Health Consultation

PETITION SITE

FORMER CAMP SIBERT

ETOWAH and ST. CLAIR COUNTIES, ALABAMA

OCTOBER 31, 2007

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service
Agency for Toxic Substances and Disease Registry
Division of Health Assessment and Consultation
Atlanta, Georgia 30333

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.

You May Contact ATSDR TOLL FREE at
1-800-CDC-INFO
or
Visit our Home Page at: http://www.atsdr.cdc.gov

HEALTH CONSULTATION

PETITION SITE

FORMER CAMP SIBERT

ETOWAH and ST. CLAIR COUNTIES, ALABAMA

Prepared By:

Site and Radiological Assessment Branch
Division of Health Assessment and Consultation
Agency for Toxic Substances and Disease Registry

Table of Contents

Statement of Issues

The Agency for Toxic Substances and Disease Registry (ATSDR) prepared this health consultation in response to a request by local citizens, to evaluate potential community exposures to contaminants that may have been released from the former Department of Defense facility, Camp Sibert in Etowah and St. Clair Counties, Alabama. Local citizens are concerned that chemical warfare materiel (CWM), conventional ordnance, or chemical contamination residues may be currently affecting their health.

Camp Sibert is a former Army base used from 1942 to 1945 for training in the use of CWM and conventional weapons. In 1948, the land was turned over to the local government. The property today is comprised of private and local government-owned land used for farming, grazing land, residential, commercial, and light industrial purposes.

Past operations at Camp Sibert include the use of CWM, conventional explosive munitions, and hazardous chemicals that may have been buried or left in place. Some decontamination efforts were conducted prior to property transfer in 1948. The U.S. Army Corps of Engineers (USACE) is currently performing environmental investigations to characterize use and disposal areas and evaluated potentially contaminated areas.

Summary of Findings

ATSDR identified potential exposure situations most likely to occur from materiel associated with the former Camp Sibert.

Adults and children could come in contact with conventional explosives or CWM hazards encountered during ground-disturbing activities.

ATSDR categories the former Camp Sibert as a current and future public health hazard because conventional munitions, explosives, or CWM hazards are likely present on privately owned residential and commercial properties close to the ground surface where ground disturbance could cause detonation resulting in significant harm.

Adults and children could come in contact with residual CWM or hazardous chemicals by drinking potentially contaminated water from their private drinking water wells.

Past investigations detected trichloroethylene (TCE) in samples from a private well, groundwater, and soil located near Site 2A. Although the details of earlier private well sampling is not available, it is possible that the residents could be drinking contaminated water. USACE is currently investigating private well contamination.

Adults and children could come in contact with residual CWM or hazardous chemicals by direct contact with contaminated soil.

Residual explosive compounds, VOCs, inorganic compounds, and chlorine used during decontamination may be detectable in soil. Contaminants in soil occur in concentrated areas and are not widespread. Although environmental investigations continue, soil contaminant levels detected to date do not appear to be high enough to cause harmful health effects in people who might directly contact residual contaminants in soil.

Background

Site Description and History

Camp Sibert occupied approximately 37,035 acres in Etowah and St. Clair Counties in the Canoe Creek Valley of northeastern Alabama. The former Camp Sibert lies in a tract of land approximately 14 miles long by 5.5 miles wide, between Chandler Mountain and Red Mountain to the northwest, and Canoe Creek, Hopewell Mountain, and Dunaway Mountain to the southeast. Interstate 59 (I-59) runs through the former Camp Sibert, and U.S. Highway 411 (US411) parallels the former camp to the southeast. Neighboring cities include Gadsden to the northeast, Attalla to the north, Rainbow City to the east, and Steele to the west. Presently, the site is mostly rural comprised of forests and open pastures.

In 1942, Camp Sibert began operating as the Replacement Training Center (RTC) for the Army Chemical Warfare Service. The RTC moved from Edgewood, Maryland to Camp Sibert in the summer. In the fall of 1942, the Unit Training Center (UTC) was added as a second command. Camp Sibert was operational from 1942 through 1945.

Groups of soldiers received basic military training and specialized training in the use of chemical weapons, including the use of live mustard, Lewisite, phosgene, and other chemical agents, decontamination procedures, and smoke operations. This facility provided the opportunity for live agent, large scale training that was previously unavailable (Parsons 2005).

Basic military training at firing ranges included use of conventional weapons of various types including the use of grenade launchers (M1), portable flame throwers, Thompson sub-machine guns (.45 caliber), carbines (.30 caliber), pistols (.45 caliber), fragmentation and white phosphorous grenades, Browning automatic rifles, 4.2 inch white phosphorous mortars, 4.2 inch high explosive mortar rounds, machine gun, both rifle and hand grenade, artillery, bazookas, and anti-aircraft weapons.

After World War II ended, several cleanup operations were conducted by the Army including decontamination of various chemical and artillery ranges. However, little historical documentation has been found that details the decontamination efforts (Parsons 2005).

In 1948, the land was declared excess and transferred back to local government ownership. Since 1949, most of the property has been privately owned and either farmed or left as woodlands. The former post airfield is now the Northeast Alabama Regional Airport and the city of Gadsden has

expanded into the local area of the airport. The barracks area was developed into single-family housing and several industrial facilities are in operation in the former Camp Sibert industrial area. The former maneuver and training areas, which comprise the majority of the land area, are now used for residences, grazing, forestry, and agriculture.

Demographics

The majority of the former Camp Sibert is undeveloped and sparsely populated. Although the number of residents living in the area is low, additional residential, commercial, and industrial development in the near future is anticipated. In developed areas, the predominant land use is agricultural. The major agricultural activities include cattle grazing. A large portion of the site is forested; however, there are no known forestry operations.

The former Camp Sibert occupied land in Etowah and St. Clair Counties in northeastern Alabama. Etowah County comprises 535 square miles and in 2003 had a population of 103,119. Gadsden, with a population of 38,978, is the largest city within Etowah County (Gadsden IDA 2002). Approximately 83% of residents in Etowah County are Caucasian (US Census Bureau 2002). The median age of residents is 39 years of age.

St. Clair County encompasses 634 square miles with a population of 66,402. Approximately 90% of residents in St. Clair County are Caucasian (US Census Bureau 2002). St. Clair County became the sixth fastest growing county in Alabama during 1990 and 2000 having approximately 30% growth. The median age of residents is 37 years of age.

Investigations

The former Camp Sibert is considered to be a formerly used defense site and is currently under environmental investigation by the USACE. Archival searches, interviews with former Camp Sibert personnel or those stationed at Camp Sibert, and historical aerial photographic reviews have been conducted. In 1993, the USACE began conducting archive searches. In 1995, Phase I and II Site Characterizations began, which included only geophysical surveys, no intrusive (below ground surface) or environmental sampling was done. In 1997, additional archive searches and reviews were conducted by the USACE. In 2000, as part of the CWM Engineering Evaluation and Cost Analysis (EE/CA) investigation, the USACE conducted geophysical surveys, trench and pit excavations, air monitoring, soil sampling and analysis, and excavation of irregularities suggesting metal items, referred to as “anomalies”. The Final Phase I CWM EE/CA was released in June 2005. Final Phase II CWM EE/CA was released in May 2006. USACE continues to investigate the former Camp Sibert.

Based on previous site studies, archive searches, and interviews, a total of thirteen locations (sites) within the former Camp property are suspect for the disposal of chemical warfare materiel. Current investigations include the thirteen suspected CWM sites, conventional sites or ranges, and conventional training areas. In addition, several areas have been selected for further investigation because of ground scars or ground disturbances seen by aerial photography as potentially of interest. Listed below are the 13 suspected CWM sites and the CWM EE/CA reports that detail the investigations.

Site 2A (Chemical Munitions Burial Site - Tract C230) - Phase I, II CWM EE/CA
Site 2B & Alternate 2B (Chemical Land Mine Training Area - Tract C230) - Phase I CWM EE/CA
Site 3 (Former Toxic Gas Yard and Burial Site -Tract D340) Access Denied by Owner
Site 4 (Toxic Gas Yard) Access Denied by Owner
Site 6 (Chemical Filling Area, DA-5) - Phase II CWM EE/CA
Site 8 (Toxic Munitions Impact Area) - Phase I CWM EE/CA
Site 9 (4.2" Mortar Range) - Phase I CWM EE/CA
Site 11 & 11A (Possible Munitions Burial Area) - Phase II CWM EE/CA
Site 12 (Smoke Generator and Possible Munitions Burial Area) Access Denied by Owner
Site 13 (Possible Contaminated Equipment Burial Site) - Phase I CWM EE/CA
Site 14 (Possible Munitions Burial Area) - Phase I CWM EE/CA
Site 15 (Possible Munitions Burial Area) - Phase II CWM EE/CA
Site 16 (Air Operations Filling Area) - Phase II CWM EE/CA

Findings from EE/CA Investigations

Five sites (Sites 2B/Alt 2B, 8, 9, 13, and 14) investigated as part of the Phase I CWM EE/CA were initially thought by USACE to present low likelihood for CWM. Sites that potentially had a greater hazard were investigated as part of the Phase II CWM EE/CA. Phase II sites included Sites 2A, 6, 11/11A, 15, and 16. Sites 3, 4, and 12 could not be investigated because the USACE was not granted access by land owners.

The USACE conducted geophysical surveys, single anomaly excavations, trench and pit excavations, air monitoring, and soil sampling and analysis at the sites beginning in 2000 (Table 2). Sites 2A, 2B, and 8 are discussed below in greater detail because of the potential hazards identified during the EE/CA investigations. No evidence of CWM was encountered and no residual chemical warfare agent was detected at Sites 6, 11/11A, 13, 14, 15, and 16.

Site 2A

Site 2A, Chemical Munitions Burial Site, Tract C230 was used for chemical agent decontamination training and is known to contain buried training materials in three separate pits. Contents of the pits were excavated during a 1948 decontamination effort by the Army and were treated by burning, hydrolysis in water, decontaminated with chloride of lime, or a combination of these. The pits were reported to contain debris as well as intact or partially intact drums, mortar rounds, and portable containers containing mustard, Lewisite, and tear gas. Contents included drums of partly decomposed mustard, drums containing Lewiste, and twenty-six 4.2-

inch mortar rounds containing tear gas. The Army recommended this area be restricted to grazing only, but when the property was transferred to private ownership, this restriction was not conveyed. The 1993 Archives Search Report conducted by the Army concluded that the possibility of other burial sites could exist within Site 2A. The Phase II EE/CA states that future development within the Site 2A property will increase the likelihood for human exposure to chemical agent contaminated media.

In the 1990 initial assessment, trichloroethylene (TCE) was detected in a private well located approximately 600 feet from the burial pits near Site 2A. TCE concentrations exceeded the State of Alabama groundwater standards at the time. Drinking water standards were not yet in place. The groundwater samples did not detect organosulfur compounds or thiodiglycol (mustard breakdown products). Soil samples near the same area contained arsenic, chromium, lead, and chlorinated solvents (Parsons 2005). It is not clear if this well was used as a primary drinking water source or if any additional action was taken regarding this well.

Further investigation of Site 2A in 1996 also identified TCE and various metals in soil and in groundwater samples above EPA's maximum contaminant level for drinking water.

Site 2B & Alternate 2B

Site 2B, Chemical Land Mine Training Area, was formerly used as the chemical land mine training area where chemical land mines were filled and detonated. The Army's investigations focused on those areas most likely used for mustard-filled land mine training and included geophysical surveys, air monitoring, and soil sampling. Site 2B/Alt 2B investigations found barbed wire, nails, horseshoes, and rusted metal slag from expended incendiary grenades. Additionally, metal rings consistent with 20-gallon drums that contained the chemical warfare decontaminant Super Topical Bleach (STB) was also found. In the soil, chlorine at levels 10 times greater than background was detected indicating decontamination efforts. The chemical agent and agent breakdown products sampling results did not detect the presence of residual chemical agents or associated chemical agent breakdown products. There are residents currently living within the boundary of Site 2B/Alt 2B. Additionally, the area is used as open pasture and is partially wooded. Based on the results of the investigations and current and near future use, human exposure to chemical agents is possible.

Site 8

At Site 8, Toxic Munitions Impact Area, an initial geophysical mapping survey was conducted on approximately 5.6 acres. To date, approximately 8,500 anomalies have been investigated, and approximately 20,000 pounds of mortar scrap and 18 intact, liquid-filled 4.2-inch mortars some containing the choking agent phosgene have been discovered. These mortars have been packaged and are stored in an interim holding facility pending final assessment and disposition.

Finding of the first liquid filled 4.2 inch mortar led to a temporary suspension of the intrusive activities. The mortar round was destroyed onsite using the Explosive Destruction System, which contains and filters all material. All residual material was drummed and transported offsite for thermal treatment as required by Army regulations. A removal action has been underway at Site 8 since April of 2006.

Since 1946, primary land use in Site 8 has been undeveloped woodland. In 1996-1997, approximately 140 acres in the central part of the site were clear-cut and converted to pasture land for cattle grazing. Site 8 also contains two residences, a barn, and some miscellaneous outbuildings. According to the USACE Phase II Report, the likelihood for human exposure to CWM at Site 8 is considered to be moderate because of the limited number of inhabitants and current passive land use activities. However, the potential for near-future development to the north by the Town of Steele and to the south will increase the likelihood for human exposure to CWM.

Other Sites

No evidence of CWM was encountered or residual chemical warfare agent was detected at Sites 6, 11/11A, 13, 14, 15, and 16. Three sites have not been fully investigated. Site 3, (Former Toxic Gas Yard and Burial Site - Tract D340) was not completely investigated because right of entry documentation was denied by one of the property owners. Site 4, Toxic Gas Yard was partially investigated because the right of entry was retracted during the intrusive investigation. Site 12, Smoke Generator and Possible Munitions Burial Area, was not investigated because right of entry was denied for the entire site.

Table 1 – Suspected Chemical Warfare Materiel Sites Investigated during EE/CA Phase I and II.

Sibert Site Designation Name and Location	Potential Chemicals	Current Use and People Potentially Impacted	Hazard Potential	ATSDR Recommendation
Site 2A (Chemical Munitions Burial Site - Tract C230) used for chemical agent decontamination training and burial site for training material and equipment. It contained a mustard agent soak pit, agent storage, and supply building. Located west of Perman Lake Road - Tract C230, Etowah County –12 acres.	Sulfur mustard (H, HS, HD), nitrogen mustard (HN-1 and HN3), chlorine (used as decontaminant). Sampled soil for chlorine, arsenic, the mustards, Lewisite (L), 1,4-dithiane, and 1,4 thioxane. Based on the EE/CA, no ordnance was encountered. During the investigation of one area at Site 2A, trace levels of mustard was detected on air monitoring equipment in one soil sample. Additional sampling in the area did not confirm the original detections. An investigation conducted prior to the EE/CA detected TCE in a residential well and TCE and metals in soil.	Privately owned, residence and open pasture area. Area to the west is partially wooded. Area to the east is open pasture. Ownership recently changed. Two new homes recently built. Future land use unknown, but possibly developed for additional residential use. Limited number of homes bordering the area along Perman Lake Road. Army reports state increasing development increases the likelihood of human exposure to contaminants.	Potential for chemical agent contaminated media, particularly in the disposal pit areas is very likely. New owners unaware of the potential hazard have a greater risk of encountering contaminants. Development of the property further increases the likelihood of exposure. Exposure to TCE and other compounds in drinking water may have occurred in the past and may still be occurring.	Previous Army recommendations for land use was for grazing only in tract C230 due to disposal practices (USACE1993). But when the property was transferred in 1948, the recommendation was never established or enforced. ATSDR recommends new and future owner notification. Additionally, due to previous detection of TCE in a residential well and metals detections in soil, ATSDR recommends USACE further sample this residential drinking water for VOCs, SVOCs, CWM degradation and decontamination chemicals and inorganic compounds (metals). Vapor intrusion and indoor air sampling should be considered if groundwater levels of VOC are elevated.
Site 2B/Alt 2B (Chemical Land Mine Training Area - Tract C230) Located in central Former Camp Sibert between Steele Station Road and Perman Lake Road (exact location uncertain). Used as area in which chemical land mines were filled, detonated, and possibly buried. Etowah County – 5 acres.	Sulfur mustard (H, HS, HD), nitrogen mustard (HN-1 and HN3), chlorine (used as decontaminant). Sampled soil for chlorine, mustards, 1,4-dithiane, and 1,4 thioxane. Based on the EE/CA, no ordnance or CWM was encountered. Elevated chlorine levels were detected suggesting decontamination.	Privately owned. Area to the west is partially wooded. Area to the east is open pasture. One resident is currently living within the site. Limited number of homes bordering the area along Perman Lake Road.	Area used mustard or CWM, soil samples indicate CWM decontamination using chloride chemical appears successful. Likely exposure to residual CWM or chloride is very low.	ATSDR recommends new and future owner notification including notification in permits and deeds.

Sibert Site Designation Name and Location	Potential Chemicals	Current Use and People Potentially Impacted	Hazard Potential	ATSDR Recommendation
Site 3 (Former Toxic Gas Yard and Burial Site -Tract D340) Located in central former Camp Sibert. Entire site covered approximately 640 acres. Training area encompasses portions of Tract D340 -36 acres including the 22-acre training area.	Sulfur mustard (H, HS, HD), nitrogen mustard (HN-1 and HN3), chlorine (used as decontaminant). Areas of focus were the western portion of Tract D340 and the area immediately west of Tract D340. Property west of Tract D340 was not investigated because the land owner denied right-of-entry to property. No chemical agent or agent breakdown products (ABPs) were detected in the soil samples. However, the USACE considers Site 3 characterization incomplete.	Privately owned. Access for investigation denied. In the 1940s the Army recommended that Tract D340 be used for surface cultivation only and that no wells be drilled. During the 1993 Archive Search and site visit, the survey team identified a large residence adjacent to Tract D340.	Although no CWM was recovered during the Phase II EE/CA investigation of the area investigated, the characterization of Site 3 is not complete. Therefore, the possibility exists for chemical agent or ABPs to remain at the site.	ATSDR recommends new and future owner notification.
Site 4 (Toxic Gas Yard) Located west of Pineview Circle and north of Steele Station Road, in the north-central portion of the former Camp Sibert 4.5 acres.	Sulfur mustard (H, HS, HD), nitrogen mustard (HN-1 and HN3), chlorine (used as decontaminant), and chlorine (used as decontaminant). Industrial chemicals stored at the site may have included FS, FM, CNB, CG, and DM. No chemical agent or ABPs were detected in the four soil samples collected at Site 4.	Privately owned. Partially investigated until property owner retracted right of entry.	Since the investigation at Site 4 was not completed, the possibility exists for chemical agent or degradation products to remain at the site. There is one residence within the site and a limited number of residential dwellings within ½ mile. The future land use is expected to remain residential.	ATSDR recommends new and future owner notification.
Site 6 (Chemical Filling Area Demonstration Area-5) Located northwest of the Northeast Alabama Regional Airport - 4 acres.	FS filling. One-ton containers and 55 gallon drums of FS, CNB, and possibly HD. Results of intrusive sampling found non-CWM scrap; thus, no soil samples were collected. Air monitoring did not detect any chemicals.	There are no residences within the site. There are a few homes just outside the area on the northern, southern, and western boundary. Future development is expected to be residential.	Presence of CWM is a remote possibility. Historical reports do not indicate the use of hazardous substances or explosives at this site. Therefore, they were investigated in the EE/CA.	None.
Site 8 (Toxic Munitions Impact Area) Located south within the former Camp Sibert between Little Canoe Creek to the northeast, Old Mockingbird Road to the southwest. Impact area for 4.2-inch mortar rounds filled with various chemicals. 375 acres, St. Clair County	Sulfur mustard (H, HS, HD), nitrogen mustard (HN-1 and HN3), chlorine (used as decontaminant), Phosgene (CG), Lewisite (L), Tearing Agent (CNB, CNS), White Phosphorus (WP, PWP), Fuming Sulfuric Acid (FS), and High Explosives (HE).	The northern 48 acres, consisting of dense pine and hardwood growth, are owned by the Town of Steele Industrial Development Board which has near-term plans for industrial development in that area. Since 2000, development by Town of Steele includes an auto parts manufacturing plant, three wastewater treatment ponds, and a cell phone tower assembly plant. Central 140 acres are privately owned and used for raising cattle. Includes two homes, barn, and farm equipment. Remaining area is under individual private ownership. Some grow timber with some recent clear cutting used as pasture.	Phosgene round found in 2002. Removal action that began in April of 2006 has recovered 18 intact rounds. Samples collected of soil and soil gas of those areas. Hazard potential is moderate at this time.	ATSDR recommends informing current and future owners, developers, and builders including notification in permits and deeds. ATSDR concurs with continued education for local first responders and medical staff.

Sibert Site Designation Name and Location	Potential Chemicals	Current Use and People Potentially Impacted	Hazard Potential	ATSDR Recommendation
Site 9 (4.2" Mortar Range) Located approximately 600 feet east of the intersection of Pleasant Valley Road and Steele Station Roads. The suspected site is approximately 15-20 acres.	Based on the EE/CA investigation, no CWM or high explosives were found at this site. Determined to be mini-mortar practice range.	Located in a sparsely populated rural area. Currently used mostly for grazing cattle.	No CWM detected in soil, soil gas, or air.	ATSDR recommends informing current and future owners, developers, and builders including notification in permits and deeds.
Site 11/11A (Possible Munitions Burial Area) North of the intersection of Pleasant Valley Rd and Steele Station Road in the central portion of the former Camp Sibert. 35-50 acres.	Possible munitions and HD drum burial area based on an interview with a former Military Policeman stationed at Camp Sibert. Air monitoring was conducted and briefly indicated the presence of VOCs during the investigation of one of the anomalies. Further air monitoring was negative for VOCs and a soil sample collected from the same are was non-detect for chemical agent and ABPs. The presence of hazardous substances and explosives was not investigated.	The area is currently used as a natural gas compressor station and a private residence.	Only non-CWM scrap (wire, welding rods, barbed wire, etc.) was encountered during the intrusive investigation. Analysis of the soil found no chemical agent or ABPs. The future land use in this area is expected to remain largely undeveloped and sparsely populated	ATSDR recommends informing current and future owners, developers, and builders including notification in permits and deeds.
Site 12 (Smoke Generator and Possible Munitions Burial Area) Located within the central portion of the former Camp Sibert, along Steele Station Road, adjacent to Site 16. Used as a training area for smoke generation. 10 acres.	Interviewee reported disposal of 37-and 55-gallon drums of HD and mortar-like munitions in ditches 10 to 12 feet long and 12 to 18 inches deep. Access denied by property owner.	A barn is currently located over the suspected burial area.	Since investigations were not conducted, the possibility exists for CWM, chemical agent, or breakdown products to remain at the site.	ATSDR recommends informing current and future owners, developers, and builders including notification in permits and deeds.
Site 13 (Possible Contaminated Equipment Burial Site). Two locations Included: 13A and 13B. Approximately 20 to 30 acres on the south side of Steele Station Road, half a block from Highway 77 (Grand Avenue) and Sutton Bridge Road.	Sampled soil in 4 trenches for HD, L, HN1, HN3, 1,4-dithiane, and 1,4 thioxane. Based on EE/CA, no ordnance-related debris or CWM was encountered.	Contains a residence and a business. Future commercial development is imminent as Rainbow City and the city of Attalla grow.	Further development of this area is likely. No evidence of hazard from investigation. Current hazard is low.	ATSDR recommends general information to local community members.

Sibert Site Designation Name and Location	Potential Chemicals	Current Use and People Potentially Impacted	Hazard Potential	ATSDR Recommendation
Site 14 (Possible Munitions Burial Area) Located just east of the former Gate 2 in the northern corner of Sibert. Behind a large white building that may have been the Post Salvage Facility. North of the former cantonment area and adjacent to the Alabama Great Southern Railroad. Approximately 5 acres.	Suspected munitions mixed with debris as reported in interviews. Trash and debris was found during excavation. Sampled soil trenches for HD, L, HN1, HN3, 1,4-dithiane, and 1,4 thioxane. Based on EE/CA, no ordnance-related debris or CWM was encountered.	Currently 2 homes on the site and many homes within ½ mile. Also used for cattle grazing. Future commercial development is imminent as Rainbow City and the city of Attalla grow.	Areas likely to remain light residential and cattle grazing. No evidence of hazard from investigation. Current hazard is low.	ATSDR recommends general information to local community members.
Site 15 (Possible Munitions Burial Area) 45 acres out of 250 possible acres of this site. This site was mentioned by a number of interviewees in the Archival Search Report who placed one or more disposal areas somewhat in the same general vicinity. Located near I-59, Old Pump Station Road (possibly Dumping Station Road), and I-759. The exact location of the burial site could not be determined based on the interviews.	The exact location is not known. Suspected burial site for the disposal of materials such as boots, dishes, trash, and possibly trucks loaded with HD. No CWM or chemical agent contamination was located during the intrusive investigation; however, MEC-related debris encountered in Test Pit #9 included the expended body of a practice 2.36-inch rocket and two flamethrower igniters.	Analysis of the soil samples collected at Site 15 found no evidence of chemical agent or ABPs. There are no homes within the site. I-59 and I-759 border the site on the east and north, respectively. Numerous vehicles use the roadways. ALDOT is planning to extend I-759 to U.S. Highway 431 which will encounter this area.	The presence and extent of hazardous substances was not investigated during this phase, but will be further evaluated under the Phase III Conventional Munitions EE/CA with respect to the ordnance related scrap found at the site. No CWM was detected.	ATSDR recommends general information to local community members.
Site 16 (Air Operations Filling Area) Site 16 is an 11-acre area located at the intersection of Steele Station Road and Perlman Lake Road (see Figure 2.2). Site 16 was used for filling airplane spray tanks with chemical agent.	Based on the activities conducted at Site 16, it was believed that excess chemical agent may have been disposed of at the site following the completion of operations. There was no detection of chemical agent or ABPs in any of the soil samples collected at Site 16.	The pull ring from a grenade was found but no grenades or grenade fragments were encountered. During the excavation of Anomaly 16-GA-A, discolored soil was encountered and a composite soil sample was collected. No CWM or chemical agent was encountered during the intrusive investigation of Site 16.	There are no residents currently living within the boundary of Site 16; however, there are a limited number of residential dwellings just outside of the area. Site 16 is currently used as croplands for growing hay. The future land use in this area is expected to remain largely undeveloped and sparsely populated.	ATSDR recommends general information to local community members.

Discussion

Conventional Explosives and CWM Hazards

Several intact mortar rounds have been found at shallow depths between 3 and 14 inches below ground surface. One containing phosgene was found in 2002 by the USACE. Additional rounds have been found during the removal action at Site 8. In 2006, after a USACE sponsored public meeting, two intact rounds were turned over to officials by a citizen who found the items on his property. The citizen kept the live rounds in his garage for nearly 20 years. Some areas likely containing CWM have not been investigated because property owners have not granted the USACE access. These privately-owned sites pose a potential hazard for the current home/property owner and also future owners who are unaware of the hazard potential. Land use restrictions issued by the Army in the 1940s for some parcels to remain as grazing land was either never established or was established and not enforced when the property was transferred to private ownership (Parson 2006).

During archival searches, the USACE found a report of a citizen detonating a live mortar round from Camp Sibert. In 1948, the driver and two passengers of a pickup truck were exposed by an accidental detonation. Their symptoms were consistent with blistering agent “burns”. From past reports and newspaper articles, it appears that contact with conventional munitions, explosives or CWM hazards encountered during ground-disturbing activities are an infrequent occurrence. Although there are no additional reports or evidence that people have detonated CWM or conventional explosives, future land use and development would increase the likelihood that someone could contact hazards from the former Camp Sibert. Detonation of World War II era CWM and munitions is possible and has occurred in other areas of the U.S. Farmers in Europe continue to encounter World War I era CWM in their fields.

Lead by the USACE, environmental investigations have increased the knowledge about areas where hazards may exist. USACE removal actions have decreased the number of CWM that remain. However, despite the tremendous effort, the current scientific investigation methods section land area into grids with each grid containing 100 feet by 100 feet area. Only a small percent of the grids for each area were fully investigated. Safety assurances cannot be made even for the small percent of grids that were fully investigated. Land within grids that did not receive ground penetrating radar or intrusive sampling may still contain CWM or explosive munitions. Heavily wooded areas were not substantially disturbed for investigations. Additionally, some areas suspected of containing potential CWM were not investigated because private land owners denied investigators access.

Future development of former Camp Sibert property for residential, commercial, and industrial uses including ground disturbing activities increases the opportunity for human contact with potential CWM and explosives that may remain just below ground surface. Disturbing soil during land clearing operations and land development could unearth once buried chemical or explosive munitions creating an immediate or future chemical or physical hazard to the machine operators, or people laying pipe or underground utilities, others nearby, and even future land users. Community awareness including training of local emergency personnel (first responders) and property deed notification would reduce the potential for people to contact CWM and explosive hazards that may remain from former Camp Sibert activities.

Residual CWM or Hazardous Chemicals in Private Drinking Water Wells

Samples collected during the 1990 initial assessment by Environmental Science & Engineering found TCE in a residential well located approximately 600 feet from Site 2A burial pits showed concentrations of trichloroethylene at levels that exceeded the State of Alabama groundwater standards. Additional samples collected from other Site 2A areas found TCE and inorganic compounds in groundwater and soil. Although details of the private well sampling are not available, it is possible that the well was used as a residential drinking water source. In 1996, further investigation detected TCE and various metals in soil and in groundwater samples above the U.S. Environmental Protection Agency's Maximum Contaminant Level for drinking water. USACE is continuing to investigate soil and groundwater contamination from former Camp Sibert activities. Samples from private drinking water wells should be included in the current investigation to determine if contaminants released from former Camp Sibert activities have potentially impacted drinking water wells.

Direct Contact with Residual CWM or Hazardous Chemicals in Soil

After 60 years, it is unlikely that chemical agents released from CWM during training exercises during the 1940s would be present in the soil today. Blistering agents are highly reactive upon contact with water or moisture in soil, air, or water. USACE continues to investigate soil, surface water, and groundwater for hazardous chemicals used at Camp Sibert. Sampling results thus far have not detected contaminants in soil detected to date in sufficient amounts to result in adverse health effects.

Mustard Agents

Mustard Agent is also known as sulfur mustard or mustard gas. There are several different chemicals included with the sulfur mustard agents. The military designations include the sulfur mustard (H, HS), distilled mustard (HD), and a mustard blend (HT). Agent H is the chemical bis (2-chloroethyl) sulfide, which contains 20-30% impurities. Agent HD is H that has been purified by washing and vacuum distillation to reduce sulfur impurities (Chemical Abstract Service Registry No. 505-60-2). Agent HT is a blend of 60% HD and 40% Agent T which allows for a lower freezing point and lower volatility.

Nitrogen mustard agents have military designations Nitrogen Mustard 1 (HN-1), Nitrogen Mustard 2 (HN-2), and Nitrogen Mustard 3 (HN-3). HN-1 was the first compound of the HN series developed in the late 1920s. It was designed as a pharmaceutical (to remove warts) and became a military agent. HN-2 was designed as a military agent and became a pharmaceutical used to treat cancer. HN-3 was designed solely as a military agent. These agents are more immediately toxic than the sulfur mustards. However, because of their similar effects, the sulfur mustard and nitrogen mustard discussions are combined below.

Mustard liquid is colorless when pure, but it is normally a yellow to brown oily substance. Mustard agent vapor is colorless with a slight garlic- or mustard-like odor. HN-1 has a faint fishy or musty odor. The mustard agents are only slightly soluble in water. Mustard agents are stable at ambient temperatures and can be active for more than three years in soil. When exposed to the air, mustard agents are stable for weeks under normal atmospheric temperature. Mustard agents hydrolyze in water to form HCl and thiodiglycol (USACHPPM 1999). Mustard agent vapors are heavier than air and settle in low lying areas.

The primary routes of human exposure to sulfur mustards are inhalation and dermal contact. Mustard Agents are vesicants or blistering agents because they cause blistering of the skin and mucous membranes and damage to the respiratory airway. Exposure to sulfur mustard is usually not fatal. The rate of detoxification of mustard agents in the body is very slow and repeated exposures produce a cumulative effect (USACHPPM 1999). People may not know right away that they have been exposed, because sulfur mustard often has a smell that might not cause alarm. Typically, signs and symptoms do not occur immediately. Depending on the severity of the exposure, symptoms may not occur for 2 to 24 hours. Some people are more sensitive to mustard than are other people, and may have symptoms sooner. Exposure is particularly harmful around sweaty parts of the body. It is also more harmful to the skin on hot, humid days, or in tropical climates.

Mustard agents can have the following effects on specific parts of the body that contact the liquid mustard agent directly or by breathing the vapor: Showing these signs and symptoms does not necessarily mean that a person has been exposed to mustard agent (ATSDR 2002). *Skin*: redness and itching of the skin may occur 2 to 48 hours after exposure and change eventually to yellow blistering of the skin. *Eyes*: irritation, pain, swelling, and tearing may occur within 3 to12 hours of a mild to moderate exposure. A severe exposure may cause symptoms within 1 to 2 hours and may include the symptoms of a mild or moderate exposure plus light sensitivity, severe pain, or temporary blindness. *Respiratory tract*: runny nose, sneezing, hoarseness, bloody nose, sinus pain, shortness of breath, and cough within 12 to 24 hours of a mild exposure and within 2 to 4 hours of a severe exposure. *Digestive tract*: abdominal pain, diarrhea, fever, nausea, and vomiting (CDC 2002).

Mustard has been determined to be a human carcinogen by the International Agency for Research on Cancer based on studies of people who routinely work with mustard chemicals which indicate that exposures causing chronic irritation for longer than one year may lead to respiratory disease and possibly cancer of the upper respiratory airways. Nitrogen mustards may cause bone marrow suppression beginning as early as 3 to 5 days after exposure. Bone marrow suppression may lead to anemia, bleeding, and increased risk for infection. The people in these studies were exposed to mustard at much higher levels than likely present today at the former Camp Sibert. Because of the strong irritation effects of mustard chemicals, repeated exposures are unlikely in non-occupational situations.

There are no scientific reports of children exposed to mustard agents. However, children exposed to mustard agents are likely to experience the same toxic effects experienced by exposed adults. Children may be more vulnerable to corrosive agents than adults because of the smaller diameter of their airways. Scientific studies of mustard agents did not show birth defects in rats that breathed it. We do not know if these substances can cause birth defects or other developmental effects in humans.

Lewisite

Lewisite is the chemical chlorovinyldichloroarsine, known by its military designation (L). Lewisite was produced in 1918 to be used in World War I, but its production was too late for it to be used in the war (CDC 2002). Pure Lewisite is colorless; however, it usually appears as an amber to dark brown oily liquid with very little odor. The vapor has a geranium-like odor.

In the environment, Lewisite is somewhat less stable than mustard agents at ambient temperatures. However, if buried, Lewisite can be active for more than three years in soil. When exposed to the air, Lewisite is stable for weeks under normal atmospheric temperature. However, in presence of moisture,

it hydrolyses rapidly, losing its ability to blister. Hydrolysis in water forms hydrochloric acid and a nonblistering arsenic compound (USACHPPM 1998).

The primary routes of human exposure to Lewisite are inhalation, ocular, and dermal contact. Lewisite is a vesicant or blistering agent because it causes blistering of the skin and mucous membranes and damage to the respiratory airway like mustard agents. Additionally, Lewisite acts as a systemic poison, causing pulmonary edema, diarrhea, restlessness, weakness, subnormal temperature, and low blood pressure.

Lewisite presents both a vapor and liquid hazard and may damage the eyes, skin, respiratory tract, and circulatory system. Exposure to Lewisite causes immediate (within 30 seconds) irritation or pain. The vapor may be inhaled into the respiratory tract, causing the immediate onset of burning pain, irritation of the nose, and reflex coughing and chest tightness. The vapor also affects the eyes, with the immediate onset of pain and redness. The vapor or a liquid splash of Lewisite on the skin may cause immediate stinging pain and nonvesicant arsenic compound

Signs and symptoms occur immediately following a Lewisite exposure. Showing these signs and symptoms does not necessarily mean that a person has been exposed to Lewisite. Lewisite can have the following effects on specific parts of the body: *Skin:* pain and irritation within seconds to minutes, redness within 15 to 30 minutes followed by blister formation within several hours. The lesions (sores) from Lewisite heal much faster than lesions caused by the other blistering agents, sulfur mustard and nitrogen mustards, and the discoloring of the skin that occurs later is much less noticeable. *Eyes:* irritation, pain, and tearing may occur on contact, uncontrollable blinking and swelling of the eyelids. *Respiratory tract:* runny nose, sneezing, hoarseness, bloody nose, sinus pain, shortness of breath, and cough. *Digestive tract:* diarrhea, nausea, and vomiting. *Cardiovascular:* "Lewisite shock" or low blood pressure may occur. Lewisite is not known to suppress the immune system.

Phosgene

Phosgene is the chemical carbonyl chloride, known by its military designation as (CG). It is a corrosive, highly toxic gas that produces a fluid buildup in the lungs. Phosgene was use extensively during World War I as a choking (pulmonary) agent. Today, it is a major industrial chemical used to make plastics and pesticides.

Phosgene gas may appear colorless or as a white to pale yellow cloud. At low concentrations, it has a pleasant odor of newly mown hay, but its odor may not be noticed by people exposed. At room temperature, phosgene is a poisonous gas. Phosgene gas can be converted into a liquid by cooling and pressure so that it can be shipped and stored. When liquid phosgene is released, it quickly turns into a gas that is heavier than air so it stays close to the ground.

Exposure to phosgene may cause delayed effects that may not be apparent for up to 48 hours after exposure, even if the person feels better or appears well following removal from exposure. Showing these signs or symptoms does not necessarily mean that a person has been exposed to phosgene. Phosgene affects the upper respiratory tract, skin, and eyes and causes severe respiratory damage as well as burns to the skin and eyes. Acute inhalation may cause respiratory and circulatory failure, coughing, feeling of suffocation, burning sensation in the throat and eyes, watery eyes, blurred vision, difficulty breathing or shortness of breath, nausea and vomiting. *Skin*: lesions similar to those from frostbite or burns. *Respiratory:* At high concentrations of phosgene, a person may develop fluid in the lungs (pulmonary edema) within 2 to 6 hours, rapid progression to pulmonary edema and pneumonia. Most people who recover after an exposure to phosgene make a complete recovery. However, chronic bronchitis and emphysema have been reported as a result of chronic inhalation of phosgene.

Table 2 – Summary of ATSDR's Public Health Findings and Recommendations

Exposure Situation	Population	Possible Chemicals	ATSDR's Public Health Findings	Recommendations
Ground Disturbing Activities	Adults and Children Residents and Land Developers	Contacting Chemical Warfare Agents and Explosive Munitions	CWM and explosive munitions that remain intact from past operations could cause immediate and substantial harm if contents are released (usually from significant force being applied). Currently contact with these materials is not occurring. The number of items remaining is probably low. However, planned development increases the chance for people to come in contact with these materials.	ATSDR recommends that USACE, state, and local environmental and health agencies work together to continue to provide public education about the potential hazards of former Camp Sibert property to current and future property developers and owners as well as first responders until deed notification can be achieved.
Drinking and indoor uses of Private Residential Wells	Adults and Children Residents	Drinking Water Containing Trichloroethylene (TCE) and Other Chemicals	Contamination of private wells on former Camp Sibert property has not been fully investigated, but was detected in 1990.	ATSDR recommends that private drinking water wells on former Camp Sibert property be sampled at the taps for chemicals including VOCs, SVOCs, inorganics, and CWM degradation and decontamination products. Vapor intrusion should be considered and indoor air sampled if groundwater values are elevated. ATSDR will work with the USACE, state, and local environmental and health agencies to encourage private well owners to allow their taps to be sampled for public health reasons.
Direct Contact with Soil	Adults and Children Residents and Land Developers	Touching Soil Possibly Containing Chemicals such as Chemical Warfare Agents	Soils collected during USACE investigations have not been found to contain CWM or hazardous chemicals at harmful levels.	None.

Managing Future Hazards

Despite investigations and removal actions with state of the art technical equipment, 100 percent safety assurances for the grids receiving investigation cannot be guaranteed. In areas that did not receive complete investigation, there greater risks may exist. To prevent or reduce the inherent risks associated with the hazards that remain, institutional controls must be implemented.

As part of the former Camp Sibert 2005 EE/CA, the USACE performed an analysis of possible institutional controls. These strategies rely on existing powers and authorities of other government agencies to protect the public. Based on interviews with authorities, the USACE assessed their capabilities and determination and willingness to support and enforce short and long-term institutional control measures.

However, at this time there are no mechanisms for establishing land use restrictions, deed notification, or access control. Therefore, the USACE recommends managing the remaining hazards through public awareness programs.

Brochures and Fact Sheets	2B, 8, 9, 13, 14
Newspaper Articles	2B, 8, 9, 13, 14
Information Packages to Public Officials	2B, 8, 9, 13, 14
Audio/Visual Media	2B, 8, 9, 13, 14
Classroom Education	2B, 8, 9, 13, 14

Based on current existing powers and authorities of other governmental agencies, there are no mechanisms for notification in deeds, permits, or signage for private property. There are no mechanisms in place to officially inform land developers, private utility workers, or potential buyers of the hazards of these properties. Public awareness programs, education, and media coverage should continue in the future until institutional controls can be established and enforced.

Community Health Concerns

1. **Local citizens have expressed concern that chemical warfare agents buried 60 years ago may be emanating up through the soil and presenting a hazard to the community and chemically sensitive individuals.**

   Environmental samples of soil, soil gas, and air collected during investigations detected chemical warfare agents and hazardous chemicals in several locations at some sites investigated. Chemical agents used at Camp Sibert require direct contact of the skin, eyes, or respiratory tract with the liquid or chemical vapors. Slow, small releases of blistering agent in a field would present minimal hazard to people living 200 yards away as long as the people stay away from the chemicals. However, a farmer or land developer who unknowingly unearths buried munitions with force, would present more of an immediate hazard due to direct contact with released chemical agent or explosive materiel.

   Live intact mortar rounds containing chemical warfare agents have been found at shallow depths under the ground surface, but unless disturbed do not pose a hazard. The chemical warfare agents used at Camp Sibert become ineffective when exposed to air, warm temperature, and water. Therefore, residual chemical agents are not expected to be present in ambient air on or surface soils. Of greatest health concern are the intact rounds that could be accidentally disturbed by digging. Pressure applied to intact rounds may cause the rounds to spray their contents with sufficient energy that people be severely harmed. People who inhale or touch the chemical agent spray or those who contact the spray indirectly may suffer severe health effects.

   The lack of reported incidents of citizens coming in contact with CWM from Camp Sibert indicates that much of the land has remained undisturbed and/or the amount of CWM is few and inaccessible. Future development of the Camp Sibert property increases the risk of encountering potentially hazardous materials.

   The health effects a person may experience from contact with hazardous chemicals depend on the amount of chemical to which someone is exposed, the route of exposure (i.e., inhalation), and the duration of exposure. A person's individual sensitivities and pre-existing health conditions also play a role in the health effect and outcome. Much less chemical would be required to produce an effect in a chemically sensitive person than would the average person. Little scientific information is available regarding the response of chemically sensitive individuals to the chemicals used at the former Camp Sibert. Occupational studies of workers using chemical agents have shown that 1) repeated exposures can produce a greater effect and 2) some workers are more sensitive to chemical mustard agent and may show symptoms at a lower dose than other workers. Dose levels at which sensitive workers have shown effects are dependent on the specific individual and the amount and frequency of their previous exposures. Information in the scientific literature is limited regarding the amount of chemical exposure required to produce adverse health effects in previously chemical-sensitized individuals.

2. Citizens have expressed concern about buildings or schools being built over a former chemical weapons burial ground and whether air quality in the schools or buildings presents a hazard to students or workers.

Although the USACE has not sampled air inside buildings and schools for chemical agents, there is no reason to believe that this scenario is occurring. Large numbers of people would be affected at the same time if air quality inside buildings and schools were impacted by chemical agents. Moreover, the ability of contaminants below the ground to migrate into schools and commercial buildings is minimized for schools and buildings built on slab foundations. The mild local climate and frequency that people open doors to enter buildings reduces the indoor pressure gradient resulting in conditions insufficient to permit vapor intrusion.

As the USACE investigations continue and additional environmental samples are collected, more information will be available to characterize the extent of contamination and identify the potential for people to come in contact with contaminants remaining from activities conducted at the former Camp Sibert.

Conclusions and Recommendations

ATSDR identified potential exposure situations most likely to occur from materiel associated with the former Camp Sibert. They are as follows: 1) adults and children could come in contact with conventional explosives or CWM hazards encountered during ground-disturbing activities, 2) adults and children could come in contact with residual CWM, explosive, or hazardous chemicals (including degradation chemicals) by drinking potentially contaminated water from their private drinking water wells, and 3) adults and children could come in contact with residual CWM, explosive, or hazardous materials by direct contact with contaminated soil or unearthed material.

Adults and children could come in contact with conventional explosives or CWM hazards encountered during ground-disturbing activities.

1) ATSDR believes that the former Camp Sibert poses a current and future public health hazard because conventional munitions, explosives, or CWM hazards are likely present on privately owned residential and commercial properties close to the ground surface where ground disturbance could cause detonation resulting in significant harm. The USACE has conducted several activities to reduce the likelihood of exposures. However, additional public health actions are needed to further reduce the likelihood of exposure.

2) USACE investigations and removal actions have reduced the opportunity for people to come in contact with CWM and munitions hazards in those areas investigated. However, despite the removal of 18 intact, liquid-filled 4.2-inch (diameter) mortars, CWM and explosive munitions likely remain near the surface on private residential, agricultural, and commercial property that is former Camp Sibert property.

3) Some areas suspected of containing potential CWM were not investigated because private land owners denied investigators access. Hazards in these areas (approximately 36 acres) could be higher than areas where live, fused, munitions were found.

4) Future development of former Camp Sibert property for residential, commercial, and industrial uses, including ground disturbing activities, increases the opportunity for human contact with CWM and explosives munitions which could result in significant harm.

5) Based on current existing powers and authorities of other governmental agencies, there are no mechanisms for notification in deeds, permits, or signage for private property. There are no mechanisms in place to officially inform land developers, private utility workers, or potential buyers of the hazards of these properties.

   ATSDR recommends that USACE, state, county, and local environmental and health agencies work together to continue to provide public awareness and education about the hazards of former Camp Sibert property to current and future property developers, private utility workers, emergency first responders and private property owners. Public

awareness programs, education, and media coverage should continue in the future until institutional controls can be established and enforced.

Adults and children could come in contact with residual CWM or hazardous chemicals by drinking potentially contaminated water from their private drinking water wells.

6) Past investigations detected trichloroethylene (TCE) in samples from a private well, groundwater, and soil located near Site 2A. Further investigation detected TCE and various metals in soil and in groundwater samples above the U.S. Environmental Protection Agency's Maximum Contaminant Level for drinking water. Although the details of earlier private well sampling is not available, it is possible that the well was used as a residential drinking water source.

7) USACE is currently investigating soil and groundwater contamination from former Camp Sibert activities. Private drinking water wells are currently included in the sampling protocol. At this time, the private property owners have not granted access to USACE for further investigation.

   ATSDR recommends that private drinking water wells be sampled at the taps for chemicals including volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), inorganics, and CWM degradation and decontamination products. Additionally, vapor intrusion into homes and buildings should be considered and indoor air sampled as necessary. ATSDR will work with the USACE, state, and local environmental and health agencies to encourage private well owners to allow their taps to be sampled for public health reasons.

Adults and children could come in contact with residual CWM or hazardous chemicals by direct contact with contaminated soil.

8) The CWM used at Camp Sibert that were released into the environment would have reacted with moisture in the soil and air. CWM released during the time that Camp Sibert was operating would not be reactive today.

9) Residual explosive compounds, VOCs, inorganic compounds, and chlorine used during decontamination may be detectable in soil. Contaminants in soil occur in concentrated areas and are not widespread. Although environmental investigations continue, soil contaminant levels detected to date do not appear to be high enough to cause harmful health effects in people who might directly contact contaminants in soil.

Author

Carole Hossom
Senior Environmental Health Scientist
Site and Radiological Assessment Branch
Division of Health Assessment and Consultation
Agency for Toxic Substances and Disease Registry

Reviewed by

Greg Zarus
Team Lead - Site and Radiological Assessment Branch
Division of Health Assessment and Consultation
Agency for Toxic Substances and Disease Registry

References

1. Agency for Toxic Substances and Disease Registry (ATSDR). 2002. ToxFAQs for Blister Agents: Sulfur Mustard Agent H/HD, Sulfur Mustard Agent HT. April 2002. http://www.atsdr.cdc.gov/tfactsd3.html.

2. ATSDR. 2001. Minimal Risk Levels (MRLs) for Hazardous Substances. http://www.atsdr.cdc.gov/mrls.html.

3. Centers for Disease Control and Prevention (CDC). 2002. Counter-Terrorism Cards: Chemical Agents. Public Health Emergency Preparedness & Response. http://www.bt.cdc.gov/agent/agentlistchem.asp.

4. Chemfinder.com. 2001. Database and Internet Searching. http://chemfinder.cambridgesoft.com/.

5. Environmental Science & Engineering Gainesville Laboratory, Gainesville, FL. http://web.ead.anl.gov/MethCom_v2/.

6. Environmental Protection Agency (EPA). 1992. Guidance for Data Usability in Risk Assessment (Part A). Document #9285.7-09A. http://www.epa.gov/oerrpage/superfund/programs/risk/datause/parta.htm.

7. EPA. 1998. SW-846, Test Methods for Evaluating Solid Wastes Physical/Chemical Methods. Office of Solid Waste. PN# 955-001-00000-1. http://www.epa.gov/epaoswer/hazwaste/test/sw846.htm.

8. EPA. 1999. Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air (second edition). Center for Environmental Research Information. EPA/625/R-96/010b. http://www.epa.gov/ttn/amtic/airtox.html.

9. EPA. 2007. Current Drinking Water Standards: Maximum Contaminant Levels (MCLs). Office of Water. http://www.epa.gov/safewater/mcl.html.

10. EPA. 2007a. Drinking Water Standards and Health Advisories. Office of Water. http://www.epa.gov/ost/drinking/standards/.

11. EPA. 2007b. Integrated Risk Information System (IRIS). http://www.epa.gov/iris/subst/index.html.

12. EPA. 2007c. Region III Risk-Based Concentration (RBC) Table (May 2001 Update). http://www.epa.gov/reg3hwmd/risk/riskmenu.htm.

13. Gadsden-Etowah County Industrial Development Authority www.gadsdenida.org/

14. Hazardous Substance Data Bank. 2002. National Library of Medicine (NLM) Specialized Information Services (SIS). http://toxnet.nlm.nih.gov/cgi-bin/sis/htmlgen?HSDB.

15. Jenkins TF, Walsh ME. 2001. Presentation: Field-Based Analytical Methods for Explosive Compounds. USA Engineer Research and Development Center, Cold Regions Research and Engineering Laboratory, Hanover, NH.

16. McGrath CJ. 1995. Review of Formulations for Processes Affecting the Subsurface Transport of Explosives. US Army Engineer Waterways Experiment Station, Vicksburg, MS. Technical Report IRRP-95-2. http://www.wes.army.mil/el/elpubs/pdf/trirrp95-2/trirrp952.pdf.

17. Methods for Organic Chemical Analysis of Municipal and Industrial Wastewater, 40 C.F.R. Part 136. Appendix A. http://www.access.gpo.gov/nara/cfr/cfrhtml_00/Title_40/40cfr136_00.html.

18. Mitretek System. 2001. Chemistry of Lethal Chemical Warfare (CW) Agents. http://www.mitretek.org/mission/envene/chemical/agents/chemagent.html.

19. Munro NB, Talmage SS, Griffin GD, Waters LC, Watson AP, King JF, Hauschild V. 1999. The Sources, Fate, and Toxicity of Chemical Warfare Agent Degradation Products. Environ Health Perspect 107(12):933–974.

20. National Research Council. 1997. Review of Acute Human-Toxicity Estimates for Selected Chemical-Warfare Agents. Subcommittee on Toxicity Values for Selected Nerve and Vesicant Agents, Committee on Toxicology, Board on Environmental Studies and Toxicology, Commission on Life Sciences, National Research Council. Washington, DC: National Academy Press. http://www.nap.edu/books/0309057493/html/index.html.

21. National Research Council. 2000. Review of the U.S. Army's Health Risk Assessments for Oral Exposure to Six Chemical-Warfare Agents. Subcommittee on Chronic Reference Doses for Selected Chemical Warfare Agents, Committee on Toxicology, Board on Environmental Studies and Toxicology, Commission on Life Sciences, National Research Council. Washington, DC: National Academy Press. http://www.nap.edu/books/0309065984/html/.

22. Parsons 2005. Chemical Warfare Materiel, Engineering Evaluation / Cost Analysis Report, Final Phase I for Former Camp Sibert, Etowah and St. Clair Counties, Alabama. For the U.S. Army Engineering and Support Center, Huntsville.

23. Parsons 2006. Chemical Warfare Materiel, Engineering Evaluation / Cost Analysis Report, Final Phase II for Former Camp Sibert, Etowah and St. Clair Counties, Alabama. For the U.S. Army Engineering and Support Center, Huntsville.

24. Reade Advanced Materials. 2001. Products. http://www.reade.com/Products/Carbons/tetracene.html.

25. Roberts WC, Hartley WR, editors. 1992. Drinking Water Health Advisory: Munitions. Office of Drinking Water Health Advisories. Lewis Publishers: Boca Raton, FL.

26. Spectrum Laboratory. 2001. Chemical Fact Sheet. http://www.speclab.com/search.html.

27. Syracuse Research Corporation (SRC). 2001. Physical Properties Database. http://esc.syrres.com/interkow/PhysProp.htm

28. The Ordnance Shop. 2001, 2002. Types of Explosives. http://www.ordnance.org/.

29. U.S. Army. 1997. Methods Manual for Detection of PEP Compounds. US Army Environmental Center. http://www.crrel.usace.army.mil/techtransfer/products/pepmanual/.

30. U.S. Army Center for Health Promotion & Preventive Medicine (USACHPPM). 1998. Detailed Chemical Facts Sheets. Office to the Deputy for Technical Services. City: The Deputy for Technical Services Publications. http://chppm-www.apgea.army.mil/dts/dtchemfs.htm.

31. USACHPPM. 1999. Derivation of Health-based Environmental Screening Levels (HBESLs) for Chemical Warfare Agents (CWA). http://chppm-www.apgea.army.mil/hrarcp/pages/CAW/index.html. March 1999.

32. USACHPPM. 2001. http://chppm-www.apgea.army.mil/hrarcp/CAW/index.html Chemical Weapons Disposal Program CDC For information about this or other CDC programs, visit www.cdc.gov/programs. January 2001.

33. U.S. Army Corps of Engineers, Huntsville Center, 2002. Determination of the Applicability of Interim Guidance for Camp Sibert, January 2002.

34. U.S. Department of the Treasury. 1999. Commerce in Explosives: List of Explosive Materiels. Bureau of Alcohol, Tobacco and Firearms. http://www.atf.treas.gov/pub/fire-explo_pub/listofexp.htm.

35. U.S. Navy. N.D. Types of Explosives. Department of the Navy Explosive Detection Equipment Program. http://www.explosivedetection.nfesc.navy.mil/.

36. Xinventions.com. Pyrotechnics—Explosive Information. http://www.xinventions.com/main/pyro/info_explosives.htm.