

APPENDIX H
PRELIMINARY RISK ASSESSMENT

Technical Memorandum

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To: Former Security Operational Test Site, Parcel 102(7), Fort McClellan, Calhoun County, Alabama
Preliminary Risk Assessment File

Date: March 18, 2002

Subject: **PRELIMINARY RISK ASSESSMENT FOR SUBJECT SITE**

This memorandum provides a Preliminary Risk Assessment (PRA) for the Former Security Operational Test Site, Parcel 102(7), herein referred to as Parcel 102(7). Parcel 102(7) consists of two separate facilities: an Administration Center and a Building Test Site, on Pelham Range. The former Building Test Site consists of a guard building, the Maintenance and Assembly Building, two ammunition bunkers (igloos), and one igloo head wall. A fire pond is present, into which troops were known to discard materials after policing the area following the performance of tests. The nature of the discarded materials is not known. Explosives were used at the head wall and at both igloos, titanium oxide smoke was used at Igloo No. 2, and caustic materials were used to make the smoke. A material called sticky foam, developed to immobilize intruders, was tested on the site. Hazardous characteristics testing of the sticky foam determined it to be nonhazardous, but details of the testing are not available.

The PRA approach is a shortened version of the Streamlined Risk Assessment (SRA) protocol developed as a uniform and economical approach to evaluating hundreds of similar sites at Fort McClellan (FTMC). It is assumed that the reader is familiar with FTMC and the fundamentals of the SRA protocol. The reader is referred to the Installation-Wide Work Plan (IT, 2002) for more detail. All the comparison and computational operations of the PRA are performed within EXCEL[®] spread sheet tables. The results of each step are described below. The PRA was performed in two iterations – a first iteration and a refined assessment – to more precisely select site-related chemicals, as explained below.

Media of Interest and Data Selection. Media of interest are surface soil, subsurface soil, and surface water and sediment from the fire pond. Three monitoring wells were drilled to the top of bedrock (27 to 34 feet below ground surface [ft bgs]), but the wells were dry and it was concluded that groundwater at this site could not be developed as a source of potable water to which receptors would be exposed. Therefore, no further attempts were made to obtain groundwater, and groundwater is not considered further in this PRA.

Data consist of three surface soil samples taken from 0 to 1 ft bgs, three subsurface soil samples (and one duplicate not used in the PRA) taken from 4 to 12 ft bgs, one surface water sample, and one sediment sample. All samples were analyzed for metals, nitroaromatic explosives,

semivolatile organic compounds (SVOC) and volatile organic compounds (VOC). All the analytical data were validated.

Site-Related Chemical Selection. Site-related chemicals are those presumed to be released by the army during operation of FTMC. Site-related chemicals were selected for the first iteration of the risk assessment by comparing the maximum detected concentration (MDC) of each chemical with its background screening criterion (BSC), computed as two times the mean of the background data set, consistent with EPA (2002a) Region IV guidance. Chemicals whose MDCs exceed their BSCs were selected as site-related chemicals and were subjected to chemical of potential concern (COPC) selection (described below) for inclusion in the first iteration of the risk assessment. The site-related chemicals chosen in this manner are identified in Tables 1, 2, and 3 for surface soil, Tables 4 and 5 for subsurface soil, Table 6 for surface water, and Table 7 for sediment. BSCs were taken from SAIC (1998). Site-related chemicals are limited to metals in all media tested, except for the VOC trichlorofluoromethane, which was identified at low concentrations in soil and sediment. Trichlorofluoromethane may be associated with sticky foam.

Upper tolerance limits (UTL), the highest metal concentrations reasonably considered to be within background, are also included in Tables 1 through 7 for information, but were not used to select site-related chemicals for the first iteration of risk estimates. The UTL provides a more refined statistical approach than the BSC for comparing site and background data, and was used where needed for the second iteration to refine the risk estimates. UTLs were developed for the entire FTMC facility, combining data from the Main Post and Pelham Range (IT, 2002).

Chemical of Potential Concern Selection. COPCs are site-related chemicals whose MDCs exceed their site-specific screening levels (SSSL), and which may contribute significantly to risk. The SSSLs are receptor-, medium-, and chemical-specific risk-based concentrations that capture all the exposure assumptions and toxicity assessment of a full-blown baseline risk assessment. COPCs were selected for both cancer risk and noncancer effects when the data were sufficient (Tables 1 through 7). COPCs are limited to arsenic, antimony and chromium in soil, and arsenic in surface water. No chemicals were selected as COPCs in sediment.

Receptor Scenario Selection. Because Parcel 102(7) is located at Pelham Range and is projected for continued use by the Alabama National Guard, it is reasonable to select the national guardsperson as the most plausible receptor scenario for military training. The national guardsperson scenario was developed for sites on FTMC expected to be used in this manner. The recreational site user is included as an alternative equally plausible receptor for the site. An on-site resident is also included as the upper-bound evaluation of exposure and risk for any land-use scenario, and to provide additional perspective. SSSLs for all three receptor scenarios were used to select COPCs for surface and subsurface soil. The assumptions for residential and recreational site user exposure to surface water and sediment are identical, and the national guardsperson is not expected to be regularly exposed to these media. Therefore, only recreational site user SSSLs were used for COPC selection for surface water and sediment.

Table 1

**Preliminary Risk Assessment for the National Guardsperson Exposure to Surface Soil
Former Security Operational Test Site, Parcel 102(7)
Fort McClellan, Calhoun County, Alabama**

Chemical	MDC	BSC	UTL	Site-Related Chemical? ^a	National Guardsperson Soil SSSL-c ^b	National Guardsperson Soil SSSL-n ^c	National Guardsperson Cancer COPC? ^d	National Guardsperson Noncancer COPC? ^e	National Guardsperson ILCR ^f	National Guardsperson HI ^g
Metals										
Aluminum	8.89E+03	1.63E+04	2.29E+04		NA	1.47E+04				
Antimony	4.80E+00	1.99E+00	7.14E+00	4.80E+00	NA	1.04E+02				
Arsenic	3.29E+01	1.37E+01	2.54E+01	3.29E+01	3.70E+00	7.96E+01	3.29E+01		8.89E-06	
Barium	5.38E+01	1.24E+02	1.94E+02		NA	1.43E+03				
Beryllium	6.30E-01	8.00E-01	1.19E+00		3.42E+01	4.42E+01				
Calcium	6.60E+03	1.72E+03	3.55E+03	6.60E+03	NA	NA				
Chromium ^h	2.19E+01	3.70E+01	6.44E+01		6.85E+00	2.26E+02				
Cobalt	5.80E+00	1.52E+01	3.25E+01		NA	6.30E+01				
Copper	2.36E+01	1.27E+01	2.25E+01	2.36E+01	NA	1.06E+04				
Iron	2.97E+04	3.42E+04	5.54E+04		NA	7.96E+04				
Lead	3.33E+02	4.01E+01	6.38E+01	3.33E+02	NA	8.80E+02				
Magnesium	9.42E+02	1.03E+03	2.16E+03		NA	NA				
Manganese	6.15E+02	1.58E+03	4.66E+03		NA	1.53E+02				
Mercury	5.70E-02	8.00E-02	1.25E-01		NA	7.12E+01				
Nickel	1.68E+01	1.03E+01	2.00E+01	1.68E+01	3.42E+02	5.00E+03				
Potassium	2.75E+02	8.00E+02	1.83E+03		NA	NA				
Vanadium	5.00E+01	5.88E+01	9.94E+01		NA	1.65E+03				
Zinc	8.83E+01	4.06E+01	7.37E+01	8.83E+01	NA	7.90E+04				
Volatile Organic Compound										
Trichlorofluoromethane	6.00E-03			6.00E-03	NA	7.47E+04				
Total ILCR, HI									8.89E-06	--

All concentrations expressed as mg/kg.

MDC = maximum detected concentration; BSC = background screening criterion; UTL = 95% Upper Tolerance Limit.

-- = No ILCR or HI calculated

NA = Not Available

^a MDC presented only if it exceeds BSC, or no BSC is available.

^b Site-specific screening level (SSSL) based on cancer risk for the National Guardsperson exposure to soil.

^c Site-specific screening level based on noncancer hazard for the National Guardsperson exposure to soil.

^d MDC presented only if it exceeds SSSL-c.

^e MDC presented only if it exceeds SSSL-n.

^f Incremental lifetime cancer risk for the National Guardsperson exposed to chemical in surface soil.

^g Hazard index for noncancer effects for the National Guardsperson exposed to chemical in surface soil.

^h SSSL based on chromium VI.

Table 2

**Preliminary Risk Assessment for the On-site Resident Exposure to Surface Soil
Former Security Operational Test Site, Parcel 102(7)
Fort McClellan, Calhoun County, Alabama**

Chemical	MDC	BSC	UTL	Site-Related Chemical? ^a	On-site Resident Soil SSSL-c ^b	On-site Resident Soil SSSL-n ^c	On-site Resident Cancer COPC? ^d	On-site Resident Noncancer COPC? ^e	On-site Resident ILCR ^f	On-site Resident HI ^g
Metals										
Aluminum	8.89E+03	1.63E+04	2.29E+04		NA	7.80E+03				
Antimony	4.80E+00	1.99E+00	7.14E+00	4.80E+00	NA	3.11E+00		4.80E+00		1.54E-01
Arsenic	3.29E+01	1.37E+01	2.54E+01	3.29E+01	4.26E-01	2.34E+00	3.29E+01	3.29E+01	7.72E-05	1.40E+00
Barium	5.38E+01	1.24E+02	1.94E+02		NA	5.47E+02				
Beryllium	6.30E-01	8.00E-01	1.19E+00		NA	9.60E+00				
Calcium	6.60E+03	1.72E+03	3.55E+03	6.60E+03	NA	NA				
Chromium ^h	2.19E+01	3.70E+01	6.44E+01		NA	2.32E+01				
Cobalt	5.80E+00	1.52E+01	3.25E+01		NA	4.68E+02				
Copper	2.36E+01	1.27E+01	2.25E+01	2.36E+01	NA	3.13E+02				
Iron	2.97E+04	3.42E+04	5.54E+04		NA	2.34E+03				
Lead	3.33E+02	4.01E+01	6.38E+01	3.33E+02	NA	4.00E+02				
Magnesium	9.42E+02	1.03E+03	2.16E+03		NA	NA				
Manganese	6.15E+02	1.58E+03	4.66E+03		NA	3.63E+02				
Mercury	5.70E-02	8.00E-02	1.25E-01		NA	2.33E+00				
Nickel	1.68E+01	1.03E+01	2.00E+01	1.68E+01	NA	1.54E+02				
Potassium	2.75E+02	8.00E+02	1.83E+03		NA	NA				
Vanadium	5.00E+01	5.88E+01	9.94E+01		NA	5.31E+01				
Zinc	8.83E+01	4.06E+01	7.37E+01	8.83E+01	NA	2.34E+03				
Volatile Organic Compound										
Trichlorofluoromethane	6.00E-03			6.00E-03	NA	2.33E+03				
Total ILCR, HI									7.72E-05	1.56E+00

All concentrations expressed as mg/kg.

MDC = maximum detected concentration; BSC = background screening criterion; UTL = 95% Upper Tolerance Limit.

NA = Not Available

^a MDC presented only if it exceeds BSC, or no BSC is available.

^b Site-specific screening level (SSSL) based on cancer risk for the on-site resident exposure to soil.

^c Site-specific screening level based on noncancer hazard for the on-site resident exposure to soil.

^d MDC presented only if it exceeds SSSL-c.

^e MDC presented only if it exceeds SSSL-n.

^f Incremental lifetime cancer risk for the on-site resident exposed to chemical in surface soil.

^g Hazard index for noncancer effects for the on-site resident exposed to chemical in surface soil.

^h SSSL based on chromium VI.

Table 3

Preliminary Risk Assessment for the Recreational Site User Exposure to Surface Soil
Former Security Operational Test Site, Parcel 102(7)
Fort McClellan, Calhoun County, Alabama

Chemical	MDC	BSC	UTL	Site-Related Chemical? ^a	Recreational Site User Soil SSSL-c ^b	Recreational Site User Soil SSSL-n ^c	Recreational Site User Cancer COPC? ^d	Recreational Site User Noncancer COPC? ^e	Recreational Site User ILCR ^f	Recreational Site User HI ^g
Metals										
Aluminum	8.89E+03	1.63E+04	2.29E+04		NA	6.27E+05				
Antimony	4.80E+00	1.99E+00	7.14E+00	4.80E+00	NA	2.47E+02				
Arsenic	3.29E+01	1.37E+01	2.54E+01	3.29E+01	2.94E+01	1.89E+02	3.29E+01		1.12E-06	
Barium	5.38E+01	1.24E+02	1.94E+02		NA	4.41E+04				
Beryllium	6.30E-01	8.00E-01	1.19E+00		NA	4.08E+02				
Calcium	6.60E+03	1.72E+03	3.55E+03	6.60E+03	NA	NA				
Chromium ^h	2.19E+01	3.70E+01	6.44E+01		NA	1.82E+03				
Cobalt	5.80E+00	1.52E+01	3.25E+01		NA	3.75E+04				
Copper	2.36E+01	1.27E+01	2.25E+01	2.36E+01	NA	2.52E+04				
Iron	2.97E+04	3.42E+04	5.54E+04		NA	1.89E+05				
Lead	3.33E+02	4.01E+01	6.38E+01	3.33E+02	NA	4.00E+02				
Magnesium	9.42E+02	1.03E+03	2.16E+03		NA	NA				
Manganese	6.15E+02	1.58E+03	4.66E+03		NA	2.85E+04				
Mercury	5.70E-02	8.00E-02	1.25E-01		NA	1.84E+02				
Nickel	1.68E+01	1.03E+01	2.00E+01	1.68E+01	NA	1.20E+04				
Potassium	2.75E+02	8.00E+02	1.83E+03		NA	NA				
Vanadium	5.00E+01	5.88E+01	9.94E+01		NA	4.00E+03				
Zinc	8.83E+01	4.06E+01	7.37E+01	8.83E+01	NA	1.88E+05				
Volatile Organic Compound										
Trichlorofluoromethane	6.00E-03			6.00E-03	NA	1.85E+05				
Total ILCR, HI									1.12E-06	--

All concentrations expressed as mg/kg.

MDC = maximum detected concentration; BSC = background screening criterion; UTL = 95% Upper Tolerance Limit.

-- = No ILCR or HI calculated

NA = Not Available

^a MDC presented only if it exceeds BSC, or no BSC is available.

^b Site-specific screening level (SSSL) based on cancer risk for the recreational site user exposure to soil.

^c Site-specific screening level based on noncancer hazard for the recreational site user exposure to soil.

^d MDC presented only if it exceeds SSSL-c.

^e MDC presented only if it exceeds SSSL-n.

^f Incremental lifetime cancer risk for the recreational site user exposed to chemical in surface soil.

^g Hazard index for noncancer effects for the recreational site user exposed to chemical in surface soil.

^h SSSL based on chromium VI.

Table 4

**Preliminary Risk Assessment for the National Guardsperson Exposure to Subsurface Soil
Former Security Operational Test Site, Parcel 102(7)
Fort McClellan, Calhoun County, Alabama**

Chemical	MDC	BSC	UTL	Site-Related Chemical? ^a	National Guardsperson Soil SSSL-c ^b	National Guardsperson Soil SSSL-n ^c	National Guardsperson Cancer COPC? ^d	National Guardsperson Noncancer COPC? ^e	National Guardsperson ILCR ^f	National Guardsperson HI ^g
Metals										
Aluminum	6.04E+03	1.36E+04	1.66E+04		NA	1.47E+04				
Arsenic	4.55E+01	1.83E+01	5.49E+01	4.55E+01	3.70E+00	7.96E+01	4.55E+01		1.23E-05	
Barium	3.59E+01	2.34E+02	3.20E+02		NA	1.43E+03				
Beryllium	9.10E-01	9.00E-01	2.19E+00	9.10E-01	3.42E+01	4.42E+01				
Calcium	5.68E+02	6.37E+02	1.71E+03		NA	NA				
Chromium ^h	8.36E+01	3.83E+01	5.34E+01	8.36E+01	6.85E+00	2.26E+02	8.36E+01		1.22E-05	
Cobalt	6.20E+00	1.75E+01	5.47E+01		NA	6.30E+01				
Copper	1.78E+01	1.94E+01	3.42E+01		NA	1.06E+04				
Iron	2.72E+04	4.48E+04	4.18E+04		NA	7.96E+04				
Lead	2.04E+01	3.85E+01	2.88E+01		NA	8.80E+02				
Magnesium	2.33E+02	7.66E+02	2.27E+03		NA	NA				
Manganese	4.43E+02	1.36E+03	3.79E+03		NA	1.53E+02				
Mercury	2.60E-02	7.00E-02	9.40E-02		NA	7.12E+01				
Nickel	3.90E+01	1.29E+01	2.92E+01	3.90E+01	3.42E+02	5.00E+03				
Potassium	3.87E+02	7.11E+02	1.42E+03		NA	NA				
Vanadium	3.61E+01	6.50E+01	9.17E+01		NA	1.65E+03				
Zinc	1.20E+02	3.50E+01	8.50E+01	1.20E+02	NA	7.90E+04				
Volatile Organic Compound										
Trichlorofluoromethane	3.40E-03			3.40E-03	NA	7.47E+04				
Total ILCR, HI									2.45E-05	--

All concentrations expressed as mg/kg.

MDC = maximum detected concentration; BSC = background screening criterion; UTL = 95% Upper Tolerance Limit.

-- = No ILCR or HI calculated

NA = Not Available

^a MDC presented only if it exceeds BSC, or no BSC is available.

^b Site-specific screening level (SSSL) based on cancer risk for the National Guardsperson exposure to soil.

^c Site-specific screening level based on noncancer hazard for the National Guardsperson exposure to soil.

^d MDC presented only if it exceeds SSSL-c.

^e MDC presented only if it exceeds SSSL-n.

^f Incremental lifetime cancer risk for the National Guardsperson exposed to chemical in subsurface soil.

^g Hazard index for noncancer effects for the National Guardsperson exposed to chemical in subsurface soil.

^h SSSL based on chromium VI.

Table 5

**Preliminary Risk Assessment for the On-site Resident Exposure to Subsurface Soil
Former Security Operational Test Site, Parcel 102(7)
Fort McClellan, Calhoun County, Alabama**

Chemical	MDC	BSC	UTL	Site-Related Chemical? ^a	On-site Resident Soil SSSL-c ^b	On-site Resident Soil SSSL-n ^c	On-site Resident Cancer COPC? ^d	On-site Resident Noncancer COPC? ^e	On-site Resident ILCR ^f	On-site Resident HI ^g
Metals										
Aluminum	6.04E+03	1.36E+04	1.66E+04		NA	7.80E+03				
Arsenic	4.55E+01	1.83E+01	5.49E+01	4.55E+01	4.26E-01	2.34E+00	4.55E+01	4.55E+01	1.07E-04	1.94E+00
Barium	3.59E+01	2.34E+02	3.20E+02		NA	5.47E+02				
Beryllium	9.10E-01	9.00E-01	2.19E+00	9.10E-01	NA	9.60E+00				
Calcium	5.68E+02	6.37E+02	1.71E+03		NA	NA				
Chromium ^h	8.36E+01	3.83E+01	5.34E+01	8.36E+01	NA	2.32E+01		8.36E+01		3.61E-01
Cobalt	6.20E+00	1.75E+01	5.47E+01		NA	4.68E+02				
Copper	1.78E+01	1.94E+01	3.42E+01		NA	3.13E+02				
Iron	2.72E+04	4.48E+04	4.18E+04		NA	2.34E+03				
Lead	2.04E+01	3.85E+01	2.88E+01		NA	4.00E+02				
Magnesium	2.33E+02	7.66E+02	2.27E+03		NA	NA				
Manganese	4.43E+02	1.36E+03	3.79E+03		NA	3.63E+02				
Mercury	2.60E-02	7.00E-02	9.40E-02		NA	2.33E+00				
Nickel	3.90E+01	1.29E+01	2.92E+01	3.90E+01	NA	1.54E+02				
Potassium	3.87E+02	7.11E+02	1.42E+03		NA	NA				
Vanadium	3.61E+01	6.50E+01	9.17E+01		NA	5.31E+01				
Zinc	1.20E+02	3.50E+01	8.50E+01	1.20E+02	NA	2.34E+03				
Volatile Organic Compound										
Trichlorofluoromethane	3.40E-03			3.40E-03	NA	2.33E+03				
Total ILCR, HI									1.07E-04	2.30E+00

All concentrations expressed as mg/kg.

MDC = maximum detected concentration; BSC = background screening criterion; UTL = 95% Upper Tolerance Limit.

NA = Not Available

^a MDC presented only if it exceeds BSC, or no BSC is available.

^b Site-specific screening level (SSSL) based on cancer risk for the on-site resident exposure to soil.

^c Site-specific screening level based on noncancer hazard for the on-site resident exposure to soil.

^d MDC presented only if it exceeds SSSL-c.

^e MDC presented only if it exceeds SSSL-n.

^f Incremental lifetime cancer risk for the on-site resident exposed to chemical in subsurface soil.

^g Hazard index for noncancer effects for the on-site resident exposed to chemical in subsurface soil.

^h SSSL based on chromium VI.

Table 6

Preliminary Risk Assessment for the Recreational Site User Exposure to Surface Water
Former Security Operational Test Site, Parcel 102(7)
Fort McClellan, Calhoun County, Alabama

Chemical	MDC	BSC	UTL	Site-Related Chemical? ^a	Recreational Site User SW SSSL-c ^b	Recreational Site User SW SSSL-n ^c	Recreational Site User Cancer COPC? ^d	Recreational Site User Noncancer COPC? ^e	Recreational Site User ILCR ^f	Recreational Site User HI ^g
Metals										
Aluminum	1.30E+00	5.26E+00	1.37E+01		NA	1.53E+01				
Arsenic	3.50E-03	2.20E-03	3.40E-03	3.50E-03	7.31E-04	4.70E-03	3.50E-03		4.79E-06	
Barium	1.44E-02	7.54E-02	1.15E-01		NA	1.10E+00				
Calcium	1.24E+01	2.52E+01	3.78E+01		NA	NA				
Chromium ^h	2.00E-03	1.11E-02	1.68E-02		NA	4.08E-02				
Iron	2.18E+00	1.96E+01	1.18E+02		NA	4.70E+00				
Magnesium	5.34E+00	1.10E+01	5.05E+01		NA	NA				
Manganese	4.61E-02	5.65E-01	1.83E+00		NA	6.40E-01				
Nickel	2.50E-03	2.25E-02	4.00E-02		NA	3.10E-01				
Potassium	7.05E-01	2.56E+00	4.25E+00		NA	NA				
Sodium	4.60E-01	3.44E+00	5.58E+00		NA	NA				
Vanadium	3.80E-03	1.52E-02	2.11E-02		NA	7.90E-02				
Zinc	7.90E-03	4.04E-02	4.56E-02		NA	4.65E+00				
Total ILCR, HI									4.79E-06	--

All concentrations expressed as mg/L.

MDC = maximum detected concentration; BSC = background screening criterion; UTL = 95% Upper Tolerance Limit.

-- = No ILCR or HI calculated

NA = Not Available

^a MDC presented only if it exceeds BSC, or no BSC is available.

^b Site-specific screening level (SSSL) based on cancer risk for the recreational site user exposure to surface water.

^c Site-specific screening level based on noncancer hazard for the recreational site user exposure to surface water.

^d MDC presented only if it exceeds SSSL-c.

^e MDC presented only if it exceeds SSSL-n.

^f Incremental lifetime cancer risk for the recreational site user exposed to chemical in surface water.

^g Hazard index for noncancer effects for the recreational site user exposed to chemical in surface water.

^h SSSL based on chromium VI.

Table 7

**Preliminary Risk Assessment for the Recreational Site User Exposure to Sediment
Former Security Operational Test Site, Parcel 102(7)
Fort McClellan, Calhoun County, Alabama**

Chemical	MDC	BSC	UTL	Site-Related Chemical? ^a	Recreational Site User Sed SSSL-c ^b	Recreational Site User Sed SSSL-n ^c	Recreational Site User Cancer COPC? ^d	Recreational Site User Noncancer COPC? ^e	Recreational Site User ILCR ^f	Recreational Site User HI ^g
Metals										
Aluminum	6.66E+03	8.59E+03	1.43E+04		NA	1.15E+06				
Arsenic	2.40E+01	1.13E+01	2.84E+01	2.40E+01	5.58E+01	3.59E+02				
Barium	1.68E+01	9.89E+01	1.91E+02		NA	8.36E+04				
Calcium	6.97E+02	1.11E+03	2.86E+03		NA	NA				
Chromium ^h	1.88E+01	3.12E+01	6.33E+01		NA	2.79E+03				
Cobalt	3.70E+00	1.10E+01	2.91E+01		NA	6.72E+04				
Copper	1.16E+01	1.71E+01	3.68E+01		NA	4.74E+04				
Iron	2.95E+04	3.53E+04	7.08E+04		NA	3.59E+05				
Lead	1.07E+01	3.78E+01	7.64E+01		NA	4.00E+02				
Magnesium	4.00E+02	9.06E+02	2.44E+03		NA	NA				
Manganese	1.18E+02	7.12E+02	2.61E+03		NA	4.38E+04				
Mercury	8.70E-02	1.10E-01	1.37E-01		NA	2.99E+02				
Nickel	1.05E+01	1.30E+01	2.58E+01		NA	1.76E+04				
Potassium	2.30E+02	1.01E+03	2.30E+03		NA	NA				
Vanadium	4.54E+01	4.09E+01	6.77E+01	4.54E+01	NA	4.83E+03				
Zinc	5.18E+01	5.27E+01	1.23E+02		NA	3.44E+05				
Volatile Organic Compounds										
Trichlorofluoromethane	4.30E-03			4.30E-03	NA	3.06E+05				
Total ILCR, HI									--	--

All concentrations expressed as mg/kg.

MDC = maximum detected concentration; BSC = background screening criterion; UTL = 95% Upper Tolerance Limit.

-- = No ILCR or HI calculated

NA = Not Available

^a MDC presented only if it exceeds BSC, or no BSC is available.

^b Site-specific screening level (SSSL) based on cancer risk for the recreational site user exposure to sediment.

^c Site-specific screening level based on noncancer hazard for the recreational site user exposure to sediment.

^d MDC presented only if it exceeds SSSL-c.

^e MDC presented only if it exceeds SSSL-n.

^f Incremental lifetime cancer risk for the recreational site user exposed to chemical in sediment.

^g Hazard index for noncancer effects for the recreational site user exposed to chemical in sediment.

^h SSSL based on chromium VI.

Risk Characterization. Risk characterization combines the exposure assumptions and toxicity assessment (incorporated in the SSSLs) with the exposure-point concentration (EPC) to quantify the incremental lifetime cancer risk (ILCR) and noncancer hazard index (HI). ILCR and HI estimates are computed for each COPC in each medium, and are summed across media to yield a total ILCR and total HI for each receptor scenario. The PRA differs from an SRA in that ordinarily no attempt is made to estimate an EPC that reflects a conservative estimate of average concentration for use in risk assessment. The 95 percent upper confidence limit on the mean (UCL) is usually used for this purpose. Instead, the MDC is adopted as the EPC, at least for the first iteration, which imparts a conservative bias to the PRA.

EPA (1990) considers ILCR estimates below $1\text{E-}6$ to be negligible, ILCR estimates from $1\text{E-}6$ to $1\text{E-}4$ to fall within a risk management range, and ILCR estimates above $1\text{E-}4$ to be generally unacceptable. Risk values may be rounded to one significant figure to reflect the uncertainty about their estimation (EPA, 1989, 2002a). For example, a calculated ILCR of $9.50\text{E-}7$ would be rounded to $1\text{E-}6$ and interpreted as falling within the risk management range. Similarly, a calculated ILCR of $1.49\text{E-}4$ would be rounded to $1\text{E-}4$ and interpreted as falling within, but not exceeding, the risk management range. Also, an HI of $1.49\text{E+}0$ would be rounded to 1 and interpreted as not exceeding the threshold level of 1. Risk estimates in this document are presented in scientific notation with two places to the right of the decimal to facilitate checking calculations. Rounding is done only if needed to simplify interpretation.

The national guardsperson is potentially exposed to surface and subsurface soil at Parcel 102(7). COPCs selected for exposure to surface soil for the national guardsperson for the first iteration of the risk assessment are limited to arsenic, based on cancer risk (Table 1). The total ILCR for exposure to surface soil was $8.89\text{E-}6$, which is within the risk management range. No chemicals were selected as COPCs for noncancer effects, and an HI was not estimated.

COPCs selected for national guardsperson exposure to subsurface soil for the first iteration of the risk assessment are limited to arsenic and chromium, based on cancer risk (Table 4). The total ILCR for exposure to subsurface soil was $2.45\text{E-}5$, which is within the risk management range. No chemicals were selected as COPCs for noncancer effects, and an HI was not estimated.

The total ILCR for national guardsperson exposure to Parcel 102(7) can be estimated by summing the ILCR estimates for exposure to surface soil and subsurface soil. The total ILCR summed across both soil media of $3.34\text{E-}5$ is within the risk management range. No HI is estimated because no chemicals were selected as COPCs for noncancer effects for exposure to surface or subsurface soil. It is concluded that exposure to media at Parcel 102(7) poses no unacceptable cancer risk or noncancer hazard for the national guardsperson.

The recreational site user is potentially exposed to surface soil, surface water and sediment at Parcel 102(7). COPCs selected for exposure to surface soil for the recreational site user for the first iteration of the risk assessment are limited to arsenic, based on cancer risk (Table 2). The total ILCR for exposure to surface soil was $1.12\text{E-}6$, which is within the risk management range. No chemicals were selected as COPCs for noncancer effects, and an HI was not estimated.

COPCs selected for recreational site user exposure to surface water for the first iteration of the risk assessment are limited to arsenic based on cancer risk (Table 6). The total ILCR for exposure to surface water was $4.79\text{E-}6$, which is within the risk management range. No chemicals were selected as COPCs for noncancer effects, and an HI was not estimated. As noted above, no chemicals were selected as COPCs for exposure to sediment.

The total ILCR for recreational site user exposure to Parcel 102(7) can be estimated by summing the ILCR estimates for exposure to surface soil and surface water. The total ILCR summed across these media of $5.91\text{E-}6$ is within the risk management range. No HI is estimated because no chemicals were selected as COPCs for noncancer effects for exposure to surface soil or surface water. It is concluded that exposure to media at Parcel 102(7) poses no unacceptable cancer risk or noncancer hazard for the recreational site user.

The on-site resident was included for the additional information and perspective provided by evaluation of the most highly exposed receptor, although residential development is not included in the plans for Parcel 102(7). Should the residential scenario “pass” the PRA, the site can be released for unrestricted use with no further action. The on-site resident is potentially exposed to surface soil, subsurface soil, surface water and sediment. COPCs selected for exposure to surface soil for the first iteration of the risk assessment are limited to arsenic, based on cancer risk and noncancer effects, and antimony, based on noncancer effects (Table 3). The total ILCR for exposure to surface soil was $7.72\text{E-}5$, which is within the risk management range. The total HI for surface soil was $1.56\text{E+}0$, due largely to arsenic, which exceeds the threshold level of 1.

COPCs selected for residential exposure to subsurface soil for the first iteration of the risk assessment are limited to arsenic, selected for cancer risk and noncancer effects, and chromium, selected only for noncancer effects (Table 5). The total ILCR for exposure to subsurface soil was $1.07\text{E-}4$, which, when rounded to one significant figure, is within the risk management range. The total HI for exposure to subsurface soil of $2.30\text{E+}0$, which exceeds the threshold limit of 1, is due largely to arsenic with a contribution from chromium as well.

Residential exposure to surface water and sediment is assumed to be identical to that of the recreational site user. As discussed above, an ILCR of $4.79\text{E-}6$ was estimated for exposure to arsenic in surface water (Table 6). No chemicals were selected as COPCs in sediment.

A second iteration or refined PRA for the on-site resident was prompted by HI estimates that exceed the threshold limit of 1. COPCs selected for surface soil include antimony and arsenic (Table 3). The MDC for antimony is less than the UTL, and it is judged that antimony is present at concentrations comparable to background. The MDC for arsenic, however, exceeds the UTL, and arsenic is assumed to be site-related. COPCs for subsurface soil include arsenic and chromium (Table 5). The MDCs of both exceed their respective UTLs, and it is concluded that both are present in subsurface soil as site-related COPCs. COPCs in surface water are limited to arsenic (Table 6). The MDC of arsenic exceeds the UTL; it is judged that arsenic is present in surface water as a site-related COPC. The second iteration, therefore, differs from the first only

in the exclusion of antimony as a COPC in surface soil.

The total ILCR and HI for on-site residential exposure to Parcel 102(7) for the refined PRA can be estimated by summing the ILCR and HI estimates for exposure to surface soil, subsurface soil and surface water. The total ILCR summed across all relevant media of $1.89\text{E-}4$, due entirely to arsenic, exceeds the risk management range. The total HI summed across media of $3.70\text{E+}0$, due to arsenic in surface and subsurface soil and chromium in subsurface soil, exceeds the threshold level of 1. The contributions to the total HI from arsenic and chromium can be separated because the two metals affect different target organs (please see toxicity profiles appended to IT [2000]). The HI associated with chromium of $3.61\text{E-}1$ is less than the threshold level of 1, and chromium is not considered further. The total HI for arsenic in surface soil and subsurface soil of $3.34\text{E+}0$ exceeds the threshold level of 1.

Arsenic in surface soil, subsurface soil and surface water arises as the only chemical of concern (COC) at Parcel 102(7), so further consideration was given to refining its status as a site-related chemical in all three media. Although the MDCs for arsenic exceed their UTLs, the MDCs fall within the range of background in all media (data not shown). The determination of arsenic as a site-related chemical or present at background concentrations is not clear-cut. Clarification was sought for arsenic in soil by combining the data sets for surface and subsurface soil and subjecting them to the Mann-Whitney U-Test (MWUT). The MWUT, including a box-and-whiskers plot, suggest that arsenic is present in soil at Parcel 102(7) at levels higher than background (Figure 1).

Arsenic in soil occurs naturally in association with various iron compounds, and the ratio of arsenic to iron in uncontaminated soil remains fairly constant regardless of the absolute concentrations of either element (IT, 2002). Therefore, further clarification was sought by plotting the concentrations of arsenic and iron for the six soil samples used in the PRA (Figure 2). Figure 2, however, identifies one surface soil and one subsurface soil sample where the arsenic-to-iron ratio appears to exceed the trend established by the other samples, suggesting that the concentration of arsenic in these samples exceeds background. Collectively, the MWUT and the geochemical analysis confirm that arsenic is appropriately determined to be a site-related chemical in soil.

Only one surface water sample was taken. The surface water data are insufficient for statistical or geochemical analysis to clarify whether or not arsenic is present at background concentrations. However, the determination that arsenic is present in soil as a site-related chemical supports the assumption that arsenic may also be site-related in surface water.

It is not plausible for the on-site resident to be simultaneously exposed to the MDC of arsenic in both surface and subsurface soil. Therefore, as a final refinement to the PRA for the resident, the surface and subsurface soil data were combined and a UCL of $3.66\text{E+}1$ mg/kg was estimated and adopted as the EPC for arsenic. An ILCR of $8.61\text{E-}5$ was estimated for residential exposure to soil based on an EPC for arsenic of $3.66\text{E+}1$ mg/kg (data not shown). The total ILCR summed across soil and surface water of $9.09\text{E-}5$ is within the risk management range. An HI of $1.56\text{E+}0$

Figure 1
Mann-Whitney U Test (102 as soil test.sta)

By variable CHEMICAL

Group 1: 100-As-site Group 2: 101-As-bkgd

	Rank Sum As-site	Rank Sum As-bkgd	U	Z	p-level	Z adjusted	p-level	Valid N As-site	Valid N As-bkgd	2*1sided exact p
VALUE_MG	678	7072	51	3.528268	0.000419	3.528307	0.000419	6	118	4.76E-05

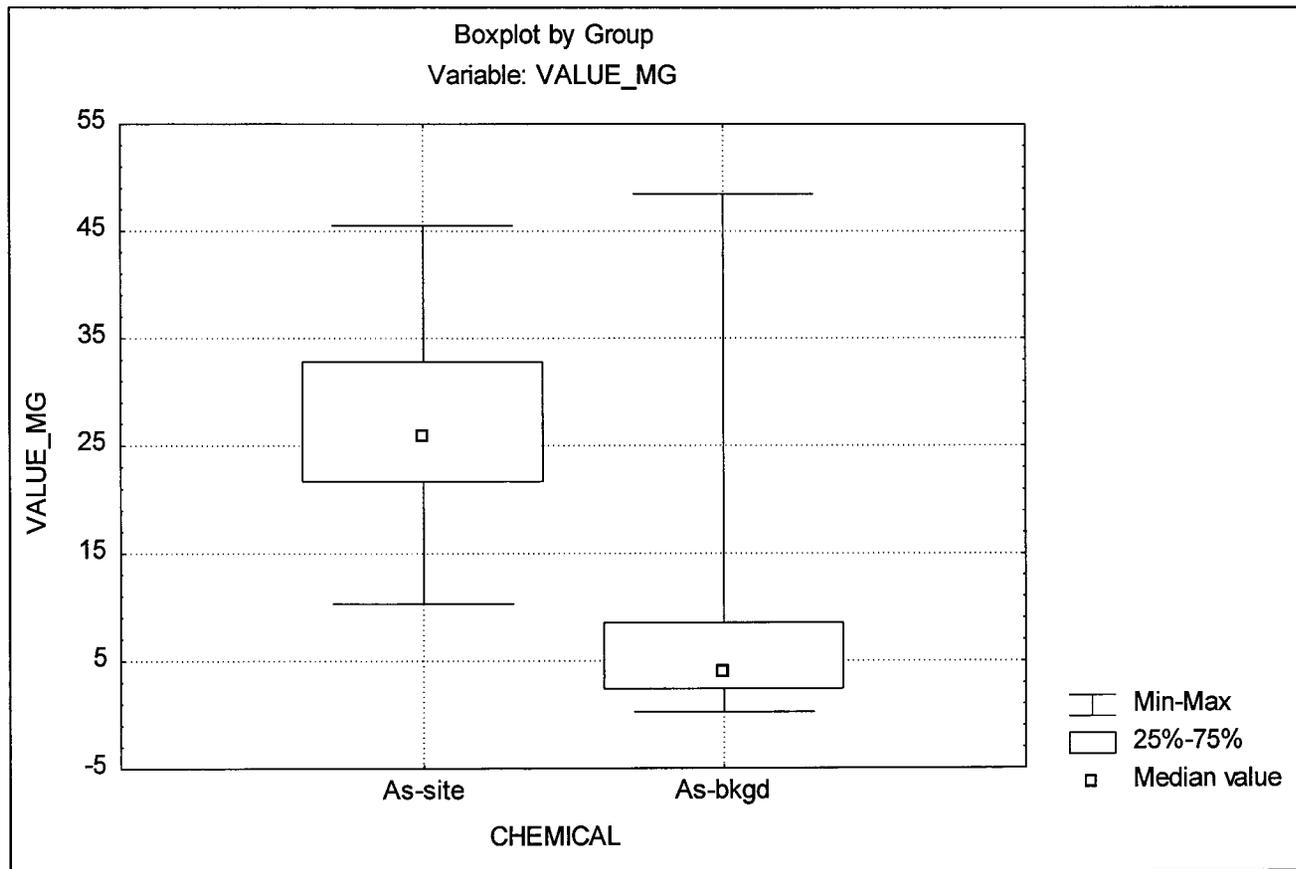
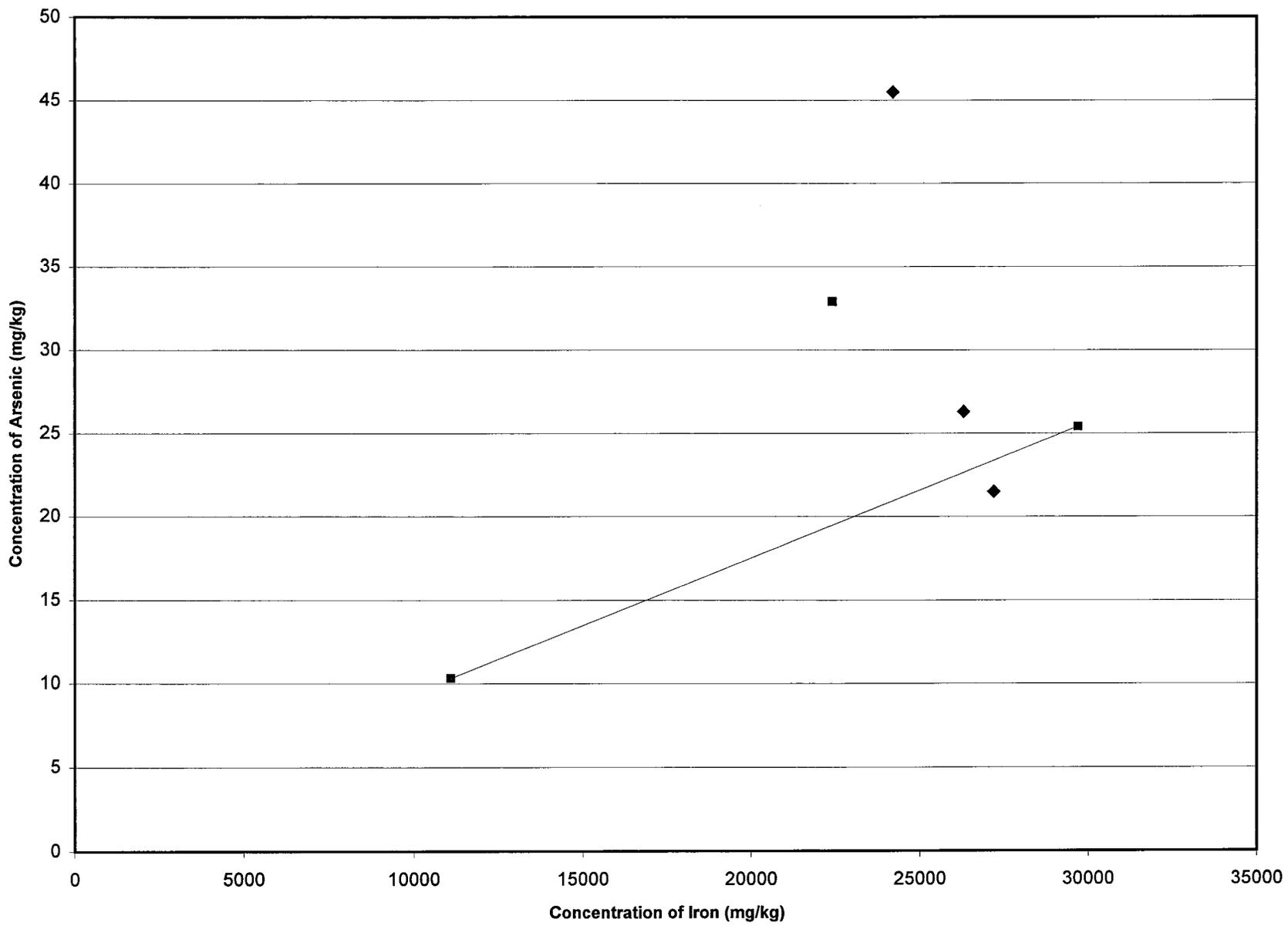


Figure 2
Parcel 102 Soil Concentrations of Iron and Arsenic



is estimated for residential exposure to soil based on the EPC for arsenic of 3.66E+1 mg/kg (data not shown).

The HI of 1.56E+0 for arsenic slightly exceeds the threshold level of 1, raising concern about releasing the site for unrestricted use with no further action. However, the HI of 1.56E+0 is near the low end of the HI range of 1 to 3 often used by EPA (2002a) for establishing remedial goal options. Also, the HI is based on an EPA (2002b) oral reference dose (RfD) of 3E-4 mg/kg-day.

EPA (2002b) notes that the RfD is enveloped with considerable uncertainty, and that values from 1E-4 to 8E-4 mg/kg-day would be reasonable. An HI of 5.63E-1, below the threshold level of 1, would be estimated from an RfD of 8E-4 mg/kg-day.

In conclusion, the PRA confirms that Parcel 102(7) can be released for military training or recreational use with no further action. The PRA suggests that concentrations of arsenic slightly exceed background levels. Given the uncertainty regarding the oral RfD, IT recommends that the site can be released for unrestricted use requiring no further action.

References

IT Corporation (IT), 2000, **Human Health and Ecological Screening Values and PAH Background Summary Report**, Final, Fort McClellan, Calhoun County, Alabama, Prepared for U.S. Army Corps of Engineers, Mobile District, August.

IT Corporation (IT), 2002, **Installation-Wide Work Plan**, Revision 2, Draft, Fort McClellan, Calhoun County, Alabama, Prepared for U.S. Army Corps of Engineers, Mobile District, February.

Science Applications International Corporation (SAIC), 1998, **Final Background Metals Survey Report**, prepared for U.S. Army Corps of Engineers, Mobile District, July.

U.S. Environmental Protection Agency (EPA), 1989, **Risk Assessment Guidance for Superfund Volume I Human Health Evaluation Manual (Part A)**, Interim Final, Office of Emergency and Remedial Response, Washington, DC, EPA/540/1-89/002, December.

U.S. Environmental Protection Agency (EPA), 1990, "National Oil and Hazardous Substances Pollution Contingency Plan," **Federal Register** 55(46): 8666-8865.

U.S. Environmental Protection Agency (EPA), 2002a, **Region 4 Human Health Risk Assessment Bulletins – Supplement to RAGS, Interim Human Health Risk Assessment Bulletins**, Waste Management Division, EPA Region 4, Atlanta, GA, on line.

U.S. Environmental Protection Agency (EPA), 2002b, **Integrated Risk Information System (IRIS)**, National Center for Environmental Assessment, Cincinnati, OH, on line, last accessed 19 March.