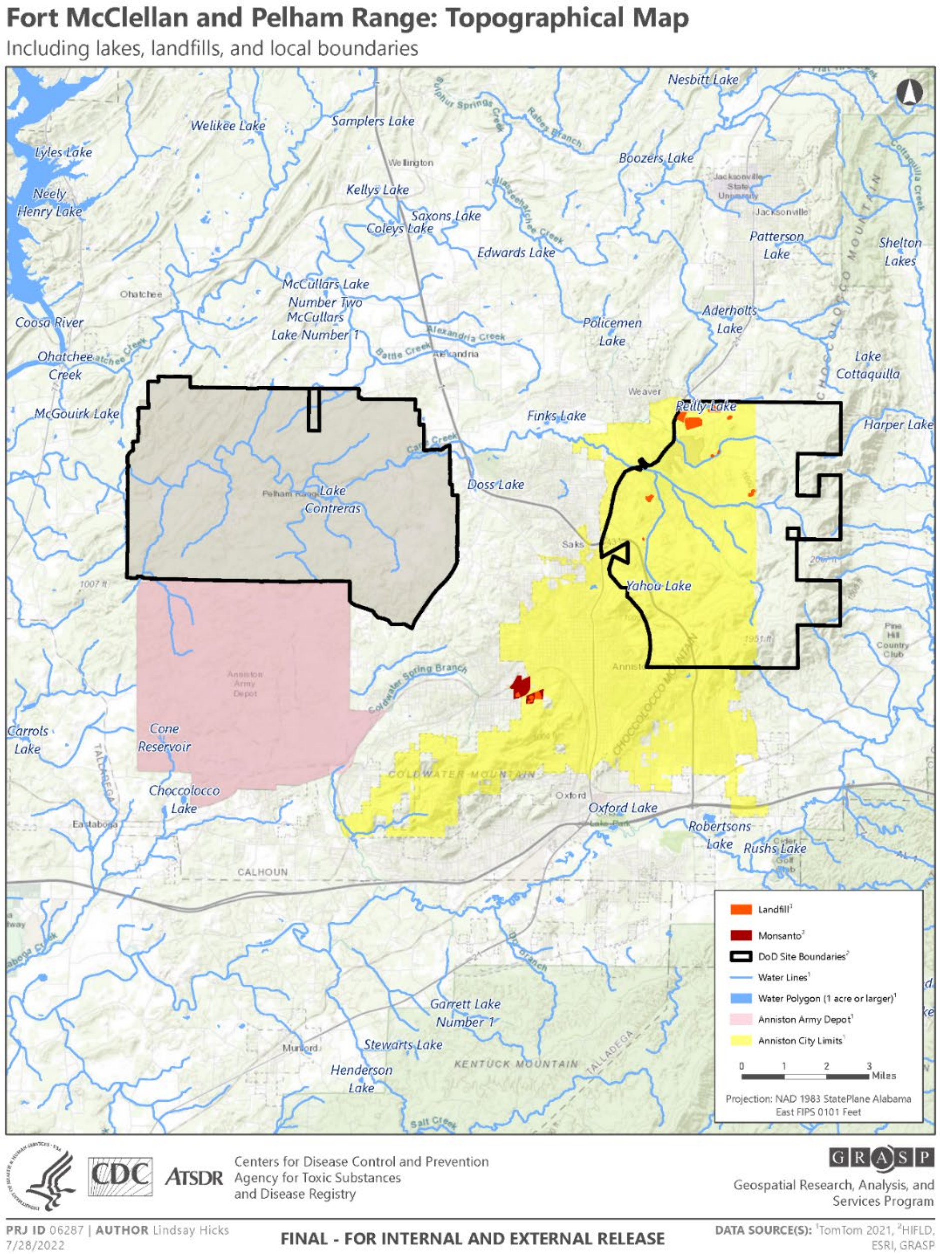
Environmental Medium	Calculated BaPE (ppm)	BaP Equivalent Comparison Value (CV) (ppm)	CV Exceeded?
Surface Soil - Athletic Field	**0.14**	0.065	**Yes**

The calculated BaP equivalent concentration (0.140 ppm) is greater than the current CV (0.065 ppm) for carcinogenic PAHs. Therefore, we calculated an incidental soil ingestion and dermal contact exposure doses and lifetime cancer risks using the calculated BaP equivalent concentration in soil (Table F2). The calculated lifetime cancer risks ranged from 1.8E-09 to 6.3E-09, which is not considered by ATSDR to be an elevated lifetime cancer risk. Based on the risk calculations, ATSDR concludes that touching or incidentally ingesting PAHs in soil on the athletic field is not expected to harm people's health because the estimated exposures are below levels of health concern.

REILLY LAKE: Reilly Lake runs through the northwestern portion of Fort McClellan (Figure 3). People who fished or recreated in Reilly Lake could have been exposed via incidental ingestion of or dermal contact with contaminants in the sediment or surface waters of Reilly Lake. They could have also eaten any fish they caught from Reilly Lake. ATSDR evaluated each of these potential exposure scenarios.

We evaluated the following environmental media/pathways associated with Reilly Lake: sediment, surface water, and fish consumption.

Figure 3. Lakes on and near Fort McClellan



Reilly Lake Surface Water: In the surface waters of Reilly Lake, the maximum concentrations of arsenic, manganese, and iron exceed their applicable CV and, therefore, require further evaluation (Table B10).

Arsenic

Arsenic is a naturally occurring element widely distributed in the earth's crust. Arsenic can be released to water by natural weathering of soil and rocks and can also be leached from soil and minerals into groundwater. The Department of Health and Human Services

(DHHS) and the EPA have determined that inorganic arsenic is a known human carcinogen (ATSDR 2007, 2016).

Using reasonable exposure assumptions, we calculated exposure doses for people who may have incidentally ingested and had dermal contact with the maximum detected concentration of arsenic in the surface waters of Reilly Lake (Table F3). The noncancer doses ranged from 1.2E-06 milligrams per kilogram per day (mg/kg/day) to 4.7E-06 mg/kg/day and are less than ATSDR's MRL of 3.0E-04 mg/kg/day for arsenic. The lifetime excess cancer risks were calculated using the cancer slope factor of 1.5 $(mg/kg/day)^{-1}$. The calculated lifetime cancer risks ranged from 5E-08 to 1.8E-07, which is not considered by ATSDR to be an elevated lifetime cancer risk. The calculated exposure doses and lifetime cancer risk estimates for arsenic in surface water are less than ATSDR's health-based values. Therefore, ATSDR concludes that dermal contact with and incidental ingestion of the maximum concentration of arsenic in the surface water of Reilly Lake is not expected to harm people's health.

Manganese

Manganese is a naturally occurring metal that is found in many types of rocks. Major industrial sources of manganese are iron and steel production facilities, power plants, and coke oven emissions. Manganese is an essential nutrient needed for normal physiologic functioning in all animal species and is obtained predominantly from food. Manganese toxicity in humans has been reported mainly by the inhalation (air) route. Much less is known about manganese toxicity by the oral route of exposure. The EPA has established a RfD of 0.14 mg/kg/day for human consumption of manganese in the diet (EPA, 1988). The RfD is an estimate (with uncertainty spanning perhaps an order of magnitude) of a daily exposure to the human population (including sensitive subgroups) that is likely to be without an appreciable risk of deleterious effects during a lifetime. This RfD should not, however, be used to evaluate manganese exposure from drinking water or soil. Since the RfD is for the total oral intake of manganese, EPA recommends applying a modifying factor of 3 when assessing nondietary exposures.

Applying the modifying factor of 3 for this assessment means a modified RfD of 0.05 mg/kg/day is used for the potential surface water exposures to manganese in Reilly Lake. Using the maximum concentration of manganese in surface water, we calculated exposure doses for adults (Table F4). The doses ranged from 0.020 mg/kg/day to 0.026 mg/kg/day. These ingestion and dermal contact doses are less than the modified RfD of 0.05 mg/kg/day for nondietary manganese exposures. Based on these risk calculations, ATSDR concludes that dermal contact with and incidental ingestion of manganese in the surface waters in Reilly Lake is not expected to harm people's health because the maximum detected concentration is below levels of health concern.

Iron

The maximum concentration of iron (14,900 parts per billion, ppb) in surface water slightly exceeds the child drinking water CV (14,000 ppb). Iron in water is generally not hazardous to health, but it can be considered a secondary or aesthetic contaminant. Given that the maximum concentration of iron in surface water only slightly exceeds the drinking water CV, ATSDR concludes that harmful health effects are not likely from incidental ingestion of or dermal contact with the maximum concentration of iron in the surface waters of Reilly Lake.

Reilly Lake Sediments: For sediments in Reilly Lake, the maximum concentrations of iron and manganese exceeded applicable CVs (Table B11).

Iron

The maximum concentration of iron in sediment (183,000 ppm) exceeds the CV of 55,000 ppm for iron in soil. Since iron is typically not harmful in the environment under most environmental exposure scenarios, no further evaluation of iron is needed.

Manganese

The maximum concentration of manganese exceeds its CV and requires further evaluation for potential harmful effects. Using the maximum concentration of manganese in sediment, we calculated exposure doses for adults (Table F5) and compared them to the modified RfD of 0.05 mg/kg/day for manganese. The calculated incidental ingestion and dermal contact doses ranged from 0.0095 mg/kg/day to 0.032 mg/kg/day. These doses are less than the modified RfD of 0.05 mg/kg/day for nondietary manganese exposures. Based on these risk calculations, ATSDR concludes that touching or incidentally ingesting manganese in sediments in Reilly Lake is not expected to harm people's health because the maximum detected concentration is below levels of health concern.

Reilly Lake Fish: Reilly Lake is identified as one of three locations (Reilly Lake, Yahou Lake, and Cane Creek) on and near Fort McClellan where sports fishing occurred. In August 2004, researchers collected fish from Reilly Lake for body burden analysis. Largemouth bass, bluegill, and red-breasted sunfish were among the fish collected from Reilly Lake and analyzed for contaminants. To evaluate fish consumption from Reilly Lake, we calculated ingestion exposure doses and lifetime excess cancer risks (Table 5), where applicable, using the exposure assumptions in Table C1. We calculated HQs to evaluate the potential for non-cancer health hazards to occur from exposure to a contaminant. Based on the calculated HQs and cancer risks, ATSDR concludes that eating fish from Reilly Lake is not expected to harm people's health.

Table 5. Exposure Dose Summary for Fish in Reilly Lake

Contaminant Name	Maximum Concentration (mg/kg)	Chronic HQ >1?	Elevated Lifetime Cancer Risk?
Aluminum	69	No	N/A
Antimony	0.045	No	N/A
Arsenic	0.12	No	No
Barium	7	No	N/A
Beryllium	0.0061	No	N/A
Cadmium	0.032	No	N/A
Chromium*	1.9	No	N/A
Cobalt	0.11	N/A	N/A
Copper	1	N/A	N/A
Iron	260	N/A	N/A
Manganese	69	N/A	N/A
Mercury†	0.28	No	N/A
Nickel	1.1	No	N/A
Selenium	1.3	No	N/A
Thallium	0.0028	N/A	N/A
Vanadium	0.77	N/A	N/A
Zinc	30	No	N/A

Source: Matrix Environmental, 2006
mg/kg = milligram per kilogram
* Evaluated as trivalent chromium
† Evaluated as methylmercury
HQ = Hazard Quotient
N/A = non-applicable

CANE CREEK: Cane Creek is identified as one of three locations on and near Fort McClellan where sports fishing occurred. People who fished or recreated in Cane Creek could have been exposed to contaminants in the sediment and surface water of Cane Creek. They could have also eaten any fish they caught from Cane Creek. However, ATSDR found no fish data to evaluate the fish exposure pathway for Cane Creek. ATSDR evaluated whether people who recreated (including swimming and wading) in Cane Creek could have been exposed via incidental ingestion and dermal contact with contaminated surface water and sediments in Cane Creek. We evaluated the following environmental media associated with Reilly Lake: surface water and sediments.

Cane Creek Surface Water: In surface water, the maximum concentrations of di(2-ethylhexyl)phthalate, trichloroethylene, and thallium exceeded applicable CVs (Table B12).

Trichloroethylene and thallium

The maximum concentrations of trichloroethylene and thallium detected in the surface waters of Cane Creek were 0.59 and 5.8 ppb, respectively, slightly exceeded the drinking water CVs for trichloroethylene (0.43 ppb) and thallium (2 ppb). Since the CVs for trichloroethylene and thallium are based on drinking approximately 2 liters of water per day, the CVs would likely be protective for the intermittent, incidental ingestion exposures associated with the Cane Creek surface water pathway. For this reason, ATSDR concludes that dermal contact with and incidental ingestion of trichloroethylene and thallium in the surface waters of Cane Creek are not expected to harm people's health.

Di(2-ethylhexyl)phthalate

Because the maximum concentration of di(2-ethylhexyl)phthalate (7.4 ppb) is an order of magnitude greater than the applicable CV (0.70 ppb), we evaluated the contaminant further for potential harmful health effects. Di(2-ethylhexyl)phthalate, commonly referred to as DEHP, is a manufactured chemical that was once widely used as a plasticizer to help make polyvinyl chloride (PVC) products soft and flexible. DEHP enters the environment predominantly through disposal of wastes into landfills. In water, DEHP is predominantly adsorbed to suspended particulates and sediments and volatilization is not likely to occur.

ATSDR has not derived a chronic-duration (≥365 days) oral MRL for DEHP. However, the EPA has established a RfD of 0.02 mg/kg/day based on increased liver weights in animal studies. DEHP has been classified by the U.S. Department of Health and Human Services (DHHS) as reasonably anticipated to be a human carcinogen and by the EPA as a probable human carcinogen.

Using the assumptions in Table C1, we calculated exposure doses for servicemembers who may have contacted DEHP in the surface waters at Cane Creek (Table F6). The non-cancer exposure doses ranged from 1.0E-06 mg/kg/day to 4.0E-06 mg/kg/day; these doses are significantly less than EPA's RfD of 0.02 mg/kg/day for DEHP. The lifetime cancer risks were calculated using the cancer slope factor of 0.014 $(mg/kg/day)^{-1}$. The calculated lifetime cancer risks ranged from 3.7E-10 to 1.5E-09, which is not considered by ATSDR to be an elevated lifetime cancer risk. The calculated exposure doses and lifetime cancer risk estimates for DEHP in surface water are less than health-based guidelines. Based on calculated exposure doses and lifetime cancer risks, ATSDR concludes that dermal contact with and incidental ingestion of the maximum concentration of DEHP in Cane Creek surface water is not expected to cause harmful health effects.

Cane Creek Sediments: In sediments, the maximum concentrations of benzo(a)pyrene, benzo(g,h,i)perylene and phenanthrene either exceeded their CVs or had no CV (Table B13). Since each compound is a PAH compound, ATSDR evaluated the PAHs for potential carcinogenic effects.

Ten PAH compounds were analyzed for in each of the sediment samples collected from Cane Creek. Of the ten PAHs analyzed, six had PEFs that could be used for calculating the BaPE concentration. Using ATSDR guidance, we calculated the BaPE concentration for the sediment sample with the highest detected PAHs. The BaPE calculation and results are in Table 6.

Table 6. BaPE Equivalent Calculation: Cane Creek Sediment			
PAH Congener	**Potency Equivalency Factor – PEF (unitless)**	**Max Sample Concentration (ppm)**	**BaP Equivalent Concentration – BEC (ppm)**
Benzo(a)pyrene	1	0.078	0.078
Benz(a)anthracene	0.1	0.066	0.0066
Benzo(b)fluoranthene	0.1	0.089	0.0089
Benzo(k)fluoranthene	0.1	0.067	0.0067
Chrysene	0.01	0.075	0.00075
Indeno(1,2,3-cd)pyrene	0.1	0.058	0.0058
BaP Equivalent (ppm)	--	--	0.106

The BaPE concentration of 0.106 ppm is greater than the current CV of 0.065 ppm for carcinogenic PAHs.

Environmental Medium	Calculated BaPE (ppm)	BaP Equivalent Comparison Value (CV) (ppm)	CV Exceeded?
Sediment – Cane Creek	**0.106**	0.065	**Yes**

The calculated BaPE concentration (0.106 ppm) is greater than the current CV (0.065 ppm) for carcinogenic PAHs. Therefore, we calculated exposure doses and lifetime cancer risks using the calculated BaPE concentration in sediment (Table F7). The lifetime calculated cancer risks ranged from 1.4E-09 to 4.8E-09, which is not considered by ATSDR to be an elevated lifetime cancer risk. Based on the risk calculations, ATSDR concludes that incidental ingestion and dermal exposure to the maximum concentration of PAHs in Cane Creek sediments is not expected to harm people's health.

HOUSING: People living in on-base housing or entering on-base buildings could have been exposed to contaminants that originated in housing materials or that migrated into these structures. People can accidentally ingest, breathe in, or have direct skin contact with contaminants in housing. Because of their play habits, children are especially susceptible to exposures associated with housing.

Lead

Lead is a naturally occurring metal that can cause negative health effects. People are exposed to lead by eating lead paint chips, ingesting contaminated food or water, or by breathing in lead dust. Lead-contaminated soil particles can also be brought inside as lead dust or on shoes, clothing, or pets.

Children younger than 6 years are more likely to be exposed to lead paint or lead dust due to their hand to mouth behavior. Many children ingest lead dust by putting objects such as toys and dirt in their mouth. Because of their developing nervous system, children younger than 6 years old are particularly vulnerable to the effects of lead exposure since lead is easily absorbed in their nervous system.

Adults who are exposed to lead over many years could develop kidney problems, high blood pressure, cardiovascular disease, and cognitive dysfunction (Kosnett *et al*., 2007). Lead crosses the placenta; consequently, it can pass from a pregnant woman to her developing fetus. Lead can also harm a developing fetus, so pregnant women or women likely to become pregnant should be especially careful to avoid exposure to lead (Mayo Clinic, 2015).

CDC uses a blood lead reference value (BLRV) of 3.5 micrograms per deciliter (µg/dL) to identify children with blood lead levels (BLLs) higher than most children's levels. However, no safe BLL in children has been identified and even low levels of lead in blood can cause developmental delays, difficulty learning, behavioral issues, and neurological damage.

<u>The IEUBK and ALM Models</u>

Neither ATSDR nor EPA has developed a health guideline (i.e., MRL or RfD) for exposure to lead. Therefore, ATSDR cannot use the usual approach of estimating human doses to an environmental contaminant and then comparing that dose to a health-based CV. Instead, lead is evaluated using a biological model that predicts BLLs that could result from human exposure to environmental lead contamination. For this evaluation, ATSDR used EPA's Integrated Exposure Uptake Biokinetic (IEUBK) model to evaluate lead exposure in children.

Note also that the EPA developed the Adult Lead Methodology (ALM) to predict the risk of elevated BLLs in nonresidential settings for adult women's exposures to soil; however, the ultimate receptor is the fetus. More information about EPA's ALM can be found at https://www.epa.gov/superfund/lead-superfund-sites.

The IEUBK model calculates exposure from lead in air, water, soil, dust, diet, paint, and other sources and predicts the risk of elevated BLLs in children 6 months to 7 years of age. The model can also be used to predict risk for specific age groups up to age 7. There is currently no generally accepted model for predicting BLLs for children 7 years of age and older. The IEUBK model is designed to integrate exposure with pharmacokinetic modeling to predict blood lead concentrations. The four main components of the current IEUBK model are: 1) an exposure model that relates environmental lead concentrations to age-dependent intake of lead into the gastrointestinal tract; 2) an absorption model that relates lead intake into the gastrointestinal tract and lead uptake into the blood; 3) a biokinetic model that relates lead uptake in the blood to the concentrations of lead in several organ and tissue compartments; and 4) a model for uncertainty in exposure and for population variability in absorption and biokinetics (USEPA, 1994). The IEUBK model results can be viewed as a predictive tool for estimating changes in blood concentrations as exposures are modified (USEPA, 1994a).

The IEUBK model provides choices a user may make in estimating a child's BLL. These are referred to "user-specified" parameters or decisions. The reliability of the results obtained using the model is very dependent on the selection of the various coefficients and default values that were used.

Lead-based Paint and Dust

Homes and buildings built before 1978 (when lead-based paints were banned) are likely to have some lead-based paint. When the paint peels and cracks, it makes lead paint chips and dust. Any surface covered with lead-based paint where the paint may wear by rubbing or friction is likely to cause lead dust including windows, doors, floors, porches, stairways, and cabinets. Due to the large number of buildings at Fort McClellan that were built prior to 1978, the Army determined that any building at Fort McClellan constructed prior to 1978 was assumed to contain lead-based paint components.

Lead based paint and/or wipe sampling was completed at Fort McClellan in 1994 and 2000. In 2000, the Army conducted a lead-based paint risk assessment at multiple buildings located on Fort McClellan. The risk assessment consisted of dust wipe samples collected in 47 buildings (55 individual units) at Fort McClellan (IT Corp, 2001g). The wipe samples for lead dust were collected from multiple locations (e.g., bedrooms, bathrooms, living rooms, etc.) and areas within each structure, including the floors, doors, windowsills, ceilings, and walls. Analytical results for the wipe samples showed levels of lead greater than Army clearance standards in some buildings, including some family housing units. The standards used by the Army at that time for leaded dust clearance levels by wipe sampling were: floors – 40 µg/ft2; interior window sills – 250 µg/ft2; and window troughs - 800 µg/ft2. The Army undertook mitigative measures to reduce the level of lead in buildings where lead exceeded the clearance standards. The Army cleaned and re-sampled, once cleaned, to confirm the area was below clearance standards.

The original Army reports contain the dust lead wipe results for specific buildings (IT Corp, 2001g). In 2000, dust wipe lead concentrations exceeded the Army's lead dust clearance standards in 13 buildings (3610, 3614, 3615, 3616, 3620, 3622, 3629, 3632, 3635, 3637, 3640, 3652, and 3668). Dust wipes collected in 2000 that exceeded the Army clearance standards in the report ranged from 60.3 µg/ft2 (Building 3616 floor) to 2,749.6 µg/ft2 (Building 3614 window trough) in residential and 238.8 µg/ft2 (Building 3640 floor) to 2,313.4 µg/ft2 (Building 3652 window trough) in non-residential buildings. When we ran the IEUBK model, the model results in the table below indicate risk of elevated child BLLs if dust in floors was similar to dust in the window troughs reported (Table 7).

Table 7. IEUBK Results for Risk of Elevated BLL using Dust Samples (Assuming Dust Levels on Floors Similar to Dust Levels in the Window Troughs)

Loading (ug/ft^2)	Converted Concentration: Central (Lower Confidence Interval, Upper Confidence Interval)* (ppm)	IEUBK probability of an exposed child exceeding BLL of 3.5 µg/dL* in a residential setting
60.3	665.1 (285, 1557.6)	65% (32%, 94%)

* Converted using methods from EPA Technical Support Document for Residential Dust-Lead Hazard Standards Rulemaking (2019).

Current models do not predict adult BLLs from exposure to lead dust loadings in mass per square foot (µg/ft2). There is too much uncertainty in converting µg/ft2 to concentration (ppm) to use the data in the IEUBK model. So ATSDR cannot estimate blood lead levels that may have resulted from the dust exposures at Fort McClellan.

Another limitation to the dust wipe sampling data is that sampling was performed in 2000 after the base closed in 1999. Unoccupied buildings that do not have regular cleanings and operational HVAC systems with air filters may differ from occupied buildings. Therefore, the dust sample results may not be representative of the past exposure to residents.

The EPA/Housing and Urban Development (HUD) standards have been lowered several times since the Fort McClellan samples were collected. The EPA/HUD standards are currently based on clearance standards (post-cleanup) of floors at 10 µg/ft2 and windowsills at 100 µg/ft2. Therefore, buildings that did not exceed the lead standards previously may exceed the current standards. The reduction in the clearance standards is expected to reduce children's BLLs and the risk of adverse cognitive and developmental effects in children.

The base closed in 1999. Some of the wipe samples were collected in 2000. A limitation to these data is that dust lead levels in unoccupied buildings may differ from occupied buildings that have regular cleanings and operational HVAC systems with air filters. Therefore, dust sample results may not be representative of the exposure of residents in the past.

Lead in Surface Soil

In 1994, the Army collected soil samples near 26 community-related buildings and 173 family housing buildings and tested for lead. The following five sampled locations exceeded the Army's action level of 400 ppm for lead in soil:

1. Workshop (Building 129),
2. Chapel (Building 893),
3. Soldier's Chapel (Building 1740),
4. Family Housing (Building 2242), and
5. WAC Chapel (Building 2293).

However, the quantitative lead sampling results were missing from the Administrative Record, so ATSDR was unable to determine the level of lead in soil at the five buildings with lead levels above the action level of 400 ppm.

Housing

IEUBK Model Results: ATSDR ran the IEUBK model (IEUBK Model 2.0 Build 1.72) using all default parameters and a soil lead concentration of 400 ppm, which was the action level used by the Army.[6] At 400 ppm of lead in soil, our analysis showed a 22% probability that child's BLL will exceed 5 µg/dL; that number increases to a 50%

[6] ATSDR used the Army's action level of 400 ppm lead in the IEUBK model because the specific lead concentrations were missing from the Administrative Record. It is likely that the lead levels in soil at the five buildings (housing and non-residential) above the action level were higher than 400 ppm.

probability when the BLL is lowered to 3.5 µg/dL.[7] These levels in the past could have been a health concern for children. However, many details about how and where the samples were collected as well as the frequency and duration of exposures creates uncertainty in the data. Therefore, ATSDR cannot determine whether past touching or accidentally swallowing lead in soil in housing and non-residential buildings at Fort McClellan could harm people's health.

Also using the IEUBK, ATSDR estimated that accidentally touching and swallowing soil with average lead in soil above 92 ppm results in a 5% or more chance of a young child (less than 7 years old) exceeding CDC's BLRV of 3.5 µg/dL. The calculations assume at least 90 days of continuous exposure and that all other model inputs are defaults except for the updated outdoor air lead concentration of 0.04 micrograms per cubic meter (µg/m3) (see additional uncertainties below). EPA supports the use of biokinetic models at the BLRV of 3.5 µg/dL when increased risk is expected due to the presence of additional lead sources at sites such as the lead-based paint identified at Fort McClellan (EPA, 2024).

If the average soil lead concentration present was greater than 92 ppm, past touching or accidentally swallowing lead in the soil could result in an increased chance of BLLs greater than 3.5 µg/dL. No safe level of lead in blood has been identified in children. Even low levels of lead in blood can cause developmental delays, difficulty learning, behavioral issues, and neurological damage.

The median soil lead background concentration for Alabama in geogenic (noncontaminated) soils is 12 ppm. If 25% of the samples (1 in 4) were 400 ppm and the other 75% were 12 ppm, the average would still be over 92 ppm and a health concern for young children at a residence. ATSDR considers this to be a public health hazard.

In 2024, EPA lowered the screening level for lead in soil at residential properties from 400 ppm to 200 ppm, or 100 ppm if multiple sources of lead are identified (EPA, 2024). During sampling events at Fort McClellan, lead concentrations in surface soil and dust wipe samples exceeded applicable standards that were established for use at that time. Exposure to these indoor and outdoor sources of lead may have resulted in elevating BLLs even further.

Non-Housing Buildings

Average soil lead levels in non-residential buildings at Fort McClellan are unknown because the soil lead sampling results are missing from the administrative records. Several buildings, i.e., the workshop (Building 129), chapel (Building 893), soldier's chapel (Building 1740), and WAC chapel (Building 2293) buildings, had at least one soil concentration greater than 400 ppm.

Exposures at non-residential buildings are usually less frequent than at housing, though areas with intense soil exposure, such as playgrounds, may result in higher soil intake rates (see additional uncertainties below). Information about frequency, duration, and nature of exposures is not available.

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[7] In 2021, CDC lowered its blood reference value from 5 to 3.5 µg/dL. However, EPA has not evaluated the IEUBK below 5 µg/dL, so uncertainties may exist when modeling at levels below 5 µg/dL [EPA 2024].

ALM Results: The ALM model calculates non-residential exposure from lead in soil and predicts the risk of elevated blood lead levels in the fetus of an exposed pregnant person. At 400 ppm of lead in soil, our analysis showed a 0.4% probability that child's blood lead level (BLL) will exceed 5 µg/dL; that number increases to a 2.1% probability when the BLL is lowered to 3.5 µg/dL. The geometric mean BLL of an adult worker is estimated to be 1.2 µg/dL.

Fetus of pregnant adult worker: Accidentally touching and swallowing soil with average lead in soil above 607 ppm results in a 5% or more chance of the fetus of an exposed adult worker exceeding the CDC BLRV of 3.5 µg/dL using the EPA ALM and assuming all other inputs are defaults.

Nonpregnant adult worker: Accidentally touching and swallowing soil with average lead concentrations above 1146 ppm are estimated to result in a 5% or more chance of the worker exceeding a BLL of 5 µg/dL using the EPA ALM and assuming all other inputs are defaults. Adverse neurological and cardiovascular health effects are associated with adult BLLs of 5 µg/dL and greater, with some evidence of effects at BLLs less than 5 µg/dL [ATSDR, 2020].

ATSDR cannot reasonably estimate whether average soil exposures may fall within the ranges mentioned above because the data set is not available. Therefore, ATSDR cannot conclude whether or not past exposure may have harmed the health of workers or non-workers and the fetus of a pregnant worker at the four non-residential sites with one or more soil lead concentrations exceeding the past screen level of 400 ppm.

<u>Uncertainties</u>

Many other factors affect exposure estimates, lead uptake into the body, and potential for health effects:

- Soil sample depth (e.g., accessible surface soil), location (e.g., playground, dripline, whole yard), number, type (e.g., discrete, composite), size fraction, pH, moisture, treatment (e.g., grinding)
- ground cover
- bioavailability of lead in the soil or dust
- nutritional status, genetics, and other exposures (e.g., hobbies)
- frequency and duration of exposures

Without access to the soil analytical data and other factors, ATSDR cannot estimate average soil exposure point concentrations at Fort McClellan, the quality of the data for representing exposures, or personal factors that affect potential for health effects from soil lead exposures. Measured soil concentrations at buildings other than the five listed in this conclusion were less than 400 ppm but the actual concentrations are unknown. Residential exposure to levels less than 400 ppm may be a health concern also but cannot be evaluated without the sampling results.

Estimating BLLs from exposure at non-residential sites would be most accurate when site-specific information is available on the frequency and duration of exposures, when the nature of exposures is understood (e.g., outdoor activities), and when exposure at alternate locations is also understood (e.g., also spends time at home or a school/day-care with lead-based paint). The ALM may not adequately represent BLLs for non-workers that spend different amounts of time at non-residential buildings than workers.

Summary of Lead Modeling Criteria
Though there is no safe level of BLL in children and thresholds for health effects have not been developed for adults, some general criteria have been identified to characterize risk. A probability greater than 5% of estimated child or fetus BLLs being greater than 3.5 µg/dL for locations where additional lead sources like lead-based paint are present is considered an elevated risk.

For adults, adverse effects are associated with BLLs of 5 µg/dL and greater, with some evidence of effects at BLLs less than 5 µg/dL [ATSDR, 2020]. A probability greater than 5% of estimated adult BLLs being greater than 5 µg/dL is considered an elevated risk.

Generally, criteria for identifying elevated risk from exposures to lead in site soils where additional lead sources like lead-based paint are present is summarized in the table below. Additional info is available in Appendix G.

Average Soil Concentration (ppm) Resulting in 5% Chance of Exceeding the Designated BLL	Type of Modeling Result Indicating Risk of Exceeding the Target BLL
93	IEUBK result for an exposed child exceeding target BLL of 3.5 µg/dL* in a residential setting
608	ALM result for a fetus of exceeding target BLL of 3.5 µg/dL[Ɨ,ǂ] in a nonresidential setting
1147	ALM result for a nonpregnant adult exceeding BLL of 5 µg/dL[Ɨ,ǂ] in a nonresidential setting (upper 5% chance derived from geometric mean and standard deviation)

* Uses IEUBK Model v2.0 and defaults except for average soil concentration for decision unit and updated outdoor air lead concentration of 0.04 µg/m^3. Greater than or equal to 5% probability of exceeding a BLL of 3.5 µg/dL is considered an increased risk of elevated BLL. Note additional uncertainties in modeling for BLLs less than 5 µg/dL.[2]

Ɨ Uses ALM version date 6/14/2017 and defaults except for average soil concentration for decision unit. Note additional uncertainties in modeling for BLLs less than 5 µg/dL.[2]

ǂ Greater than or equal to 5% probability of exceeding a BLL of 5 µg/dL is considered an increased risk of potential health effects. Adverse effects are associated with adult BLLs of 5 µg/dL and greater, with some evidence of effects at BLLs less than 5 µg/dL.

The median soil lead background concentration for Alabama in geogenic (noncontaminated) soils is 12 ppm [https://www.epa.gov/superfund/usgs-background-soil-lead-survey-state-data#AL]. So even if 25% of the samples were 400 ppm and the other 75% of samples were 12ppm, the average would still be over 92 ppm and a health concern for the residential scenario. ATSDR assumed that data quality and sampling plans were reviewed and approved by EPA to collect soil samples that were reasonably representative of exposures for performing risk-assessment screening analyses, which is typically the case for DoD sites.

Radon

Radon is a naturally occurring, radioactive, noble gas that is odorless, colorless, and tasteless. Radon gas released from rocks and soil can move to air, groundwater, and surface water. The DHHS, EPA, and International Agency for Research on Cancer (IARC) consider radon to be a human carcinogen. The greater your exposure to radon, especially if you smoke cigarettes, the greater your chance of developing lung cancer (ATSDR, 2012b).

The U.S. Army Radon Reduction Program was implemented at Fort McClellan in 1989 and 451 of 714 buildings were tested for radon. Six buildings had radon levels above 4 picocuries per liter pCi/L (Table 8). The EPA currently recommends that people take steps to reduce radon levels in their homes if the radon levels are above 4 pCi/L (EPA, 2022). ATSDR does not consider levels above 4 pCi/L to be protective of human health and recommends reducing indoor radon levels to the lowest achievable level. In the United States, the average indoor radon level is about 1.3 pCi/L.

Radon was mitigated in the three family housing buildings (Buildings 7, 10, 102) in 1994 and two additional buildings (Buildings 141A and 3295) in 1996. Building 129 was vacant and not remediated (IT Corporation, 2001f).

Table 8. Buildings at Fort McClellan with Radon Levels Greater than 4 pCi/L

Building #	Type of Building	Radon Levels (pCi/L)
7	Family Housing Senior Non-commissioned Officer	3.9, 4.1, 5.1
10	Family Housing Colonel	4.5, 5.0, 5.3, 5.9
102	Family Housing Senior Non-commissioned Officer	6.1, 8.3, 10.5
129	Administrative General Purpose	8.1
141A	Company Headquarters Building	4.2, 4.3, 4.5, 9.0, 10.6, 15.4
3295	Administrative General Purpose	5.6, 7.1

Source: IT Corporation, 2001f; pCi/L = picocuries per liter

Asbestos

Asbestos is the name given to a group of six different fibrous minerals (amosite, chrysotile, crocidolite, and the fibrous varieties of tremolite, actinolite, and anthophyllite) that occur naturally in the environment. Asbestos minerals have separable long fibers that are strong and flexible enough to be spun and woven and are heat resistant. Because of these characteristics, asbestos has been used for a wide range of manufactured goods, mostly in building materials (roofing shingles, ceiling and floor tiles, paper products, and asbestos cement products), friction products (automobile clutch, brake, and transmission parts), heat-resistant fabrics, packaging, gaskets, and coatings (ATSDR, 2001).

Exposure to asbestos usually occurs by breathing contaminated air in workplaces that make or use asbestos. Asbestos is also found in the air of buildings containing asbestos that are being torn down or renovated. Asbestos exposure can cause serious lung problems and cancer (ATSDR, 2001).

The Army conducted surveys of asbestos-containing materials in 122 family housing buildings and 52 other purpose buildings in 1986, 1987, and 1990 (IT Corporation, 2001f). Another survey of all buildings likely to contain asbestos-containing materials was conducted in 1997 and 1998. Many buildings were found to contain both friable and non-friable asbestos-containing materials. The results of these surveys are summarized in a report that only identified the presence or absence of asbestos-containing materials and did not contain other relevant information needed to conduct a public health evaluation.

Prior to closure, the Army abated friable asbestos that was deemed to be of the type and condition to not comply with applicable laws, and regulations (IT Corporation, 2001f).

ATSDR cannot conclude whether asbestos-containing materials in family housing and other purpose buildings could harm people's health. Critical information such as the condition and location of the asbestos-containing materials; size, shape, and chemical makeup of the fibers; and measured airborne fiber levels is lacking to support a determination about the level of public health hazard.

Tumor Records

ATSDR reviewed information provided in National Archives files. Individual cancer cases were reported in the Tumor Board Cancer Committee and the Tissue and Transfusion Committee notes. The data reported from each meeting were de-identified; therefore, some notes may have contained reports of duplicate cases. Additionally, some cases may have had multiple cancers. The data contained in the files were limited to treatment plan, age, and sex; race and military status were included in some, but not all, case reports. Upon review of the files, we abstracted 306 reports of cancer cases that were reported between 1979-1983. The majority of these cases were skin (31%) and breast (21%) cancers. Exposure to environmental hazards was not noted for any of the cases. Overall, these data are not suitable for conducting a health outcome data evaluation or for determining causal associations between exposures and harmful health outcomes.

CONCLUSIONS Based on the evaluation of environmental contaminant concentrations and using the specific exposure assumptions detailed in this report, ATSDR reached the following seven conclusions for the former Fort McClellan site:

Conclusion 1 ATSDR concludes that servicemembers' past exposure to environmental contaminants while engaging in non-occupational activities at certain locations (see below) at Fort McClellan is not expected to harm their health.

Basis for Conclusion 1 ATSDR evaluated the environmental sampling data collected at the following non-occupational areas on Fort McClellan to determine if past exposures could have been harmful to people's health:

- Landfills
- Golf course
- Athletic field
- Reilly Lake
- Lake Yahou
- Cane Lake
- Mock Village

For each exposure area, we used the maximum detected concentration of each contaminant in environmental media to calculate exposure doses and lifetime excess cancer risks, when appropriate. Based on these risk calculations, ATSDR concluded that exposure to contaminants in these non-occupational areas is not likely to harm people's health because the estimated exposures are below levels of health concern.

ATSDR did not evaluate work-related exposures of service members as they performed military duties or training specific for their military occupational specialties. We did not evaluate exposures related to military field maneuvers or to (bacterial, radiological, or chemical) gases or agents used for training or warfare.

Conclusion 2 ATSDR concludes that servicemembers are not at risk for harmful health effects from exposure to contaminated groundwater at Fort McClellan since no exposures occurred because the groundwater was not used for potable purposes.

Basis for Conclusion 2

ATSDR evaluated whether servicemembers were exposed to contaminated groundwater while stationed at Fort McClellan. Exposure to contaminated groundwater can occur via human consumption, dermal contact, or inhalation. We determined that groundwater at Fort McClellan was not used for potable purposes, such as drinking or other household uses. Since construction, Fort McClellan received its drinking water supply from the Anniston Water Works and Sewer Board (Army, 2021). When in operation, Fort McClellan personnel conducted routine monitoring of the drinking water. Based on a 1997 records review and 1994 environmental compliance assessment, "the system has operated in compliance with state and federal drinking water standards" (Environmental Science & Engineering, 1998).

Conclusion 3

ATSDR reached the following conclusions regarding exposures to lead in soil:

<u>Housing</u>: ATSDR concludes that past touching or accidentally swallowing lead in soil near at least one housing building at Fort McClellan could have harmed a child's health. However, missing data prevented site-specific estimates of blood lead levels (BLLs).

<u>Non-housing buildings</u>: ATSDR cannot conclude whether past touching or accidentally swallowing lead in soil near non-housing buildings at Fort McClellan could harm a person's health due to insufficient information on soil lead concentrations and frequency, duration, and nature of exposures.

Basis for Conclusion 3

One or more concentrations of lead greater than the Army's action level of 400 ppm were detected in soil near five Ft McClellan buildings, but average concentrations (required for site-specific exposure modeling) are unknown. ATSDR used modeling to describe potential BLLs that would be of concern if sensitive populations were exposed in the past to various soil concentrations near Fort McClellan housing and non-housing buildings. The modeled soil concentrations are used to help understand potential for health effects from various levels of exposure. Lead based paint (discussed separately) may also contribute to BLLs for past Fort McClellan building occupants.

Housing

Average soil lead levels in past Fort McClellan housing are unknown because the quantitative soil lead sampling results are missing from the administrative records. A family housing building (Building 2242) had at least one soil concentration greater than 400 ppm.

ATSDR ran the EPA Integrated Exposure Uptake Biokinetic (IEUBK) model using all default parameters and a soil lead concentration of 400 ppm, which was the action level used by the Army at that time.[8] At 400 ppm of lead in soil, our analysis showed a 22% probability that child's BLL will exceed 5 µg/dL; that number increases to a 50% probability when the BLL is lowered to 3.5 µg/dL.[9] These levels in the past would have been a health concern for children at a residence. However, many details about how and where the samples were collected as well as the frequency and duration of exposures creates too much uncertainty in the data. Therefore, ATSDR cannot determine whether past touching or accidentally swallowing lead in soil in housing at Fort McClellan could harm people's health.

In 2024, EPA lowered the screening level for lead in soil at residential properties from 400 ppm to 200 ppm, or 100 ppm if multiple sources of lead are identified [EPA 2024]. During sampling events at Fort McClellan, lead concentrations in surface soil and dust wipe samples exceeded applicable standards that were established for use at that time. Exposure to indoor and outdoor sources of lead may have resulted in elevating BLLs even further.

Non-residential buildings

Average soil lead levels in non-housing buildings at Fort McClellan are unknown because the soil lead sampling results are missing from the administrative records. Four buildings, i.e., the workshop (Building 129), chapel (Building 893), soldier's chapel (Building 1740), and WAC chapel (Building 2293) buildings, had at least one soil concentration greater than 400 ppm.

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[8] ATSDR used the Army's action level of 400 ppm lead in the IEUBK model because the specific lead concentrations were missing from the Administrative Record. It is likely that the lead levels in soil at the five buildings (housing and non-residential) above the action level were higher than 400 ppm.

[9] In 2021, CDC lowered its blood reference value from 5 to 3.5 µg/dL. However, EPA has not evaluated the IEUBK below 5 µg/dL, so uncertainties may exist when modeling at levels below 5 µg/dL [EPA 2024].

Exposures at non-residential buildings are usually less frequent than at housing, though areas with intense soil exposure, such as playgrounds, may result in higher soil intake rates (see additional uncertainties below). Information about frequency, duration, and nature of exposures is not available.

The ALM model calculates non-residential exposure from lead in soil and predicts the risk of elevated blood lead levels in the fetus of an exposed pregnant person. At 400 ppm of lead in soil, our analysis showed a 0.4% probability that child's blood lead level (BLL) will exceed 5 µg/dL; that number increases to a 2.1% probability when the BLL is lowered to 3.5 µg/dL. The geometric mean BLL of an adult worker is estimated to be 1.2 µg/dL.

ATSDR cannot reasonably estimate whether average soil exposures at non-residential buildings at Fort McClellan would cause harmful health effects because the data set is not available. Therefore, ATSDR cannot conclude whether past exposures may have been harmful to health at the four non-housing buildings with one or more soil lead concentrations exceeding the past screening level of 400 ppm.

<u>Uncertainties</u>

Many factors affect exposure estimates, lead uptake into the body, and potential for health effects:

- Soil sample depth (e.g., accessible surface soil), location (e.g., playground, dripline, whole yard), number, type (e.g., discrete, composite), size fraction, pH, moisture, treatment (e.g., grinding)
- ground cover
- bioavailability of lead in the soil or dust
- nutritional status, genetics, and other exposures (e.g., hobbies)
- frequency and duration of exposures

Without access to the soil analytical data and other factors, ATSDR cannot estimate average soil exposure point concentrations at Fort McClellan, the quality of the data for representing exposures, or personal factors that affect potential for health effects from soil lead exposures. Measured soil concentrations at buildings other than the five listed in this conclusion were less than 400 ppm but the actual concentrations are unknown. Residential exposure to levels less than 400 ppm may be a health concern also but cannot be evaluated without the sampling results.

Estimating BLLs from exposure at non-housing sites would be most accurate when site-specific information is available on the frequency and duration of exposures, when the nature of exposures is understood (e.g., outdoor activities), and when exposure at alternate locations is also understood (e.g., also spends time at home or a school/day-care with lead-based paint).

In 2024, EPA lowered the screening level for lead in soil at residential properties from 400 ppm to 200 ppm, or 100 ppm if multiple sources of lead are identified (EPA, 2024). During sampling events at Fort McClellan, lead concentrations in surface soil and dust wipe samples exceeded applicable standards that were established for use at that time. Exposure to indoor and outdoor sources of lead may have resulted in elevating BLLs even further.

Conclusion 4

ATSDR cannot conclude whether past touching or accidentally swallowing lead in dust from buildings sampled at Fort McClellan could harm people's health. The reasons for this include (1) the full data results are not available for review, and (2) the samples are not representative of potential past exposures as the buildings were vacated before the sampling was performed with no normal/regular cleanings or filtered ventilation systems running.

Basis for Conclusion 4

Lead based paint and/or dust wipe sampling was conducted at Fort McClellan in 1994 and 2000. In 2000, dust wipe lead loadings in 13 buildings exceeded the Army lead dust standards in use at the time of sampling. The standards used by the Army for leaded dust clearance levels by wipe sampling were: interior floors – 40 $\mu g/ft^2$; interior window sills – 250 $\mu g/ft^2$; and windows troughs – 800 $\mu g/ft^2$. The EPA/HUD post-cleanup clearance standards have been lowered since 2000 to 10 $\mu g/ft^2$ for floors and 100 $\mu g/ft^2$ for windowsills.

The new lower standards further reduce children's BLLs and the risk of adverse cognitive and developmental effects in children from lead exposures.[10] No safe level of lead in blood has been identified in children, and past exposures to lead in dust at Fort McClellan may have resulted in health effects to children.

[10] https://www.federalregister.gov/documents/2021/01/07/2020-28565/review-of-dust-lead-post-abatement-clearance-levels

Current models do not predict adult BLLs from exposure to lead dust loadings in mass per square foot (µg/ft^2). There is too much uncertainty in converting µg/ft^2 to concentration (ppm) to use the data in the IEUBK model. Therefore, ATSDR cannot estimate blood lead levels that may have resulted from the dust exposures at Fort McClellan.

Another limitation to the dust wipe sampling data is that sampling was performed in 2000 after the base closed in 1999. Unoccupied buildings that do not have regular cleanings and operational HVAC systems with air filters may differ from occupied buildings. Therefore, the dust sample results may not be representative of the past exposure to residents.

Conclusion 5 ATSDR concludes that servicemembers and families who live in or visited some on-base housing units and buildings may have been exposed to radon at levels above recommended action levels (currently 4 picocuries per liter) that may have increased their risk for harmful health effects.

Basis for Conclusion 5 Beginning in 1989, the U.S. Army's Radon Reduction Program began testing on-base buildings for radon. The radon sampling program detected radon levels above 4 picocuries per liter (pCi/L) in six on-base buildings. The EPA recommends that people take remedial actions in their homes if the radon levels are above 4 pCi/L (EPA, 2022). Radon levels above 4 pCi/L are not protective of human health and should be mitigated to reduce radon levels. ATSDR was not able to determine the levels of radon in buildings before 1989.

Conclusion 6 Because of lack of data ATSDR cannot conclude whether servicemembers were exposed to asbestos in some on-site buildings and whether those exposures might have harmed their health. Critical information – such as condition, location, size, shape, and chemical make-up of the fibers – is lacking to support a determination of the level of public health hazard.

Basis for Conclusion 6 Based on surveys conducted by the Army, some on-site buildings were found to contain both friable and non-friable asbestos-containing materials. The results of these surveys are summarized in a report that only identified the presence or absence of asbestos-containing materials and did not contain other relevant information ATSDR would need to conduct a public health evaluation.

Conclusion 7 ATSDR determined that the notes by the Tumor Health Registry (specifically, the Tumor Board Cancer Committee and the Tissue and Transfusion Committee) are too limited to be used for public health assessment purposes and are not suitable for determining causal associations in environmental exposure investigations.

Basis for Conclusion 7 ATSDR evaluated information provided by the petitioner from the National Archives files. Individual cancer cases were reported in the Tumor Board Cancer Committee and the Tissue and Transfusion Committee notes. The data contained in the files were limited to treatment plan, age, and sex; race and military status were included in some, but not all, case reports. The data reported from each meeting were de-identified; therefore, some notes may contain reports of duplicate cases. Additionally, some cases may have had multiple cancers. Upon review of the files, we abstracted 306 reports of cancer cases that were reported between 1979-1983. The majority, 52%, of these cases were skin (31%) and breast (21%) cancers. Exposure to environmental hazards was not noted for any of the cases. Overall, these data are not suitable for conducting a health outcome data evaluation or for determining causal associations or links between exposures and harmful health outcomes in environmental exposure investigations.

Next Steps ATSDR does not have any health protective recommendations considering the exposures were so far in the past. Individuals may consult their personal physician if they have concerns related to their health.

Further characterization of lead in soil and dust and taking appropriate remedial actions, if warranted, are recommended if the area and buildings are reused in the future.

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Appendix A: Brief Summary of ATSDR's Public Health Assessment (PHA) Process

ATSDR follows the PHA process to find out:

- Whether people living near a hazardous waste site are being exposed to toxic substances.
- Whether that exposure is harmful.
- What must be done to stop or reduce exposure.

The PHA process is a step-by-step consistent approach during which ATSDR:

- Establishes communication mechanisms, including engaging communities at the beginning of site activities and involves them throughout the process to respond to their health concerns.
- Collects many different kinds of site information.
- Obtains, compiles, and evaluates the usability and quality of environmental and biological sampling data (and sometimes modeling data) to examine environmental contamination at a site.
- Conducts four main, sequential scientific evaluations.
    - Exposure pathways evaluation to identify past, present, and future site-specific exposure situations, and categorize them as completed, potential, or eliminated.
    - Screening analysis to compare the available sampling data to media-specific environmental screening levels (ATSDR comparison values [CVs] and non-ATSDR screening levels). This identifies potential contaminants of concern that require further evaluation for completed and potential exposure pathways.
    - Exposure Point Concentrations (EPCs) and exposure calculations for contaminants flagged as requiring further evaluation in completed and potential exposure pathways. It involves calculating EPCs, using the estimated EPCs to perform exposure calculations, and determining which site-specific scenarios requires an in-depth toxicological effects analysis.
    - In-depth toxicological effects evaluation, if necessary, based on the three previous scientific evaluations. This step looks more closely at contaminant-specific information in the context of site exposures. This evaluation can also help determine if there is a potential for non-cancer or cancer health effects.
- Summarizes findings and next steps, while acknowledging uncertainties and limitations.
- Provides recommendations to site-related entities, partner agencies, and communities to prevent and minimize harmful exposures.

The sequence of steps can differ based on site-specific factors. For instance, health assessors might define an exposure unit before or after the screening analysis.

For more detail on the PHA process, please visit Understanding the PHA Process | PHA Guidance Manual. Readers can also refer to ATSDR's Public Health Assessment Guidance Manual for all information related to the stepwise PHA process.

Appendix B.

Fort McClellan: Contaminant Screening Tables by Environmental Media

Table B1. Screening Using Comparison Values (CV): Sediment at Lake Yahou

Contaminant Name	Maximum Concentration (ppm)	ATSDR Recommended CV (ppm)	Soil CV Type	Selected for Further Evaluation?
Acetone	0.39	31,000	Intermediate EMEG Child	No
Aluminum	21,200	52,000	Chronic EMEG Child / Intermediate EMEG Child	No
Arsenic	3.38	16	Chronic EMEG Child / RMEG Child	No
Barium	119	10,000	Chronic EMEG Child / Intermediate EMEG Child / RMEG Child	No
Beryllium	0.7	100	Chronic EMEG Child / RMEG Child	No
2-butanone	0.033	31,000	RMEG Child	No
Cadmium	0.46	5.2	Chronic EMEG Child	No
Carbon disulfide	0.013	5,200	RMEG Child	No
Chromium	20.9	78,000	RMEG Child for Cr(III)*	No
Cobalt	4.27	520	Intermediate EMEG Child	No
Copper	9.59	1,000	Intermediate EMEG Child	No
Methylene chloride	0.0056	55	CREG	No
Nickel	4.68	1,000	RMEG Child	No
Selenium	1.21	260	Chronic EMEG Child / RMEG Child	No
Toluene	0.0034	4,200	RMEG Child	No
Vanadium	35.6	520	Intermediate EMEG Child	No
Zinc	98.9	16,000	Chronic EMEG Child / Intermediate EMEG Child / RMEG Child	No
Butylbenzene, n-	0.0074	3,900	EPA Child RSL	No
Iron	18,000	55,000	EPA Child RSL	No
Lead	25.2	400	EPA Child RSL	No
Manganese	138	1,800	EPA Child RSL	No

Source: Shaw Environmental, 2003

ppm – parts per million; EMEG = ATSDR environmental media evaluation guide; RMEG = ATSDR reference dose media evaluation guide; CREG = ATSDR cancer risk evaluation guide; RSL = EPA Regional Screening Level; Bolded text = exceeds applicable comparison value (CV)

*In most soils, chromium will be present predominantly in the chromium (III) state (ATSDR, 2012)

Table B2. Screening Using Comparison Values (CV): Surface Water at Lake Yahou

Contaminant Name	Maximum Concentration (ppb)	ATSDR Recommended CV (ppb)	ATSDR CV Type	Selected for Further Evaluation?
Acetone	11	4,200	Intermediate EMEG Child	No
Aluminum	382	7,000	Chronic EMEG Child / Intermediate EMEG Child	No
Barium	26.3	1,400	Chronic EMEG Child / Intermediate EMEG Child / RMEG Child	No
Methylene chloride	2	6.1	CREG	No
Zinc	8.47	2,100	Chronic EMEG Child / Intermediate EMEG Child / RMEG Child	No
Iron	2,930	14,000	EPA Child RSL	No
Lead	1.98	15	EPA Child RSL	No
Manganese	294	430	EPA Child RSL	No

Source: Shaw Environmental, 2003
ppb – parts per billion; EMEG = ATSDR environmental media evaluation guide; RMEG = ATSDR reference dose media evaluation guide; CREG = ATSDR cancer risk evaluation guide; RSL = EPA Regional Screening Level; Bolded text = exceeds applicable comparison value (CV)

Table B3. Screening Using Comparison Values (CV): Surface Soil at the Mock Village

Contaminant Name	Maximum Concentration (ppm)	ATSDR Recommended CV (ppm)	Soil CV Type	Selected for Further Evaluation?
Acetone	0.3	31,000	Intermediate EMEG Child	No
Aluminum	23,100	52,000	Chronic EMEG Child / Intermediate EMEG Child	No
Arsenic	3.99	16	Chronic EMEG Child / RMEG Child	No
Barium	95.3	10,000	Chronic EMEG Child / Intermediate EMEG Child / RMEG Child	No
Beryllium	0.69	100	Chronic EMEG Child / RMEG Child	No

2-butanone	0.037	31,000	RMEG Child	No
Cadmium	0.25	5.2	Chronic EMEG Child	No
Carbon disulfide	0.0021	5,200	RMEG Child	No
Chromium	25.2	78,000	RMEG Child for Cr(III)*	No
Cobalt	3.66	520	Intermediate EMEG Child	No
Copper	7.77	1,000	Intermediate EMEG Child	No
Mercury	0.074	0.52	Intermediate EMEG Child	No
Methylene chloride	0.0034	55	CREG	No
Nickel	11	1,000	RMEG Child	No
Selenium	1.04	260	Chronic EMEG Child / RMEG Child	No
Silver	0.99	260	RMEG Child	No
Toluene	0.0033	4,200	RMEG Child	No
Vanadium	29.4	520	Intermediate EMEG Child	No
Zinc	69.4	16,000	Chronic EMEG Child / Intermediate EMEG Child / RMEG Child	No
Iron	21,300	55,000	EPA Child RSL	No
Lead	17.9	400	EPA Child RSL	No
Manganese	161	1,800	EPA Child RSL	No

Source: Shaw Environmental, 2003

ppm – parts per million; EMEG = ATSDR environmental media evaluation guide; RMEG = ATSDR reference dose media evaluation guide; CREG = ATSDR cancer risk evaluation guide; RSL = EPA Regional Screening Level; Bolded text = exceeds applicable comparison value (CV)

*In most soils, chromium will be present predominantly in the chromium (III) state (ATSDR, 2012a).

Table B4. Screening Using Comparison Values (CV) – Surface Soil at Landfill 1

Contaminant Name	Maximum Concentration (ppm)	Recommended CV (ppm)	Soil CV Type	Selected for Further Evaluation?
Aluminum	31,200	52,000	Chronic EMEG Child / Intermediate EMEG Child	No
Arsenic	8.76	16	Chronic EMEG Child / RMEG Child	No
Barium	182	10,000	Chronic EMEG Child / Intermediate EMEG Child / RMEG Child	No
Beryllium	3.16	100	Chronic EMEG Child / RMEG Child	No
Boron	10.9	10,000	Intermediate EMEG Child / RMEG Child	No
Cobalt	18.6	520	Intermediate EMEG Child	No
Copper	53.4	1,000	Intermediate EMEG Child	No
Chromium	31.4	78,000	RMEG Child for Cr(III)*	No
DDE, p,p'-	0.011	1.1	CREG	No
Fluoranthene	0.19	2,100	RMEG Child	No
Nickel	40.3	1,000	RMEG Child	No
Pyrene	0.28	1,600	RMEG Child	No
Vanadium	44.1	520	Intermediate EMEG Child	No
Zinc	125	16,000	Chronic EMEG Child / Intermediate EMEG Child / RMEG Child	No
Benz(a)anthracene	0.17	1.1	EPA Child RSL	No
Benzyl alcohol	0.057	6,300	EPA Child RSL	No
Chrysene	0.17	110	EPA Carcinogenic RSL	No
Iron	**80,000**	**55,000**	**EPA Child RSL**	**Yes (above CV)**
Lead	20.4	400	EPA Child RSL	No
Manganese	165	1,800	EPA Child RSL	No
Phenanthrene	**0.25**	**NA**	**NA**	**Yes (no CV)**

Source: IT Corporation, 2002a
ppm – parts per million; EMEG = ATSDR environmental media evaluation guide; RMEG = ATSDR reference dose media evaluation guide; CREG = ATSDR cancer risk evaluation guide; RSL = EPA Regional Screening Level; NA = Not applicable; Bolded text = exceeds applicable comparison value (CV)
*In most soils, chromium will be present predominantly in the chromium (III) state (ATSDR 2012a).

Table B5. Screening Using Comparison Values (CV) – Vapor Intrusion at Landfill 1

Contaminant Name	Maximum Concentration in GW (ppb)	ATSDR Recommended CV (ppb)	ATSDR GW VI CV Type*	Selected for Further Evaluation?
Acetone	**14**	**NA**	**NA**	**Yes (no CV)**
Aluminum	213	NA	NA	No. Not a volatile, so not a concern for vapor intrusion.
Barium	618	NA	NA	No. Not a volatile, so not a concern for vapor intrusion.
Di(2-ethylhexyl)phthalate	21	290,000	Intermediate EMEG/MRL	No
Di-n-butyl phthalate	**12**	**NA**	**NA**	**Yes (no CV)**
1,3-dinitrobenzene	**0.57**	**NA**	**NA**	**Yes (no CV)**
Hexachlorocyclohexane, beta-	0.35	110	CREG	No
Iron	611	NA	NA	No. Not a volatile, so not a concern for vapor intrusion.
Lead	7.21	NA	NA	No. Not a volatile, so not a concern for vapor intrusion.
Manganese	1,440	NA	NA	No. Not a volatile, so not a concern for vapor intrusion.
Methylene chloride	0.49	470	CREG	No
Toluene	0.22	14,000	Chronic EMEG/MRL	No
1,1,1-trichloroethane	2.1	5,400	Intermediate EMEG/MRL	No
Zinc	32.4	NA	NA	No. Not a volatile, so not a concern for vapor intrusion.

Source: IT Corporation, 1999
*Groundwater/vapor intrusion comparison values (CVs) selected from ATSDR's Public Health Assessment Site Tool (PHAST)
ppb = parts per billion; VI = vapor intrusion; GW = groundwater; EMEG = ATSDR environmental media evaluation guide; CREG = ATSDR cancer risk evaluation guide; MRL = Minimum Risk Level; NA = Not applicable; Bolded text = exceeds applicable comparison value (CV)

Table B6. Screening Using Comparison Values (CV) – Surface Soil on the Golf Course

Contaminant Name	Maximum Concentration (ppm)	Recommended CV (ppm)	Soil CV Type	Selected for Further Evaluation?
Acetone	0.32	31,000	Intermediate EMEG Child	No
Aluminum	11,100	52,000	Chronic EMEG Child / Intermediate EMEG Child	No
Arsenic	32.7	240	Chronic EMEG Adult	No
Barium	79	10,000	Chronic EMEG Child / Intermediate EMEG Child / RMEG Child	No
Benzene	0.001	7.0	CREG	No
Benzo(a)pyrene	**0.069**	**0.065**	**CREG**	**Yes (above CV)**
Beryllium	0.99	100	Chronic EMEG Child / RMEG Child	No
2-butanone	0.034	31,000	RMEG Child	No
Cadmium	0.34	5.2	Chronic EMEG Child	No
Chromium	31.9	78,000	RMEG Child for Cr(III)*	No
Cobalt	7.18	520	Intermediate EMEG Child	No
Copper	28.9	1,000	Intermediate EMEG Child	No
DDE, p,p'-	0.013	1.1	CREG	No
DDT, p,p'-	0.011	1.1	CREG	No
1,1-dichloroethene	0.0029	2,600	Chronic EMEG Child / RMEG Child	No
Di(2-ethylhexyl)phthalate	0.18	5.2	Intermediate EMEG Child	No
Dieldrin	0.0069	0.024	CREG	No
Di-n-butyl phthalate	0.12	5,200	RMEG Child	No
Ethylbenzene	0.0086	21,000	Intermediate EMEG Child	No
Fluoranthene	0.12	2,100	RMEG Child	No
Mercury	0.088	0.52	Intermediate EMEG Child for inorganic mercury	No
Methoxychlor	0.0017	260	Intermediate EMEG Child / RMEG Child	No
Methylene chloride	0.056	55	CREG	No
Nickel	9.4	1,000	RMEG Child	No
Nitrate	25.8	83,000	RMEG Child	No
Pyrene	0.08	1,600	RMEG Child	No
Selenium	1.8	260	Chronic EMEG Child / RMEG Child	No
Silver	1	260	RMEG Child	No
Tetrachloroethylene	0.053	180	CREG	No

Contaminant Name	Maximum Concentration (ppm)	Recommended CV (ppm)	Soil CV Type	Selected for Further Evaluation?
Toluene	0.0083	4,200	RMEG Child	No
1,1,1-trichloroethane	0.037	100,000	RMEG Child	No
Trichloroethylene	0.021	5.6	CREG	No
Vanadium	25.1	520	Intermediate EMEG Child	No
Xylenes, total	0.037	10,000	Chronic EMEG Child / RMEG Child	No
Zinc	57	16,000	Chronic EMEG Child / Intermediate EMEG Child / RMEG Child	No
Benz(a)anthracene	0.052	1.1	EPA Child RSL	No
Benzo(b)fluoranthene	0.093	1.1	EPA Carcinogenic RSL	No
Benzo(g,h,i)perylene	**0.044**	**NA**	**NA**	**Yes (no CV)**
Benzo(k)fluoranthene	0.062	11	EPA Carcinogenic RSL	No
Chlordane	0.021	1.7	EPA Carcinogenic RSL for technical chlordane	No
Chrysene	0.075	11	EPA Carcinogenic RSL	No
1,2-dichloroethylene (mixed isomers)	0.0023	70	EPA Child RSL	No
Indeno(1,2,3-cd)pyrene	0.044	1.1	EPA Carcinogenic RSL	No
Iron	21,400	55,000	EPA Child RSL	No
Lead	93.3	400	EPA Child RSL	No
Manganese	1,340	1,800	EPA Child RSL	No
Phenanthrene	**0.048**	**NA**	**NA**	**Yes (no CV)**

Source: IT Corporation, 2001e
ppm – parts per million; EMEG = ATSDR environmental media evaluation guide; RMEG = ATSDR reference dose media evaluation guide; CREG = ATSDR cancer risk evaluation guide; RSL = EPA Regional Screening Level; NA= Not applicable; Bolded text = exceeds applicable comparison value (CV)
*In most soils, chromium will be present predominantly in the chromium (III) state (ATSDR, 2012).

Table B7. Screening Using Comparison Values (CV) – Surface Water on the Golf Course

Contaminant Name	Maximum Concentration (ppb)	ATSDR Recommended CV (ppb)	Drinking Water CV Type	Selected for Further Evaluation?
Aluminum	146	7,000	Chronic EMEG Child / Intermediate EMEG Child	No
Barium	43.2	1,400	Chronic EMEG Child / Intermediate EMEG Child / RMEG Child	No
Manganese	282	430	EPA Child RSL	No
Thallium	**5.8**	**2**	**MCL**	**Yes (above CV)**
Lead	3	15	EPA Child RSL/MCL	No
Iron	457	14,000	EPA Child RSL	No

Source: IT Corporation, 2001e

ppb – parts per billion; EMEG = ATSDR environmental media evaluation guide; RMEG = ATSDR reference dose media evaluation guide; MCL = EPA Maximum Contaminant Level; Bolded text = exceeds applicable comparison value (CV)

Table B8. Screening Using Comparison Values (CV) – Sediments on the Golf Course

Contaminant Name	Maximum Concentration (ppm)	ATSDR Recommended CV (ppm)	Soil CV Type	Selected for Further Evaluation?
Aluminum	7,300	52,000	Chronic EMEG Child / Intermediate EMEG Child	No
Arsenic	6.6	240	Chronic EMEG Adult	No
Barium	57.7	10,000	Chronic EMEG Child / Intermediate EMEG Child / RMEG Child	No
Beryllium	0.65	100	Chronic EMEG Child / RMEG Child	No
Chromium	14.6	78,000	RMEG Child for Cr(III)*	No
Cobalt	7.4	520	Intermediate EMEG Child	No
Copper	38.1	1,000	Intermediate EMEG Child	No
DDD, p,p'-	0.0016	1.6	CREG	No
DDE, p,p'-	0.0044	1.1	CREG	No
DDT, p,p'-	0.0027	1.1	CREG	No
Hexachlorocyclohexane, beta-	0.0021	0.22	CREG	No
Mercury	0.1	0.52	Intermediate EMEG Child for inorganic mercury	No
Nickel	14.6	1,000	RMEG Child	No
Selenium	1.4	260	Chronic EMEG Child / RMEG Child	No
Vanadium	17.1	520	Intermediate EMEG Child	No
Zinc	69.4	16,000	Chronic EMEG Child / Intermediate EMEG Child	No
Iron	19,700	55,000	EPA Child RSL	No
Lead	159	400	EPA Child RSL	No
Manganese	507	1,800	EPA Child RSL	No

Source: IT Corporation, 2001e

ppm – parts per million; EMEG = ATSDR environmental media evaluation guide; RMEG = ATSDR reference dose media evaluation guide; CREG = ATSDR cancer risk evaluation guide; RSL = EPA Regional Screening Level; Bolded text = exceeds applicable comparison value (CV)
*In most soils, chromium will be present predominantly in the chromium (III) state (ATSDR, 2012).

Table B9. Screening Using Comparison Values (CV) – Surface Soil at the Athletic Field

Contaminant Name	Maximum Concentration (ppm)	ATSDR Recommended CV (ppm)	Soil CV Type	Selected for Further Evaluation?
Acenaphthene	3.3	3,100	RMEG Child	No
Acetone	0.53	31,000	Intermediate EMEG Child	No
Aluminum	14,200	52,000	Chronic EMEG Child / Intermediate EMEG Child	No
Anthracene	9.3	16,000	RMEG Child	No
Arsenic	13.8	16	Chronic EMEG Child / RMEG Child	No
Barium	255	10,000	Chronic EMEG Child / Intermediate EMEG Child / RMEG Child	No
Benzo(a)pyrene	**11**	**0.065**	**CREG**	**Yes (above CV)**
Beryllium	1.1	100	Chronic EMEG Child / RMEG Child	No
2-butanone	0.034	31,000	RMEG Child	No
Butyl benzyl phthalate	0.38	10,000	RMEG Child	No
Cadmium	3.8	5.2	Chronic EMEG Child	No
Carbon disulfide	0.013	5,200	RMEG Child	No
Chromium	147	78,000	RMEG Child for Cr(III)*	No
Cobalt	6.2	520	Intermediate EMEG Child	No
Copper	424	1,000	Intermediate EMEG Child	No
Di(2-ethylhexyl)phthalate	3	5.2	Intermediate EMEG Child	No
Di-n-butyl phthalate	0.25	5,200	RMEG Child	No
Di-n-octyl phthalate	0.3	21,000	Intermediate EMEG Child	No
Fluoranthene	28	2,100	RMEG Child	No
Fluorene	8.9	2,100	RMEG Child	No
Mercury	0.15	0.52	Intermediate EMEG Child for inorganic mercury	No
Methylene chloride	0.012	55	CREG	No
2-methylnaphthalene	2.4	2,100	Chronic EMEG Child	No
Naphthalene	1.9	1,000	RMEG Child	No
Nickel	64.9	1,000	RMEG Child	No
Pyrene	20	1,600	RMEG Child	No
Selenium	1.3	260	Chronic EMEG Child / RMEG Child	No
Toluene	0.0031	4,200	RMEG Child	No
1,2,4-trimethylbenzene	0.0074	520	RMEG Child	No
1,3,5-trimethylbenzene	0.0027	520	RMEG Child	No

Contaminant Name	Maximum Concentration (ppm)	ATSDR Recommended CV (ppm)	Soil CV Type	Selected for Further Evaluation?
Vanadium	46.7	520	Intermediate EMEG Child	No
Zinc	518	16,000	Chronic EMEG Child / Intermediate EMEG Child / RMEG Child	No
Benz(a)anthracene	11	1.1	EPA Carcinogenic RSL	No
Benzo(b)fluoranthene	11	1.1	EPA Carcinogenic RSL	No
Benzo(g,h,i)perylene	**4.5**	**NA**	**NA**	**Yes (no CV)**
Benzo(k)fluoranthene	8.3	11	EPA Carcinogenic RSL	No
Carbazole	**2.3**	**NA**	**NA**	**Yes (no CV)**
Chrysene	10	110	EPA Carcinogenic RSL	No
Dibenz(a,h)anthracene	**2.6**	**0.11**	**EPA Carcinogenic RSL**	**Yes (above CV)**
Dibenzofuran	3.5	78	EPA Child RSL	No
Indeno(1,2,3-cd)pyrene	**4.7**	**1.1**	**EPA Carcinogenic RSL**	**Yes (above CV)**
Iron	44,800	820,000	EPA RSL Commercial	No
Lead	355	400	EPA Child RSL	No
Manganese	840	26,000	EPA RSL Commercial	No
Methyl isobutyl ketone	0.014	33,000	EPA Child RSL	No
Phenanthrene	**26**	**NA**	**NA**	**Yes (no CV)**
Xylene, o-	0.0038	640	EPA Child RSL	No

Source: IT Corporation, 2001c *In most soils, chromium will be present predominantly in the chromium (III) state" (ATSDR, 2012).
ppm – parts per million; EMEG = ATSDR environmental media evaluation guide; RMEG = ATSDR reference dose media evaluation guide; CREG = ATSDR cancer risk evaluation guide; RSL = EPA Regional Screening Level; NA = Not applicable; Bolded text = exceeds applicable comparison value (CV)

Table B10. Screening Using Comparison Values (CV) – Surface Water at Reilly Lake

Contaminant Name	Maximum Concentration (ppb)	ATSDR Recommended CV (ppb)	Drinking Water CV Type	Selected for Further Evaluation?
Acetone	3.6	4,200	Intermediate EMEG Child	No
Aluminum	1,540	7,000	Chronic EMEG Child / Intermediate EMEG Child	No
Arsenic	**8.55**	**0.016**	**CREG**	**Yes (above CV)**
Barium	62.8	1,400	Chronic EMEG Child / Intermediate EMEG Child / RMEG Child	No
Cobalt	8.28	70	Intermediate EMEG Child	No
Di(2-ethylhexyl)phthalate	**2.3**	2.6	Intermediate EMEG Adult	No
Mercury	0.17	0.26	Intermediate EMEG Adult	No
Methylene chloride	1.2	6.1	CREG	No
Phenol	6.2	2,100	RMEG Child	No
Toluene	0.22	560	RMEG Child	No
Zinc	41.6	2,100	Chronic EMEG Child / Intermediate EMEG Child / RMEG Child	No
Iron	**14,900**	**14,000**	**EPA Child RSL**	**Yes (above CV)**
Lead	6.5	15	EPA Child RSL	No
Manganese	**11,100**	**430**	**EPA Child RSL**	**Yes (above CV)**

Source: IT Corporation, 2002b

ppb – parts per billion; EMEG = ATSDR environmental media evaluation guide; RMEG = ATSDR reference dose media evaluation guide; Bolded text = exceeds applicable comparison value (CV)

Table B11. Screening Using Comparison Values (CV) – Sediments at Reilly Lake

Contaminant Name	Maximum Concentration (ppm)	ATSDR Recommended CV (ppm)	Soil CV Type	Selected for Further Evaluation?
Acetone	0.48	31,000	Intermediate EMEG Child	No
Aluminum	26,500	52,000	Chronic EMEG Child / Intermediate EMEG Child	No
Antimony	6.84	21	RMEG Child	No
Arsenic	60	240	Chronic EMEG Adult	No
Barium	515	10,000	Chronic EMEG Child / Intermediate EMEG Child / RMEG Child	No
Beryllium	1.57	100	Chronic EMEG Child / RMEG Child	No
2-butanone	0.034	31,000	RMEG Child	No
Carbon disulfide	0.023	5,200	RMEG Child	No
Chromium	358	78,000	RMEG Child for Cr(III)*	No
Cobalt	68.6	520	Intermediate EMEG Child	No
Copper	42.9	1,000	Intermediate EMEG Child	No
Di(2-ethylhexyl)phthalate	0.53	5.2	Intermediate EMEG Child	No
Mercury	0.12	0.52	Intermediate EMEG Child for inorganic mercury	No
Methylene chloride	0.06	55	CREG	No
Nickel	23.7	1,000	RMEG Child	No
Selenium	3.2	260	Chronic EMEG Child / RMEG Child	No
Silver	1.15	260	RMEG Child	No
Toluene	0.0068	4,200	RMEG Child	No
Vanadium	77	520	Intermediate EMEG Child	No
Zinc	99	16,000	Chronic EMEG Child / Intermediate EMEG Child / RMEG Child	No
Iron	**183,000**	**55,000**	**EPA Child RSL**	**Yes**
Lead	122	400	EPA Child RSL	No
Manganese	**19,600**	**1,800**	**EPA Child RSL**	**Yes**

Source: IT Corporation, 2002b

ppm – parts per million; EMEG = ATSDR environmental media evaluation guide; RMEG = ATSDR reference dose media evaluation guide; CREG = ATSDR cancer risk evaluation guide; RSL = EPA Regional Screening Level; Bolded text = exceeds applicable comparison value (CV)

*In most soils, chromium will be present predominantly in the chromium (III) state (ATSDR, 2012).

Table B12. Screening Using Comparison Values (CV) – Surface Water in Cane Creek

Contaminant Name	Maximum Concentration (ppb)	ATSDR Recommended CV (ppb)	Drinking Water CV Type	Selected for Further Evaluation?
Acetone	5.6	4,200	Intermediate EMEG Child	No
Aluminum	122	7,000	Chronic EMEG Child / Intermediate EMEG Child	No
Antimony	1.4	2.8	RMEG Child	No
Barium	43.2	1,400	Chronic EMEG Child / Intermediate EMEG Child / RMEG Child	No
Beryllium	0.16	14	Chronic EMEG Child / RMEG Child	No
Copper	1.9	140	Intermediate EMEG Child	No
2,2-dichloropropionic acid	2.7	210	RMEG Child	No
Di(2-ethylhexyl)phthalate	**7.4**	**0.70**	**Intermediate EMEG Child**	**Yes (above CV)**
Hexachlorobutadiene	0.14	0.31	CREG	No
Mercury	0.055	0.07	Intermediate EMEG Child for inorganic mercury	No
Methylene chloride	1.2	6.1	CREG	No
Naphthalene	0.37	140	RMEG Child	No
Phenol	7.4	2,100	RMEG Child	No
Selenium	2.7	35	Chronic EMEG Child / RMEG Child	No
Toluene	0.58	560	RMEG Child	No
Trichloroethylene	**0.59**	**0.43**	**CREG**	**Yes (above CV)**
Vanadium	2.8	70	Intermediate EMEG Child	No
Chromium	1.6	100	EPA Child RSL	No
Iron	707	14,000	EPA Child RSL	No
Lead	13.4	15	EPA Child RSL	No
Manganese	131	430	EPA Child RSL	No
Thallium	**5.8**	**2**	**MCL**	**Yes (above CV)**

Sources: IT Corporation, 2001a, 2001b, 2001d, 2001e, 2002c
ppb – parts per billion; EMEG = ATSDR environmental media evaluation guide; RMEG = ATSDR reference dose media evaluation guide; CREG = ATSDR cancer risk evaluation guide; RSL = EPA Regional Screening Level; MCL = EPA Maximum Contaminant Level; Bolded text = exceeds applicable comparison value (CV)

Table B13. Screening Using Comparison Values (CV) – Sediment at Cane Creek

Contaminant Name	Maximum Concentration (ppm)	ATSDR Recommended CV (ppm)	ATSDR CV Type	Selected for Further Evaluation?
Acetone	0.83	31,000	Intermediate EMEG Child	No
Aluminum	8,700	52,000	Chronic EMEG Child / Intermediate EMEG Child	No
Antimony	9.1	21	RMEG Child	No
Arsenic	6.5	16	Chronic EMEG Child / RMEG Child	No
Barium	96	10,000	Chronic EMEG Child / Intermediate EMEG Child / RMEG Child	No
Benzene	0.0021	7.0	CREG	No
Benzo(a)pyrene	**0.079**	**0.065**	**CREG**	**Yes (above CV)**
Beryllium	1.8	100	Chronic EMEG Child / RMEG Child	No
Bromomethane	0.0036	73	RMEG Child	No
2-butanone	0.0077	31,000	RMEG Child	No
Cadmium	0.76	5.2	Chronic EMEG Child	No
Carbon disulfide	0.0083	5,200	RMEG Child	No
Chromium	22.3	78,000	RMEG Child for CR(III)*	No
Cobalt	12.9	520	Intermediate EMEG Child	No
Copper	38.1	1,000	Intermediate EMEG Child	No
DDE, p,p'-	0.0044	1.1	CREG	No
DDT, p,p'-	0.0022	1.1	CREG	No
Di(2-ethylhexyl)phthalate	0.17	5.2	Intermediate EMEG Child	No
Di-n-butyl phthalate	0.31	5,200	RMEG Child	No
Fluoranthene	0.19	2,100	RMEG Child	No
Hexachlorocyclohexane, beta-	0.0021	0.22	CREG	No
Mercury	0.052	0.52	Intermediate EMEG Child for inorganic mercury	No
Methylene chloride	0.012	55	CREG	No
Nickel	13.2	1,000	RMEG Child	No
Pyrene	0.14	1,600	RMEG Child	No
Selenium	1.2	260	Chronic EMEG Child / RMEG Child	No
Toluene	0.0089	4,200	RMEG Child	No
Vanadium	17.6	520	Intermediate EMEG Child	No

Contaminant Name	Maximum Concentration (ppm)	ATSDR Recommended CV (ppm)	ATSDR CV Type	Selected for Further Evaluation?
Zinc	78.7	16,000	Chronic EMEG Child / Intermediate EMEG Child / RMEG Child	No
Benz(a)anthracene	0.097	1.1	EPA Carcinogenic RSL	No
Benzo(b)fluoranthene	0.089	1.1	EPA Carcinogenic RSL	No
Benzo(g,h,i)perylene	**0.062**	**NA**	**NA**	**Yes (no CV)**
Benzo(k)fluoranthene	0.081	11	EPA Carcinogenic RSL	No
Chrysene	0.097	110	EPA Carcinogenic RSL	No
Cresol, para-	0.51	1,300	EPA Child RSL	No
Indeno(1,2,3-cd)pyrene	0.061	1.1	EPA Carcinogenic RSL	No
Iron	28,200	55,000	EPA Child RSL	No
Lead	159	400	EPA Child RSL	No
Manganese	649	1,800	EPA Child RSL	No
Phenanthrene	**0.055**	**NA**	**NA**	**Yes (no CV)**
Thallium	0.56	0.78	EPA Child RSL	No

Sources: IT Corporation, 2001a, 2001b, 2001d, 2001e, 2002c

ppm – parts per million; EMEG = ATSDR environmental media evaluation guide; RMEG = ATSDR reference dose media evaluation guide; CREG = ATSDR cancer risk evaluation guide; RSL = EPA Regional Screening Level; NA = Not applicable; Bolded text = exceeds applicable comparison value (CV)

*In most soils, chromium will be present predominantly in the chromium (III) state (ATSDR, 2012)

Appendix C. Calculating Exposure Doses & Determining Potential Health Effects

This appendix summarizes the ATSDR health effects evaluation process. The process involves looking more closely at site specific exposures, estimating exposure doses, and using the dose estimates to interpret health risks. Exposure dose calculations for soil ingestion, soil/sediment dermal absorption, surface water ingestion, surface water dermal absorption, and fish are explained and provided below.

For this evaluation, ATSDR used the exposure parameters shown in Table C1 to calculate exposure doses.

Table C1: Fort McClellan Site-Specific Exposure Factors/Parameters

Exposure Element	Input
Target Population	Veterans stationed at Fort McClellan from 1945 until base closure around 1998/9
Target Land Use	Past land use for housing and recreational/leisure activities
Exposure Duration	2 years
Exposure Groups	• 16 to <21 years • Adults • Children, when appropriate
Contaminant Concentration	Maximum detected
Fish Intake Rate, non-subsistence	44 g/day
Fishing, Days per Week	2
Fishing, Weeks per Year	36 (9 months)
Fishing, Total Years	2
Surface water, Hours per Event	2
Surface water, Events per Day	1
Surface water, Days per Week	2
Surface water, Weeks per Year	26 (6 months)
Surface water, Total Years	2
Sediment/soil Days per Week	2
Sediment/soil Weeks per Year	52.14
Sediment/soil Total Years	2

Equations used to estimate exposure doses from past exposures to environmental contamination at Fort McClellan are shown below. These equations can be found in the ATSDR Public Health Assessment Guidance Manual (ATSDR, 2022) and are supported in ATSDR's Public Health Assessment Site Tool (PHAST). PHAST is a flexible online tool that ATSDR uses to evaluate environmental data and perform complex dose calculations. PHAST contains the most current public health assessment tools and guidance.

Surface Water Ingestion Exposure Dose Equation

$$D = (C \times IR \times t_{event} \times EV \times EF) / BW$$

D = Exposure Dose (mg/kg/day)
C = Contaminant Concentration (mg/L)
IR = Intake Rate (L/hr)
t_{event} = Event Duration (hr/event)
EV = Event Frequency (events/day)
EF = Exposure Factor (unitless)
BW = Body Weight (kg)

Surface Water Dermal Absorbed Dose Equation

$$ADD = (DA_{event} \times SA \times EV \times EF) / (BW \times ABS_{GI})$$

ADD = Administered Dermal Dose (mg/kg/day)
DA_{event} = Absorbed Dose per Event (mg/cm^2/event)
SA = Surface Area Available for Contact (cm^2)
EV = Event Frequency (events/day), EF = Exposure Factor (unitless)
BW = Body Weight (kg)
ABS_{GI} = Gastrointestinal Absorption Factor (unitless)

Soil Ingestion Exposure Dose Equation

$$D = (C * IR * EF * CF) / BW$$

D = Exposure Dose (mg/kg-day)
C = Contaminant Concentration (mg/kg)
IR = Intake Rate (mg/day)
EF = Exposure Factor (unitless)
CF = Conversion Factor (10-6 kg/mg)
BW = Body Weight (kg)

Soil Administered Dermal Dose Equation

$$ADD = (C * EF * CF * AF * ABSd * SA) / BW * ABSGI$$

ADD = Administered Dermal Dose (mg/kg-day)
C = Contaminant Concentration (mg/kg)
EF = Exposure Factor (unitless)
CF = Conversion Factor (10^{-6} kg/mg)
AF = Adherence Factor to Skin (mg/cm^2-event)
ABSd = Dermal Absorption Fraction to Skin (unitless)
SA = Skin Surface Area Available for Contact (cm^2)
BW = Body Weight (kg)
ABSGI = Gastrointestinal Absorption Factor (unitless)

Fish Ingestion Exposure Dose Equation

$$D = (C * IR * EF) / BW$$

D = Exposure Dose (mg/kg-day)
C = Contaminant Concentration (mg/kg or mg/L)
IR = Intake Rate (kg/day or L/day)
EF = Exposure Factor (unitless)
BW = Body Weight (kg)

Cancer Risk Equations

$$CR = D_{noncancer} \times CSF \times (ED \div LY)$$

CR = cancer risk (unitless)
$D_{noncancer}$ = dose
CSF = oral cancer slope factor [$(mg/kg/day)^{-1}$],
ED = exposure duration
LY = lifetime of 78 years

Using the exposure parameters in Table C1 and the exposure dose equations above, ATSDR calculated exposure doses and cancer risks, where applicable, for adults (and children in limited scenarios), using reasonable maximum exposure (RME) and central tendency exposure (CTE) scenarios.

- **Reasonable Maximum Exposure** (RME), which refers to people who are at the high end of the exposure distribution (approximately the 95th percentile). The RME scenario is intended to assess exposures that are higher than average, but still within a realistic exposure range.

- **Central Tendency Exposure** (CTE), which refers to individuals who have average or typical exposure to a contaminant.

Noncancer Health Effects

Once we have our estimated exposure doses for each contaminant and exposure pathway, we compare them to contaminant-specific health guidelines (used to evaluate noncancer health effects), such as an MRL, RfD, or RfC, to assess whether harmful health effects are expected. Health guidelines are derived from data in the epidemiologic and toxicologic literature with appropriate uncertainty or safety factors applied to ensure they are set at levels below those that could result in harmful health effects. The values do not represent thresholds of toxicity. For reference, the common health guidelines ATSDR uses are defined in the table below.

Health Guidelines	Definition
ATSDR-Developed Minimal Risk Levels (MRLs)	• Represent estimates of the daily human exposure to a contaminant that, based on ATSDR evaluations, are not expected to cause noncancer health effects during a specified exposure duration. • Are set below levels that might cause harmful health effects in most people, including sensitive populations. • Are derived for acute (1-14 days), intermediate (15-364 days), and chronic (365 days and longer) exposure durations. • Are available for oral and inhalation exposures. • A complete list of the available MRLs can be found at About Minimal Risk Levels | Minimal Risk Levels (MRLs) | ATSDR
EPA-Derived Reference Doses (RfDs)	• Are estimates of daily oral exposures to a contaminant not likely to have a discernible risk of deleterious effects to the general human population, including sensitive subgroups, during a lifetime of exposure. • A complete list of EPA's available RfDs can be found at Integrated Risk Information System | US EPA.
EPA-Derived Reference Concentrations (RfCs)	• Are estimates of daily inhalation exposures to a contaminant not likely to have a discernible risk of deleterious effects to the general human population, including sensitive subgroups, during a lifetime of exposure. • A complete list of EPA's available RfCs can be found at Integrated Risk Information System | US EPA.

An exposure dose is an estimate of the amount of a substance in the environment a person may come into contact with during a specific time period, expressed relative to body weight. The exposure doses are then compared to the ATSDR health-based guidelines by calculating the hazard quotients (HQs). The HQ is calculated to evaluate the potential for non-cancer health hazards to occur from exposure to a contaminant with available non-cancer health guidelines (MRLs, RfDs, RfCs). The HQ is calculated by dividing the exposure dose by the health guideline as follows:

HQ = (Exposure Dose)/(Health Guideline)

The resulting HQ is compared to 1. If the HQ is <1, then no adverse health effects are expected as a result of the exposure. If the hazard quotient is >1, then further toxicological evaluation is needed to determine if exposed persons could be at risk of harmful effects.

Cancer Health Effects

ATSDR conducted a separate evaluation to determine the potential risks from cancer-causing chemicals detected at this site. Information about the increased risk for cancer from exposure to these chemicals is also provided in each exposure scenario. Cancer is a complex subject, so we provide background information here before discussing cancer evaluations of specific chemicals. According to the American Cancer Society, the overall probability that U.S. residents will develop cancer at some point in their lifetime is 1 in 2 for men (40.14%) and 1 in 3 (38.70%) for women. This is considering the background risk of developing cancer. Stated another way, half of all men and one-third of all women will develop some type of cancer in their lifetime. This is based on medical data collected on all types of cancer, regardless of whether the cause was identified, the case was successfully treated, or the patient died (directly or indirectly) of the cancer.

Factors that play major roles in cancer development include:

- lifestyle (what we eat, drink, and smoke; where we live);
- exposures to natural light (sunlight) and medical radiation;
- workplace exposures;
- drug use;
- socioeconomic factors; and
- chemicals in our air, water, soil, or food.

Infectious diseases, aging, and individual susceptibilities such as genetic predisposition are also important factors in cancer development.

We rarely know the environmental factors or conditions responsible for cancer onset and development. We understand cancer development for some occupational exposures or for the use of specific drugs. Overall cancer risks can be reduced by eating a balanced diet, getting regular exercise, having regular medical exams, and avoiding high-risk behaviors such as tobacco use and excessive alcohol consumption. Using proper safety procedures, appropriate personal protective equipment, and medical monitoring programs can decrease workplace cancer risks.

ATSDR calculates a population's cancer risk estimate for carcinogens with available cancer risk values (EPA's CSFs and IURs). In general, we use EPA's quantitative approach for estimating a theoretical risk of cancer in the exposed population. When we have exposure doses, we obtain the CR by multiplying a chemical-specific CSF by the estimated exposure dose. When we have air concentrations, we obtain the CR by multiplying an IUR by the chemical concentration in air. This table below describes these cancer risk values.

EPA-Derived Cancer Risk Values	Definition
Oral Cancer Slope Factors (CSFs)	• Measure of the relative potency of various carcinogens from oral exposures. • Are estimates of possible increases in cancer cases in a human population. • Represent the result of EPA's quantitative evaluation of oral exposure to a suspected carcinogenic contaminant. • A complete list of the available CSFs can be found at Integrated Risk Information System | US EPA.
Inhalation Unit Risks (IURs)	• Measure of the relative potency of various carcinogens from inhalation exposures. • Are estimates of possible increases in cancer cases in a human population. • Represent the result of EPA's quantitative evaluation of inhalation exposure to a suspected carcinogenic contaminant. • A complete list of the available IURs can be found at About Minimal Risk Levels | Minimal Risk Levels (MRLs) | ATSDR.

ATSDR calculates CTE and RME CRs, depending on what is appropriate for the site-specific scenario, and calculates the cancer risk for children separately from the cancer risk for adults. When childhood exposure continues into adulthood or if exposure occurs for a lifetime, ATSDR combines the cancer risks for children and adults. For children, CRs are derived for a combined child: CTE (12 years) and RME (21 years) at a given residence. For the CTE child CR, the combined child is the sum of the cancer risks for each age group for the first 12 years of exposure only. The RME CR for the combined child is derived by summing all the cancer risks for each age group from birth to < 21 years. The adult CR assumes living at the residence for 12 (CTE) or 33 (RME) years.

The resulting risk of cancer is called an estimated excess cancer risk because it is the risk of cancer greater than the background risk of cancer that already exists. Unless directly stated, ATSDR cancer risk estimates for exposure to environmental contaminants do not include the existing background cancer rate in the U.S. population. Once we have a CR, we see if it is greater than 1.0E-06 (i.e., cancer risk exceeds one extra case in a million people similarly exposed). We retain those contaminants with CRs greater than 1.0E-06 and conduct further evaluation in the in-depth toxicological effects analysis.

In-depth Toxicological Effects Analysis

At this point in the process, we have ruled out those exposure pathways and contaminants that pose no health hazards and retained those requiring more examination. During this last scientific evaluation step in the PHA process, we closely analyze toxicological information for contaminants to determine whether people could possibly have health problems from their exposure. Contaminants examined during this analysis are those that exceeded acceptable noncancer (HQ>1) and cancer (CR>1.0E-06) levels, had no available health guidelines or cancer risk levels, represented contaminants of community concern, or had other factors (e.g., multiple contaminant exposures) that warranted evaluation.

During the in-depth toxicological analysis, we review information to understand questions such as these:

- How does the contaminant get into the body?
- What happens to the contaminant after it gets into the body?
- What data were used to develop the health guidelines and/or cancer risk values?
- What health effects are associated with the contaminant and at what doses or concentrations?
- How do site-specific doses or concentrations compare to health effects doses or concentrations in published studies?

The analysis then helps us find answers about 1) what harmful effects might be expected in exposed people and 2) what public health actions are needed to prevent or reduce exposures.

We evaluate and integrate exposure data (e.g., site-specific exposure conditions, doses, concentrations) and contaminant-specific health effects data from toxicologic or epidemiologic studies. We consider the exposure assumptions used when site-specific exposure parameters are unavailable.

For noncancer effects, we compare site-specific doses and concentrations to effect levels from critical studies. Critical studies are those used to generate noncancer health guidelines as well as studies for contaminants without noncancer health guidelines. This process helps us determine where site-specific doses and concentrations lie in relation to the observed-effect levels in the published literature. We look to see if differences between the study data and the exposure scenario we are evaluating make health effects more or less likely.

For cancer effects, we look at results quantitatively, as a theoretical risk, and qualitatively. The quantitative results describe the cancer risk numerically, such as three extra cancer cases for every 100,000 similarly exposed persons (3×10^{-5}). These theoretical risk estimates are calculated assuming people have the same exposures (e.g., the same soil concentration, soil ingestion rate, specified duration), and do not represent individual cancer risks or account for variation in exposure in people living around a site. The objective of the cancer risk estimate (quantitative) and hazard (qualitative) evaluation is to draw conclusions and make recommendations that will protect the public.

As included in the body of this document, the result of our in-depth toxicologic analysis is a **qualitative description** of whether site-specific exposures could result in harmful health effects. The findings help us determine the health conclusions and recommendations for public health actions presented herein. For more information on this in-depth analysis, refer to the Process and Decision Logic for ATSDR's In-Depth Toxicological Effects Analysis in ATSDR's PHAGM.

Appendix D: ToxFAQs for Polycyclic Aromatic Hydrocarbons (PAHs)

Polycyclic Aromatic Hydrocarbons (PAHs) | ToxFAQs™ | ATSDR

Appendix E. Evaluating PAHs for Cancer Health Effects

PAHs are a group of more than 100 different chemicals that are formed through the incomplete burning of materials such as coal, garbage, combustible gas, oil, tobacco, wood, and charbroiled meat. The Department of Health and Human Services (DHHS) has determined that some PAHs may reasonably be expected to be carcinogens. When evaluating cancer effects, PAHs are typically analyzed as mixtures because they are rarely found in the environment as individual compounds. Individual PAHs are referred to as “congeners.” Potency equivalency factors (PEFs) provide a way to assess the relative potency of PAH congeners measured in environmental samples as a group. This approach includes using benzo(a)pyrene (BaP) as an equivalent (surrogate) to assess the relative toxicity of PAHs in environmental media.

ATSDR’s general approach for evaluating PAHs is to calculate a benzo(a) pyrene equivalent (BaPE) with collected data. To calculate a BaPE for a sample, first multiply the concentration of each PAH congener by that congener’s PEF to produce a congener-specific BaP equivalent concentration (BEC). (Note that some PAH congeners do not have PEFs.) The calculated BECs for all measured congeners are then summed to obtain a total BaPE. The table below shows an example of how to use the PEFs to calculate BaPEs.

PAH Congener	Sample 1 (µg/kg)	Sample 2 (µg/kg)	PEF (µg/kg)	Sample 1 BEC (µg/kg)	Sample 2 BEC (µg/kg)
Benzo(a)anthracene	40	88	0.1	4.0	8.8
Benzo(a)pyrene	60	147	1	60	147
Benzo(b)fluoranthene	129	210	0.1	12.9	21
Benzo(k)fluoranthene	101	199	0.1	10.1	19.9
Chrysene	43	88	0.01	0.43	0.88
Dibenzo(a,)anthracene	20	69	2.4	48	166
Indeno(1,2,3-cd)pyrene	<2	66	0.1	0.2	6.6
BaPE (µg-BaP/kg)	--	--	--	**135.6**	**369.8**

Appendix F.

PHAST-generated Results for Exposure Doses, Hazard Quotients, and Cancer Risks for Non-occupational Areas of Interest at Fort McClellan

Table F1. PHAST Exposure Report for BaP Equivalents (PAHs) – Golf Course Surface Soils

Soil Combined Chronic

BaP Equivalent

Table F1. Trespasser/Recreational: Site-specific combined ingestion and dermal exposure doses for chronic exposure to BaP Equivalent in soil at 0.095 mg/kg along with cancer risk estimates*

Exposure Group	CTE Dose (mg/kg/day)	CTE Non-cancer Hazard Quotient	CTE Cancer Risk	RME Dose (mg/kg/day)	RME Non-cancer Hazard Quotient	RME Cancer Risk	Exposure Duration (yrs)
16 to < 21 years	7.1E-08	-	3.1E-9	9.8E-08	-	4.3E-9	2
Adult	2.9E-08	-	1.3E-9	5.3E-08	-	2.3E-9	2

Abbreviations: CTE = central tendency exposure (typical); mg/kg/day = milligram chemical per kilogram body weight per day; mg/kg = milligram chemical per kilogram soil; RME = reasonable maximum exposure (higher); yrs = years

[*] The calculations in this table were generated using ATSDR's PHAST v2.2.1.0 and the exposure factors in Table C1. The cancer risks were calculated using the cancer slope factor of 1.7 $(mg/kg/day)^{-1}$ and age-dependent adjustment factors.

Table F2. PHAST Exposure Report for BaP Equivalents (PAHs) – Athletic Field Surface Soils

Soil Combined Chronic

BaP Equivalent

Table F2. Trespasser/Recreational: Site-specific combined ingestion and dermal exposure doses for chronic exposure to BaP Equivalent in soil at 0.14 mg/kg along with cancer risk estimates*

PHAST Public Health Assessment Site Tool Exposure Group	CTE Dose (mg/kg/day)	CTE Non-cancer Hazard Quotient	CTE Cancer Risk	RME Dose (mg/kg/day)	RME Non-cancer Hazard Quotient	RME Cancer Risk	Exposure Duration (yrs)
16 to < 21 years	1.0E-07	-	4.6E-9	1.4E-07	-	6.3E-9	2
Adult	4.2E-08	-	1.8E-9	7.7E-08	-	3.4E-9	2

Abbreviations: CTE = central tendency exposure (typical); mg/kg/day = milligram chemical per kilogram body weight per day; mg/kg = milligram chemical per kilogram soil; RME = reasonable maximum exposure (higher); yrs = years

* The calculations in this table were generated using ATSDR's PHAST v2.2.1.0 and the exposure factors in Table C1. The cancer risks were calculated using the cancer slope factor of 1.7 $(mg/kg/day)^{-1}$ and age-dependent adjustment factors.

Table F3. PHAST Exposure Report for Arsenic – Surface Water in Reilly Lake

Surface Water Combined Chronic

Arsenic

Table F3. Swimming: Site-specific combined ingestion and dermal exposure doses for chronic exposure to arsenic in surface water at 0.0086 mg/L along with non-cancer hazard quotients and cancer risk estimates*

Exposure Group	CTE Dose (mg/kg/day)	CTE Non-cancer Hazard Quotient	CTE Cancer Risk	RME Dose (mg/kg/day)	RME Non-cancer Hazard Quotient	RME Cancer Risk	Exposure Duration (yrs)
16 to < 21 years	2.3E-06	0.0076	8.8E-8	4.7E-06	0.016	1.8E-7	2
Adult	1.2E-06	0.0041	4.8E-8	2.8E-06	0.0092	1.1E-7	2

Abbreviations: CTE = central tendency exposure (typical); mg/kg/day = milligram chemical per kilogram body weight per day; mg/L = milligram chemical per liter water; RME = reasonable maximum exposure (higher); yrs = years

* The calculations in this table were generated using ATSDR's PHAST v2.2.1.0 and the exposure factors in Table C1. The non-cancer hazard quotients were calculated using the concentration of 0.0086 mg/L and chronic (greater than 1 year) minimal risk level of 0.0003 mg/kg/day and the cancer risks were calculated using the cancer slope factor of 1.5 $(mg/kg/day)^{-1}$.

Table F4. PHAST Exposure Report for Manganese – Surface Water in Reilly Lake

Surface Water Combined Chronic

Manganese

Table F4. Swimming: Site-specific combined ingestion and dermal exposure doses for chronic exposure to manganese in surface water at 11.1 mg/L*

PHAST Public Health Assessment Site Tool Exposure Group	CTE Dose (mg/kg/day)	CTE Non-cancer Hazard Quotient	CTE Cancer Risk	RME Dose (mg/kg/day)	RME Non-cancer Hazard Quotient	RME Cancer Risk	Exposure Duration (yrs)
16 to < 21 years	0.022	0.44	-	0.026	0.52	-	2
Adult	0.020	0.40	-	0.022	0.44	-	2

Abbreviations: CTE = central tendency exposure (typical); mg/kg/day = milligram chemical per kilogram body weight per day; mg/L = milligram chemical per liter water; RME = reasonable maximum exposure (higher); yrs = years

* The calculations in this table were generated using ATSDR's PHAST v2.2.1.0 and the exposure factors in Table C1.

Table F5. PAST Exposure Report for Manganese – Sediments in Reilly Lake

Soil Combined Chronic

Manganese

Table F5. Trespasser/Recreational: Site-specific combined ingestion and dermal exposure doses for chronic exposure to manganese in soil at 19,600 mg/kg*

Exposure Group	CTE Dose (mg/kg/day)	CTE Non-cancer Hazard Quotient	CTE Cancer Risk	RME Dose (mg/kg/day)	RME Non-cancer Hazard Quotient	RME Cancer Risk	Exposure Duration (yrs)
16 to < 21 years	0.026	0.52	-	0.032	0.64	-	2
Adult	0.0095	0.19	-	0.014	0.28	-	2

Abbreviations: CTE = central tendency exposure (typical); mg/kg/day = milligram chemical per kilogram body weight per day; mg/kg = milligram chemical per kilogram soil; RME = reasonable maximum exposure (higher); yrs = years

* The calculations in this table were generated using ATSDR's PHAST v2.2.1.0 and the exposure factors in Table C1 .

Table F6. PHAST Exposure Report for Di(2-ethylhexyl)phthalate – Surface Water in Cane Creek

Surface Water Combined Chronic

Di(2-ethylhexyl)phthalate

Table F6. Swimming: Site-specific combined ingestion and dermal exposure doses for chronic exposure to di(2-ethylhexyl)phthalate in surface water at 0.0074 mg/L along with cancer risk estimates*

Exposure Group	CTE Dose (mg/kg/day)	CTE Non-cancer Hazard Quotient	CTE Cancer Risk	RME Dose (mg/kg/day)	RME Non-cancer Hazard Quotient	RME Cancer Risk	Exposure Duration (yrs)
16 to < 21 years	2.0E-06	-	7.0E-10	4.0E-06	-	1.5E-9	2
Adult	1.0E-06	-	3.7E-10	2.4E-06	-	8.5E-10	2

Abbreviations: CTE = central tendency exposure (typical); mg/kg/day = milligram chemical per kilogram body weight per day; mg/L = milligram chemical per liter water; RME = reasonable maximum exposure (higher); yrs = years

* The calculations in this table were generated using ATSDR's PHAST v2.2.1.0 and the exposure factors in Table C1. The cancer risks were calculated using the cancer slope factor of 0.014 $(mg/kg/day)^{-1}$.

Table F7. PHAST Exposure Report for BaP Equivalents (PAHs) – Sediments in Cane Creek

Soil Combined Chronic

BaP Equivalent

Table F7. Trespasser/Recreational: Site-specific combined ingestion and dermal exposure doses for chronic exposure to BaP Equivalent in soil at 0.11 mg/kg along with cancer risk estimates*

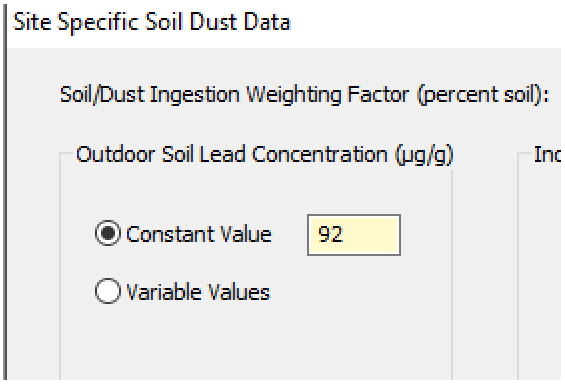
PUBLIC HEALTH ASSESSMENT SITE TOOL PHAST Exposure Group	CTE Dose (mg/kg/day)	CTE Non-cancer Hazard Quotient	CTE Cancer Risk	RME Dose (mg/kg/day)	RME Non-cancer Hazard Quotient	RME Cancer Risk	Exposure Duration (yrs)
16 to < 21 years	8.0E-08	-	3.5E-9	1.1E-07	-	4.8E-9	2
Adult	3.2E-08	-	1.4E-9	5.9E-08	-	2.6E-9	2

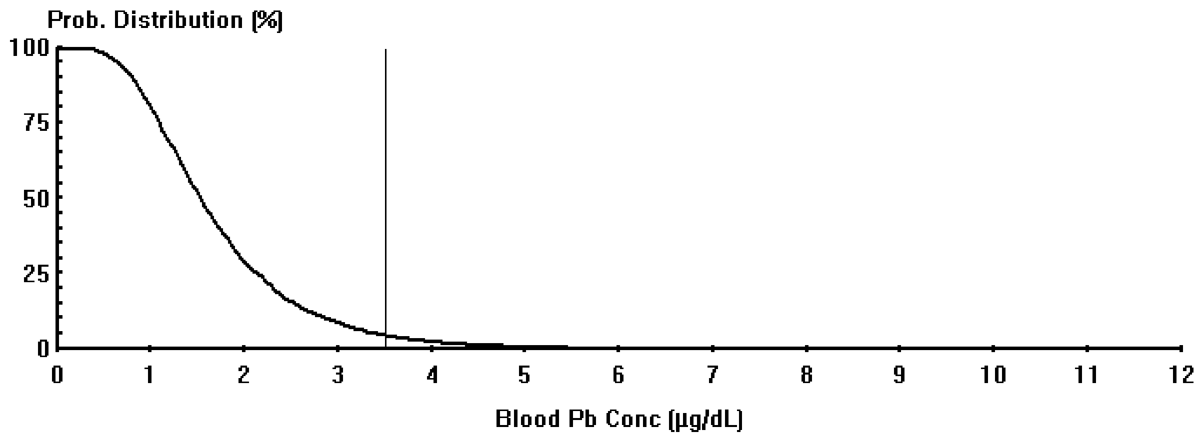
Abbreviations: CTE = central tendency exposure (typical); mg/kg/day = milligram chemical per kilogram body weight per day; mg/kg = milligram chemical per kilogram soil; RME = reasonable maximum exposure (higher); yrs = years

* The calculations in this table were generated using ATSDR's PHAST v2.2.1.0 and the exposure factors in Table C1. The concentration of 0.11 mg/kg and cancer risks were calculated using the cancer slope factor of 1.7 $(mg/kg/day)^{-1}$ and age-dependent adjustment factors.

Appendix G. Lead Modeling Results

Childs resident, IEUBK: exposure to average soil above 92 ppm is estimated to result in the fetus of an exposed pregnant adult in a non-residential setting having a 95% chance of BLL at or above 3.5 µg/dL





Cutoff = 3.500 µg/dl
Geo Mean = 1.613
GSD = 1.600
% Above = 4.960

Age Range = 12 to 72 months

Run Mode = Research

Fetus of pregnant adult, ALM: exposure to average soil above 607 ppm is estimated to result in the fetus of an exposed pregnant adult having a 95% chance of BLL at or above 3.5 µg/dL

Calculations of Blood Lead Concentrations (PbBs) and Risk in Nonresidential Areas
U.S. EPA Technical Review Workgroup for Lead.
Version date 06/14/2017

Variable	Description of Variable	Units	GSDi and PbBo from Analysis of NHANES 2009-2014
PbS	Soil lead concentration	µg/g or ppm	607
$R_{fetal/maternal}$	Fetal/maternal PbB ratio	--	0.9
BKSF	Biokinetic Slope Factor	µg/dL per µg/day	0.4
GSD_i	Geometric standard deviation PbB	--	1.8
PbB_0	Baseline PbB	µg/dL	0.6
IR_S	Soil ingestion rate (including soil-derived indoor dust)	g/day	0.050
IR_{S+D}	Total ingestion rate of outdoor soil and indoor dust	g/day	--
W_S	Weighting factor; fraction of IR_{S+D} ingested as outdoor soil	--	--
K_{SD}	Mass fraction of soil in dust	--	--
$AF_{S,\ D}$	Absorption fraction (same for soil and dust)	--	0.12
$EF_{S,\ D}$	Exposure frequency (same for soil and dust)	days/yr	219
$AT_{S,\ D}$	Averaging time (same for soil and dust)	days/yr	365
PbB_{adult}	PbB of adult worker, geometric mean	µg/dL	1.5
$PbB_{fetal,\ 0.95}$	95th percentile PbB among fetuses of adult workers	µg/dL	3.5
PbB_t	Target PbB level of concern (e.g., 2-8 ug/dL)	µg/dL	**3.5**
$P(PbB_{fetal} > PbB_t)$	**Probability that fetal PbB exceeds target PbB, assuming lognormal distribution**	**%**	**4.9%**

ALM nonpregnant adult: exposure to average soil above 1146 ppm is estimated to result in a nonpregnant adult in a non-residential setting having a 95% chance of BLL at or above 5 µg/dL (estimated from a geo mean of 2.3 µg/dL)

Calculations of Blood Lead Concentrations (PbBs) and Risk in Nonresidential Areas U.S. EPA Technical Review Workgroup for Lead.
Version date 06/14/2017

Variable	Description of Variable	Units	GSDi and PbBo from Analysis of NHANES 2009-2014
PbS	Soil lead concentration	µg/g or ppm	1146
$R_{fetal/maternal}$	Fetal/maternal PbB ratio	--	0.9
BKSF	Biokinetic Slope Factor	µg/dL per µg/day	0.4
GSD_i	Geometric standard deviation PbB	--	1.8
PbB_0	Baseline PbB	µg/dL	0.6
IR_S	Soil ingestion rate (including soil-derived indoor dust)	g/day	0.050
IR_{S+D}	Total ingestion rate of outdoor soil and indoor dust	g/day	--
W_S	Weighting factor; fraction of IR_{S+D} ingested as outdoor soil	--	--
K_{SD}	Mass fraction of soil in dust	--	--
$AF_{S,\ D}$	Absorption fraction (same for soil and dust)	--	0.12
$EF_{S,\ D}$	Exposure frequency (same for soil and dust)	days/yr	219
$AT_{S,\ D}$	Averaging time (same for soil and dust)	days/yr	365
PbB_{adult}	PbB of adult worker, geometric mean	µg/dL	2.1
$PbB_{fetal,\ 0.95}$	95th percentile PbB among fetuses of adult workers	µg/dL	5.0
PbB_t	Target PbB level of concern (e.g., 2-8 ug/dL)	µg/dL	**5.0**
$P(PbB_{fetal} > PbB_t)$	**Probability that fetal PbB exceeds target PbB, assuming lognormal distribution**	**%**	**6.2%**

Text Description for Equations and Figures

Equation for calculating a groundwater screening concentration

The air comparison value measured in micrograms per cubic meter multiplied by a unit conversion factor of zero point zero zero one cubic meters per liter divided by Henry's law constant multiplied by the EPA's screening attenuation factor equals the screening value measured in micrograms per liter, or nineteen-thousand multiplied by zero point zero zero one divided by one point four e to the negative three multiplied by zero point zero zero one equals thirteen-million five-hundred seventy-one thousand four-hundred twenty-nine micrograms per liter.

Surface Water Ingestion Exposure Dose Equation

Noncancer dose equals concentration times intake rate times event duration times event frequency times noncancer exposure factor divided by body weight.

Surface Water Dermal Absorbed Dose Equation

Noncancer administered dermal dose equals absorbed dose per event times skin surface area times event frequency times noncancer exposure factor divided by body weight times GI absorption factor.

Soil Administered Dermal Dose Equation

Noncancer administered dermal dose equals concentration times noncancer exposure factor times conversion factor times adherence factor times dermal absorption fraction times skin surface area divided by body weight times GI absorption factor.

Cancer Risk Equations

Cancer risk is equal to the noncancer dose multiplied by the cancer slope factor multiplied by the exposure duration divided by the lifetime.

Appendix G. Lead Modeling Results

Screenshot of IEUBK model output showing a graph of the probability distribution for blood lead concentrations measured in micrograms per deciliter with a line indicating CDC's blood lead reference value at 3.5 micrograms per deciliter.