DOCUMENTATION OF ENVIRONMENTAL INDICATOR DETERMINATION

Interim Final 2/5/99

RCRA Corrective Action
Environmental Indicator (EI) RCRIS Code (CA725)

Current Human Exposures Under Control

Facility Name: **Sunflower Army Ammunition Plant**
Facility Address: **DeSoto, Kansas**
Facility EPA ID #: **KS3213820878**

1. Has **all** available relevant/significant information on known and reasonably suspected releases to soil, groundwater, surface water/sediments, and air, subject to RCRA Corrective Action (e.g., from Solid Waste Management Units (SWMU), Regulated Units (RU), and Areas of Concern (AOC)), been **considered** in this EI determination?

   __X__ If yes - check here and continue with #2 below.

   _____ If no - re-evaluate existing data, or

   _____ If data are not available skip to #6 and enter"IN" (more information needed) status code.

The Sunflower Army Ammunition Plant (SFAAP) is located just southwest of DeSoto, in Johnson County, Kansas. The location and general layout of SFAAP are shown on Figures 1 and 2, respectively, in Attachment 1. Sixty-five SWMUs and 22 AOCs have been identified at SFAAP. These SWMUs and AOCs are described below and are depicted in Figure 3 in Attachment 1.

Where samples were collected at the SWMUs and AOCs, analytical results were evaluated relative to risk-based comparison values established by the Agency for Toxic Substances and Disease Registry (ATSDR) and U.S. Environmental Protection Agency (EPA). Comparison values for surface water analytical results included the ATSDR Cancer Risk Evaluation Guide (CREG) and Chronic Environmental Media Evaluation Guide (C-EMEG), and the EPA Lifetime Health Advisory for Drinking Water (LTHA), Risk-Based Concentration (RBC), and Reference Dose Media Evaluation Guide (RMEG). Comparison values for soil and sediment analytical results included the ATSDR CREG and C-EMEG, and the EPA RBC, RMEG, and Soil Screening Level (SSL). Comparison values for groundwater analytical results included the ATSDR CREG, C-EMEG, and Intermediate Environmental Media Evaluation Guide (I-EMEG), as well as the EPA LTHA, RMEG, Maximum Contaminant Level (MCL), and Secondary Maximum Contaminant Level (SMCL). The tables provided in Appendix 1 list the contaminants detected in each environmental media above comparison levels, as well as the type of comparison level exceeded.

SWMUs

SWMU-1: Classification Area

SWMU-1 is a 42-acre area along the railroad yard, where incoming raw materials have been sorted for distribution, beginning in 1942. Although no hazardous wastes were generated here, some incoming raw materials were classified as hazardous materials. Investigations of groundwater, surface water, sediment, and surface soil have been conducted at SWMU-1; no subsurface soil samples have been collected. Contaminants identified at concentrations above comparison values included thallium in surface water and arsenic and iron in sediment and surface soil. Phenanthrene was detected in surface soil, but does not have a comparison value (ATSDR 2002). A Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) report completed for SWMU-1 recommended no further action (NFA), and no further investigatory or remedial actions are planned (Law Engineering and Environmental Services, Inc. [Law] 1999a).

SWMU-2: River Water Treatment Plant (RWTP), Lagoons, and Dredged Material

The RWTP was operational from 1943 to 1971, treating water from the Kansas River by lime addition, sedimentation, carbon filtration, and chlorination. Two unlined lagoons collected RWTP wastes; however, lagoon overflow eventually reached the Kansas River through Hansen and Kill Creeks. Acid was added to the lagoons whenever the pH became too high. Contaminants include lime and filter backwash solids from RWTP activities, nitroguanidine (NQ), acid wastewater, calcium cyanide, and toxic unionized ammonia from NQ production. Investigations of groundwater, surface water, surface soil, subsurface soil, and sludge have been conducted at SWMU-2. Contaminants identified at concentrations above comparison values included fluoride in groundwater and arsenic and iron in surface soil and sludge. Guanidine nitrate (GN) was detected in sludge, but does not have a comparison value (ATSDR 2002). An RFI report completed for SWMU-2 recommended NFA, with the exception of an assessment of Hansen Creek downgradient from the lagoons (Law 1999j).

SWMU-3: Main Sewage Treatment Plant (STP) and Disposal Pond

The 3-acre STP, operational since 1943, treats sanitary wastewater with a bar screen, Parshall flume, Inhoff tank, trickling filter, final clarifier, and unlined effluent holding pond and then discharges the treated water into Kill Creek. Wastewater treated by the STP is primarily domestic sewage, but historically has included wastewater from laboratory and production facilities. Investigations of surface water, sediment, surface soil, and sludge have been conducted at SWMU-3. Contaminants identified at concentrations above comparison values included dieldrin in surface water; arsenic in sediment; aldrin, chlordane, dieldrin, and polychlorinated biphenyl (PCB)-1260 in surface soil; and aldrin, arsenic, chlordane, dieldrin, and PCB-1260 in sludge. Phenanthrene was detected in surface soil and sludge, and 4-bromodiphenyl ether was detected in sludge; however, these compounds do not have comparison values (ATSDR 2002). An RFI report completed for SWMU-3 recommended additional investigation to determine the nature and extent of contamination in subsurface soil and groundwater at the site (Law 1999b).

SWMU-4: Pond A and Sludge Disposal Area

Pond A is an unlined, 86,200-square-foot (ft^2) pond built in the 1940s. Pond A was used for sedimentation of solids and equalization of wastewater from the nitrocellulose (NC) area. Pond A also received wastes from the NQ support area, as well as surface water runoff from the metal salvage yard, corporation yard, and North Acid Area. Surface water runoff and wastewaters discharged to Pond A were contaminated with nitric and sulfuric acids, NC fines, and acidic sludge neutralized with lime. This sludge was dredged from Pond A and landfilled in a 6.4-acre area north of the pond. Production ceased in 1971, and Pond A has received only natural drainage and storm sewer outfall since that time. Sludge samples collected in the Sludge Disposal Area revealed concentrations of arsenic, iron, and manganese above comparison values. Phenanthrene and NC were also detected in sludge; however, these compounds do not have comparison values. No semivolatile organic compounds (SVOC), pesticides, PCBs, or inorganics were detected in groundwater (ATSDR 2002). An RFI report completed for SWMU-4 recommended additional investigation of the Sludge Disposal Area and the drainage pipe and tributary running from Pond A to B. SFAAP is scheduled to close the pond in 2004 (Law 1999c).

SWMU-5: Pond A Neutralization Area

SWMU-5 was constructed in 1942 and 1943 to treat acidic wastewater from the NC area. Prior to discharge into Pond B, Pond A effluent was neutralized here using burnt lime slurry. Sludge samples collected at SWMU-4 revealed concentrations of arsenic, iron, and manganese above comparison values. Phenanthrene and NC also were detected in sludge; however, these compounds do not have comparison values. No SVOCs, pesticides, PCBs, or inorganics were detected in groundwater (ATSDR 2002). SFAAP is scheduled to remove and treat about 5,000 cubic yards (yd^3) of soil and close Pond A by 2004 (Law 1999c).

SWMU-6: Pond B and Sludge Disposal Area

Pond B is a 9-acre, unlined pond that was constructed downstream of Pond A in the 1940s. Pond B was used for sedimentation of solids from SWMU-5 discharge. Pond B received neutralized wastewater from SWMU-5 and effluent from the Industrial Waste Treatment (IWT) Lagoons. Pond B currently is used to detain runoff, control flow from Pond A, and receive effluent from the IWT lagoons. Investigations of groundwater, surface water, sediment, and sludge have been conducted at SWMU-6. Contaminants identified at concentrations above comparison values included ammonia nitrogen, sulfate, and manganese in groundwater; dieldrin in surface water; arsenic and iron in sediment; and arsenic and iron in sludge. NC was detected in sediment and sludge, but does not have a comparison value (ATSDR 2002). An RFI report completed for SWMU-6 recommended NFA for surface water and sludge; however, SFAAP is scheduled to remove and treat about 40,000 yd^3 of soil and close Pond B by 2004. No additional remedial action was recommended for groundwater; however, the potential need to determine the extent of manganese contamination in groundwater downgradient of Pond B was noted (Law 1999h).

SWMU-7: North Acid Area - Chromate Area

The North Acid Area manufactured ammonium nitrate liquor from 1947 to 1948 and from 1953 to 1954. The treatment unit for this manufacturing process included a cooling tower that used chromate as a

corrosion inhibitor. Chromium-contaminated wastewater from the tower was collected in two basins (one steel and one concrete) on site. The treatment unit and cooling tower were dismantled in 1958; however, the two collection basins remain, the contents of which were transported to an off-site disposal area between 1981 and 1983 (ATSDR 2002). Samples collected during an RFI of SWMUs 7, 8, and 9 revealed chromium above comparison values in surface soil and surface water. Other heavy metals were detected above background in groundwater, surface soil, and surface water. Polycyclic aromatic hydrocarbons and phthalates also were detected above background in surface soil. The RFI report recommended additional action to determine the extent of soil contamination and the nature of subsurface anomalies. Additionally, the report recommended removal and treatment of contaminated surface water, excavation and disposal of sludge, and steam cleaning (Burns and McDonnell Engineering Company, Inc. [BMcD] 2001a).

SWMU-8: North Acid Area - Chromate Concentration Pond

The Chromate Concentration Pond was located within the North Acid Area, but was drained and partially filled during dismantling activities in 1958. The exact location of the former pond is uncertain. Sampling activities, results, and recommendations from the RFI of the North Acid Area are discussed under SWMU-7 above (BMcD 2001a).

SWMU-9: North Acid Area - Wastewater Treatment Lagoon

The Wastewater Treatment Lagoon for the North Acid Area is believed to have been similar to that in the South Acid Area, where wastewater was neutralized with lime and then discharged to a holding pond or lagoon. Calcium sulfate sludge and chromate-contaminated water are believed to be the results of these practices (ATSDR 2002). Sampling activities, results, and recommendations from the RFI of the North Acid Area are discussed under SWMU-7 above (BMcD 2001a).

SWMU-10: F-Line Ditches

SWMU-10 was an automated roll house where carpet and breaker rolls converted back-process grains into sheet rock. Twenty-one unlined drainage ditches transported wastewater containing propellant solids (some with lead salts and nitroglycerine [NG]) to the settling ponds and then to Spoon and Kill Creeks. Groundwater, surface water, sediment, and surface soil samples were collected at SWMU-10. Contaminants identified at concentrations above comparison values included ammonia nitrogen, cadmium, manganese, and NG in groundwater; ammonia nitrogen and sulfate in surface water; arsenic and NG in sediment; and arsenic, iron, lead, and NG in surface soil. Phenanthrene and NC were detected in surface soil; however, no comparison values exist for these compounds. NC also was detected in sediment (ATSDR 2002). An RFI of SWMUs 10 and 11 revealed that remediation and monitoring were necessary (Law 1997c). Remediation of SWMUs 10 and 11, which included excavation and disposal of about 45,848 tons of treated soils, was completed in 2001 (International Technology Corporation [IT] 2001).

SWMU-11: F-Line Area Settling Ponds and Blender Ponds

Wastewater from the F-Line facilities was transported by drainage ditches to six unlined settling ponds and two blender ponds. The wastewater contained raw and uncolloided propellants contaminated with lead salts, NC, and other waste. The ponds were constructed in 1943. Six were closed in 1969, and two were closed in 1971. Groundwater, surface water, sediment, and surface soil samples were collected at SWMU-11. Contaminants identified at concentrations above comparison values included ammonia nitrogen, cadmium, manganese, and NG in groundwater; ammonia nitrogen and sulfate in surface water; arsenic and NG in sediment; and arsenic, iron, lead, and NG in surface soil. Phenanthrene and NC were detected in surface soil; however, no comparison values exist for these compounds. NC also was detected in sediment (ATSDR 2002). An RFI of SWMUs 10 and 11 revealed that remediation and monitoring were necessary (Law 1997c). Remediation of SWMUs 10 and 11, which included excavation and disposal of about 45,848 tons of treated soils, was completed in 2001 (IT 2001).

SWMU-12: Pyott's Pond and Sludge Disposal Area

Pyott's Pond is an unlined, 1.7-acre pond built in 1968 to help with pollution control. Historically, the pond has received drainage from the South Acid Area and Solvent Area, wastes from the F-Line Paste Area and NC Area, and untreated wastewater from the NC Area. About 9 acres of dredged sludge were landfilled to the north and south of the pond. Groundwater, surface water, sediment, and surface soil samples were collected at SWMU-12. Contaminants identified at concentrations above comparison values included sulfate in groundwater; 1,1,2-trichloroethane in surface water; arsenic and benzo(a)pyrene in sediment, and arsenic in surface soil. Phenanthrene and NC were detected in sediment; however, no comparison values exist for these compounds. NC also was detected in sediment. Pyott's Pond currently receives neutralized acid from the South Acid Area and is used for flow control and emergency containment for acid manufacturing by Koch Industries. An RFI has been conducted at SWMU-12. SFAAP is scheduled to remove about 7,000 yd^3 of soil and close Pyott's Pond by 2003, followed by 5 years of long-term monitoring (ATSDR 2002; Law 1999k).

SWMU-13: South Acid Area Liquid Waste Treatment Plant (LWTP) and Evaporative Lagoons

The South Area LWTP, first operated in 1979, consists of five aboveground storage tanks (AST) and four evaporative lagoons. The LWTP treats corrosive wastewater from the acid production area and sulfuric acid concentration unit with lime to neutralize the acid and heat to destroy any NQ contamination. The wastewater is then transported to the evaporative lagoons to settle out the resulting calcium sulfate sludge. Groundwater, surface water, surface soil, and sludge samples were collected at SWMU-13. Contaminants identified at concentrations above comparison values included nitrate/nitrite and sulfate in groundwater, manganese, nitrate/nitrite, and sulfate in surface water; and arsenic and iron in surface soil and sludge (ATSDR 2002). An RFI has been conducted at SWMU-13. Currently, the lagoons are being closed and groundwater monitoring is underway (Law 1999e).

SWMU-14: Rocket Static Test Area

The 3-acre Rocket Static Test Area consists of four firing platforms located adjacent to two Proving Ground buildings. Rocket propellant grains, about 1 centimeter in diameter, were tested for acceptance

here, with about 79,500 test firings conducted from 1965 to 1971. Groundwater, surface water, sediment, and surface and subsurface soil samples were collected at SWMU-14. Contaminants identified at concentrations above comparison values included arsenic, iron, and manganese in sediment; and arsenic, bis(2-ethylhexyl)phthalate, cadmium, copper, iron, lead, and NG in surface soil. NC was detected in sediment and surface soil, but has no comparison value (ATSDR 2002). An RFI conducted at SWMU-14 recommended additional sampling, well installation, potential interim measures, and a corrective measures study (CMS). The CMS at SWMU-14 is ongoing (BMcD 2002b).

SWMU-15: Waste Storage Magazines

SWMU-15 consists of nine magazine buildings with natural lighting, locked doors, and concrete floors with secondary containment. Six buildings contain production waste from propellant manufacturing (drums of dry GN waste, off-specification NQ waste, and wet NQ laboratory waste), one contains spent solvents, and two contain sulfuric acid regeneration boiler ash, explosive waste incinerator ash, explosive waste burning grounds ash, and solid and liquid hazardous wastes (ATSDR 2002). Surface and subsurface soil samples were collected at SWMU-15. Contaminants of concern in surface soil included aldrin, dieldrin, aluminum, antimony, chromium, and manganese, and in subsurface soils included aldrin, dieldrin, antimony, and manganese. An RFI conducted at SWMU-15 recommended further investigation of surface water and sediment adjacent to Spoon Creek (BMcD 2000d).

SWMU-16: Temporary Waste Storage Magazines

SWMU-16 consists of six magazines, which have contained 550 gallons of spent chlorinated degreasing solvents, 19.8 tons of actual waste and reprocessable material, and 7.3 tons of containerized toxic wastes and nonhazardous sludge over time. Waste from five of the buildings was transferred to SWMU-15 in 1984 and 1985 (ATSDR 2002). Groundwater, surface soil, and subsurface soil samples were collected at SWMU-16. Although contaminants were identified at levels above background, no contaminant concentration exceeded regulatory standards. An RFI conducted at SWMU-16 found that no remedial action was required there (BMcD 2000k).

SWMU-17: G-Line Area Ditches

The G-Line Area is an idle solvent propellant area, and the G-Line Area Ditches are expected to have received similar contaminants to those discharged to the F-Line Area Ditches (lead and propellant solids). NC spills were reported in the G-Line Area in the 1940s (ATSDR 2002). Surface soil and groundwater samples were collected at SWMU-17, and nitrate/nitrite was detected at concentrations above its comparison value in groundwater. An RFI conducted at SWMU-17 recommended further investigation of groundwater, surface water, sediment, and the sumps and the soils surrounding them (BMcD 2000m).

SWMU-18: Old and New Sanitary Landfills

The Old Sanitary Landfill opened in 1943 and is assumed to have received all types of waste from SFAAP. The New Sanitary Landfill was opened in 1967 and has received about 791,000 cubic feet of garbage, trash, waste sulfur and vanadium pentoxide dust, and reacted carbide and calcium cyanamide,

none of which constitutes a hazardous waste. Buried containers of lead and two asbestos landfills are located near the sanitary landfills. Groundwater, surface water, sediment, surface soil, and soil gas samples were collected at SWMU-18. Contaminants identified at concentrations above comparison values included nitrate/nitrite in groundwater, arsenic in sediment, and arsenic and dioxins/furans in surface soil. Sulfide was detected in groundwater but does not have a comparison value (ATSDR 2002). An RFI conducted at SWMU-18 recommended additional surface water and groundwater monitoring, as well as institutional controls to restrict access to surface soils, and possible expansion of the groundwater monitoring well network. Interim remedial actions included diverting groundwater flow and controlling erosion; final remedial action will include diverting groundwater flow around the landfill and constructing a landfill cap (Law 1997d).

SWMU-19: Ash Landfill

SWMU-19 is an unlined 10-acre landfill used before 1966 for the disposal of fly ash and coal fines. The fly ash, from the ash-sluice system, may contain heavy metals. Groundwater, surface water, sediment, and surface soil samples were collected at SWMU-19. Contaminants identified at concentrations above comparison values included nitrate/nitrite in groundwater, arsenic in sediment, and arsenic and dioxins/furans in surface soil. Sulfide was detected in groundwater but does not have a comparison value (ATSDR 2002). The RFI for SWMU-19 was conducted in conjunction with that for SWMU-18. Remedial actions applicable to SWMU-18 also apply to this SWMU (Law 1997d).

SWMU-20: Ash Lagoons and Sludge Disposal Area

SWMU-20 consists of four unlined Ash Lagoons, which, since 1979, have collected fly ash and bottom ash from the boiler house through an ash sluice system. The lagoons are dredged periodically and the sludge disposed of in a landfill. Fly ash may contain heavy metals (ATSDR 2002). Groundwater samples were collected from SWMU-20, and aluminum, manganese, and ammonia nitrogen were detected. In the absence of a site-specific risk, the final RFI for SWMU-20 recommended NFA to assess groundwater contamination at SWMU-20. However, the RFI states that samples should be collected from lagoon floors, residual sludge, drainage ditch, and surface water to adequately define the extent of contamination (BMcD 2000g).

SWMU-21: Contaminated Materials Burning Ground

Since 1943, the 4-acre SWMU-21 has decontaminated scrap metal and other combustible material contaminated with explosives or propellants. The fire has been ignited with diesel fuel, waste oils, and scrap wood. Metal items are salvaged, and the ash is transported to a sanitary landfill. Groundwater, surface water, sediment, and surface soil samples have been collected from SWMU-21. Contaminants identified at concentrations above comparison values included antimony, arsenic, manganese, and nickel in groundwater; arsenic in sediment; and aldrin, antimony, arsenic, cadmium, dieldrin, dioxins/furans, and lead in surface soil. Endrin ketone, benzo(g,h,i)perylene, and phenanthrene also were detected in surface soil but do not have comparison values (ATSDR 2002). An RFI conducted at SWMU-21 recommended interim measures to control hydrocarbon release to the stream, installation of well nests to evaluate potential contaminant migration, a CMS, and long-term monitoring following site cleanup for dioxins/furans (BMcD 2002c).

SWMU-22: Old Explosives Waste Burning Ground

SWMU-22 is a 7-acre site, consisting of five burning trenches, an NQ dump area, and a lead recovery area used from 1943 to 1980. NG mixed with sawdust and various propellants were burned in the trenches. Groundwater, surface water, sediment, and surface soil samples were collected at SWMU-22. Contaminants identified at concentrations above comparison values included nickel in groundwater; arsenic in sediment; and arsenic, cadmium, dioxins/furans, iron, lead, manganese, and NG in surface soil. NC and pentaerythritol teranitrate also were detected in surface soil but do not have comparison values (ATSDR 2002). An RFI conducted simultaneously at SWMUs-22 and -32 recommended a CMS and NFA for groundwater, because the constituents at the site appeared to be remaining in the soil (Law 1997b). A CMS has been completed for SWMU-32; lead-contaminated soil has been excavated, treated, and disposed of; and long-term monitoring has begun (ATSDR 2002).

SWMU-23: New Explosives Waste Burning Ground

SWMU-23 replaced SWMU-22 in 1980 and consists of a 130- by 340-foot earthen pad. Up to 5,000 pounds (lb) of NQ, GN, explosives, or propellant wastes can be burned or detonated on this pad at one time. Groundwater and surface soil samples were collected at SWMU-23. Contaminants identified at concentrations above comparison values included arsenic and iron in surface soil only (ATSDR 2002). This site has undergone RCRA closure, removing all contaminated surface soil and eliminating the potential for contaminant migration to groundwater (MKM Engineers, Inc. and Parsons Engineering Science, Inc. 1999).

SWMU-24: NG Ditches

SWMU-24, operational from World War II to 1971, consists of unlined tributary ditches running from six buildings to Kill Creek. Acidic rinse water, soda ash wash, and floor and equipment cleaning water were discharged to these ditches. Two spills of NG, one of 2 lb and one of 1,200 lb, occurred on the soil in this area in 1944. Groundwater, surface water, sediment, and surface soil samples were collected at SWMU-24. Contaminants identified at concentrations above comparison values included bis(2-ethylhexyl)phthalate, nitrate/nitrite, and thallium in groundwater; arsenic, lead, and manganese in surface water; arsenic, benzo(a)pyrene, and manganese in sediment; and arsenic and lead in surface soil. NC also was detected in sediment and surface soil but does not have a comparison value (ATSDR 2002). An RFI conducted at SWMU-24 recommended removal, institutional controls, and additional sampling. Contaminated materials will be excavated, treated, and disposed of off site in 2004, and long-term monitoring is expected to begin in 2005 (Law 1999d).

SWMU-25: NC Area Ditches

SWMU-25, operation from 1942 to 1960 and from 1965 to 1971, consisted of open drainage ditches leading to Pond A. Wastes from NC production and acid wash water were discharged to these ditches (ATSDR 2002). Groundwater, sediment, surface soil, and subsurface soil samples were collected at SWMU-25. The primary contaminant of concern (COC) was identified as manganese in groundwater. An RFI conducted at SWMU-25 recommended no remedial action without first modeling groundwater transport (BMcD 2000o).

SWMU-26: Single Base Area Wastewater Settling Sumps

From 1943 to 1971, SWMU-26 periodically produced single-base propellant for small arms, cannons, and rockets. SWMU-26 consists of four production buildings, each with its own sump and flow equalization tank and each discharging wastewater to open ditches draining into Captain Creek and Pond A (ATSDR 2002). Groundwater, sediment, surface soil, and subsurface soil samples were collected at SWMU-26. The primary site contaminant, NC, was detected in sediment samples only. Aluminum, iron, magnesium, and sodium were detected in soils, sediments, and groundwater. An RFI conducted at SWMU-26 recommended resampling some areas and collecting additional samples from the wastewater distribution system pipes (BMcD 2001b). Many buildings in this area have been removed by demolition and burning (ATSDR 2002).

SWMU-27: NQ Area Sulfuric Acid Concentrator (SAC) LWTP and SAC Evaporative Lagoons

SWMU-27, operational since 1984, includes a 45,000-gallon tank for SAC distillate, and a 17,000 gallon tank for other corrosives from NQ production. Process wastewater, potentially containing NQ and GN, is mixed with lime and discharged to two lined evaporative lagoons. In 1987, the lagoon liners were replaced as a result of damage; however, releases to underlying soils had already occurred at one lagoon. Groundwater, surface water, and surface soil samples were collected at SWMU-27. Contaminants identified at concentrations above concern included nitrate/nitrite, NQ, and sulfate in groundwater; ammonia nitrogen, manganese, nitrate/nitrite, and NQ in surface water, and arsenic in surface soil. GN was detected in surface water and surface soil but does not have a comparison value. In 1996, the sludge was remediated and the lagoon was closed and capped (ATSDR 2002). Remaining contamination is undergoing in situ denitrification, and long-term groundwater monitoring is underway. An RFI conducted at SWMU-27 recommended NFA (Law 1999i).

SWMU-28: Waste Calcium Carbide Treatment Area

SWMU-28 was a 55- by 114-foot pad where up to 2 tons of waste calcium carbide could be treated by adding water and releasing acetylene gas. Wastewater from the treatment process flowed to a tank and then a 41,800-ft^2 evaporation lagoon. Potential contaminants in the wastewater included cyanide, nitroguanidine, GN, and calcium carbide. The EPA and the Kansas Department of Health and Environment (KDHE) have certified SWMU-28 as having undergone "clean closure." NFA is planned for this SWMU (ATSDR 2002).

SWMU-29: IWT Lagoons

SWMU-29 consists of four connected, unlined treatment lagoons. Powerhouse wastewater and coal pile runoff are pH-adjusted and directed to Lagoon 165-7. The effluent then travels to Lagoon 165-5N, 165-5S, or both, where the pH of the water is raised to precipitate iron. The effluent then travels to Lagoon 165-6, where the pH is lowered again. The effluent then flows into Pond B. EPA and KDHE have certified SWMU-29 as having undergone "clean closure." NFA is planned for this SWMU (ATSDR 2002).

SWMU-30: Pesticide Handling Area

SWMU-30 is a building used to store and mix pesticides and herbicides. All liquids from the sumps are recycled, and no discharge, spills, or releases have been reported. The current building was constructed in 1984 to replace the old pesticide storage building. Before the new building was constructed, the old building and surrounding area were decontaminated to remove any pesticide residues (ATSDR 2002). Groundwater, surface soil, and subsurface soil samples were collected at SWMU-30. Contaminants with concentrations above background levels included dieldrin and endrin ketone in groundwater and pesticide and dioxin/furan contamination in soils, primarily surface soils. An RFI conducted at SWMU-30 recommended additional investigation to determine the extent of surface soil contamination and the direction of groundwater flow. The RFI also noted that a removal action potentially was warranted (BMcD 2001c).

SWMU-31: Contaminated Waste Processor (CWP) and Evaporative Lagoon

The CWP, operational since 1985, can incinerate up to 600 lb of explosive-contaminated waste per hour or decontaminate up to 600 lb of explosive-contaminated metal per hour. Trace concentrations of explosive and propellant compounds may remain after incineration. Therefore, runoff and wastewater from the CWP area are collected in the Evaporative Lagoon northwest of CWP. Surface water, surface soil, and sludge samples were collected at SWMU-31. No contaminants were detected at concentrations above comparison values. GN was detected but does not have a comparison value. An RFI completed for SWMU-31 noted that the samples had not been analyzed for metals, a data gap. SFAAP is scheduled to excavate, treat, and dispose of any contaminated soils by 2004. Also by 2004, SFAAP is scheduled to close the lagoon in accordance with State guidelines (ATSDR 2002; Law 1999f).

SWMU-32: Lead Decontamination and Recovery Unit

SWMU-32, operational from 1943 to 1970, consisted of a small building, a melting rack, and a paved area. Lead was recovered from manufacturing buildings, melted down, and molded for salvage. Groundwater, surface water, sediment, and surface soil samples were collected at SWMU-32. Contaminants identified at concentrations above comparison values included nickel in groundwater; arsenic in sediment; and arsenic, cadmium, dioxins/furans, iron, lead, manganese, and NG in surface soils. NC and pentaerythritol tetranitrate were detected in surface soils but do not have comparison values. An RFI conducted simultaneously at SWMUs-22 and -32 recommended a CMS and NFA for groundwater, because the constituents at the site appeared to be remaining in the soil (Law 1997b). A CMS has been completed for SWMU-32; lead-contaminated soil has been excavated, treated, and disposed of; and long-term monitoring has begun (ATSDR 2002).

SWMU-33: Paste Area Half Tanks and Settling Ponds

SWMU-33, operational from the mid-1960s to 1971, consisted of 10 steel half tanks used to receive wastewater from cleaning propellant processing equipment and buildings. Wastewater was transferred from the half tanks to two unlined settling ponds, where explosive particulate material was allowed another chance to settle. Water from the settling ponds was discharged to Pyott's Pond (ATSDR 2002). Groundwater, surface water, sediment, surface soil, and subsurface soil samples were collected from

SWMU-33. Contaminants detected at concentrations above comparison values included arsenic and lead in surface soil and NG and benzo(a)pyrene in sediment. An RFI conducted simultaneously at SWMUs 33, 34, and 35 recommended a CMS and eventual remediation of the soil and sediment (BMcD 2002a).

SWMU-34: Five Corners Settling Ponds

SWMU-34 consisted of two unlined ponds that received equipment and building wash water and sprinkler trip water from the early 1950s to 1971. Contaminants transferred to the ponds with the wastewater included propellant solids, lead salts, soil, paste, soda ash wash, acidic rinse water, and carbon black (ATSDR 2002). Groundwater, surface water, sediment, surface soil, and subsurface soil samples were collected from SWMU-34. Contaminants detected at concentrations above comparison values include arsenic and lead in surface soil, and lead in sediment. An RFI conducted simultaneously at SWMUs 33, 34, and 35 recommended a CMS and eventual remediation of the soil and sediment (BMcD 2002a).

SWMU-35: Nitroglycerin Area Settling Ponds

SWMU-35 consisted of settling ponds that received equipment and building wash water and sprinkler trip water from the early 1950s to 1971. Lead salts and propellant solids settled in these ponds, and the sludge was dredged and burned at the burning grounds (ATSDR 2002). Contaminants detected at concentrations above comparison values included arsenic in surface soil and lead, NG, and benzo(a)pyrene in sediment. An RFI conducted simultaneously at SWMUs 33, 34, and 35 recommended a CMS and eventual remediation of the soil and sediment (BMcD 2002a).

SWMU-36: N-Line Area

From 1943 to 1946, 1951 to 1960, and 1965 to 1971, the N-Line area completed the final machining and inspection of propellant grains. Wastewater from floor and equipment washing, which contained propellant solids, drained into about 20 unlined ditches leading to a tributary of Spoon Creek. Groundwater, surface water, sediment, and surface soil samples were collected at SWMU-36. Contaminants identified at concentrations above comparison values included cadmium, manganese, and sulfate in groundwater; manganese in surface water; arsenic, iron, and manganese in sediment; and arsenic, benzo(a)pyrene, iron, and manganese in surface soil. Phenanthrene was detected in surface soil, and NC was detected in sediment; however, these compounds do not have comparison values (ATSDR 2002). An RFI conducted at SWMU-36 recommended NFA for surface water and sediment and further investigation of groundwater and surface soil (Law 1999g).

SWMU-37: Sandblast Area

Sandblasting occurred east of Building 245-3 from 1964 to 1969, west of Building 504 from 1980 to 1984, and south of Building 566-1 from 1980 or earlier to present. Most of the sand and associated paint wastes was recovered and disposed of in the sanitary landfill; however, some sand and paint waste was dispersed on the ground or in the air. Paint wastes may have included lead, cadmium, and chromium (ATSDR 2002). Surface soil samples were collected at SWMU-37 and were found to contain elevated

metal concentrations. An RFI conducted at SWMU-37 recommended subsurface soil sampling and removal of contaminated soils (BMcD 2000a).

SWMU-38: Oil Separator

From 1971 to 1993, the 800-gallon oil separator tank received wastewater from a car wash floor drain and building steam radiators. When the tank reached three-quarter capacity, the liquid was discharged to Pond A through a sewer line. Runoff was directed to Pyott's Pond. The wastewater was potentially contaminated with oil, grease, solders, and solvents. The separator was removed after operations were discontinued in 1993 (ATSDR 2002). Surface water, sediment, surface soil, and subsurface soil samples were collected at SWMU-38 and were found to be contaminated with metals and other site constituents. The RFI for SWMU-38 recommended NFA, based on risk assessment calculations that indicated no risk to human health (BMcD 2000b).

SWMU-39: South Acid Area Drainage Ditch and Plant

The South Acid Area Drainage Ditch begins near the Calcium Carbide Disposal Area and drains into Pyott's Pond. The South Acid Area Plant handled sulfuric and nitric acids containing NG and NQ (ATSDR 2002). Surface water and sediment samples were collected at SWMU-39. Nitrate/nitrite, sulfate, copper, magnesium, sodium, zinc, lead, chromium, aluminum, and potassium were detected in both surface water and sediment above background concentrations. The RFI for SWMU-39 recommended NFA, based on risk assessment calculations that indicated no risk to human health (BMcD 2000e).

SWMU-40: Calcium Carbide Disposal Area

SWMU-40 was a natural ravine that received NQ pilot plant wastes, including calcium cyanamide and calcium fluoride, for 3 months in 1982. The ravine was covered to form a 1-acre landfill, which was enclosed with a barbed wire fence. Wastes included are expected to contain calcium carbonate, nitrate, calcium cyanamide, ammonium, sulfate, GN, and metals. By-products include carbide, cyanide, ammonia, and nitrates (ATSDR 2002). Groundwater, surface water, sediment, and surface soil samples were collected at SWMU-40. Beryllium, nickel, and sulfate exceeded primary MCLs in groundwater. An RFI conducted at SWMU-40 recommended further evaluation of the nature and extent of contamination and of the hydrogeology beneath the site (BMcD 2000h). SFAAP is scheduled to excavate, treat, and dispose of contaminated soils and to close the pond according to State guidelines by 2003 (ATSDR 2002).

SWMU-41: Calcium Carbide Cake (CCC) Landfill

SWMU-41 was operated as a landfill from 1986 to 1988 and from 1992 to present, accepting containerized and noncontainerized CCC from NQ production. The CCC contained calcium carbonate, calcium cyanamide, ammonium, GN, nitrate, sulfate, metals, and fluoride (ATSDR 2002). Soil gas, groundwater, and subsurface soil samples were collected at SWMU-41. Aluminum and bis(2-ethylhexyl)phthalate were identified as contaminants of potential concern (COPC) in groundwater. An RFI conducted at SWMU-41 recommended additional investigation of the extent of the contamination

plume, leachate sample collection, a CMS, and potential closure of the landfill (BMcD 2000p). Long-term groundwater monitoring and landfill maintenance are ongoing at this SWMU (ATSDR 2002).

SWMU-42: Temporary Sanitary Landfill

SWMU-42 is a three-cell landfill that has operated under Kansas State Solid Waste Permit No. 340 since 1988. SWMU-42 accepts general trash and some other nonhazardous wastes, but initially accepted CCC in its first cell (ATSDR 2002). Soil gas, groundwater, and subsurface soil samples were collected at SWMU-41. Aluminum and bis(2-ethylhexyl)phthalate were identified as COPCs in groundwater. An RFI conducted at SWMU-42 recommended additional investigation of the extent of the contamination plume, leachate sample collection, a CMS, and potential closure of the landfill (BMcD 2000p). Long-term groundwater monitoring and landfill maintenance are ongoing at this SWMU (ATSDR 2002).

SWMU-43: Tunnel Dryers (CCC Storage)

SWMU-43 consists of three Tunnel Dryers that have been used for CCC storage since 1986. The Tunnel Dryers are not enclosed, but do have individual leachate collection systems (ATSDR 2002). Groundwater samples were collected at SWMU-43, and a number of inorganic compounds, including GN, were detected above background. The RFI for SWMU-43 recommended NFA for groundwater, based on risk assessment calculations that indicated no risk to human health. Because COCs had to pass through surface and subsurface soil to reach groundwater, the RFI recommended further investigation to determine the nature and extent of contamination in these media. (BMcD 2000i).

SWMU-44: Tank T784

Tank T784, also known as Structure 9049, is a 100,000-gallon AST that collects cooling tower blowdown water, NQ crystalizer condensate, GN evaporator condensate, and noncontact cooling water. When the tank reaches 65,000-gallon capacity, the effluent pipe discharges wastewater to the RWTP Lagoons through an underground transfer line. Line breaks and tank overflow have released wastewater to the environment (ATSDR 2002). Surface soil and groundwater samples were collected at SWMU-44. A total of 15 metals in surface soil and 5 metals in groundwater were detected in these samples. The RFI for SWMU-44 recommended NFA, based on risk assessment calculations that indicated no risk to human health (BMcD 2000j).

SWMU-45: Building 9040 (Calcium Cyanamide Conveyors and Storage Unit)

Building 9040 is the wet GN production building. Calcium cyanamide is produced there and transferred to four storage bins east of the building for use in the GN process. Calcium cyanamide has been released during transport through spills and wind activity, as have calcium carbide and calcium fluoride (ATSDR 2002). Groundwater, surface soil, and subsurface soil samples were collected at SWMU-45. COCs included nitrate/nitrite as nitrogen, aluminum, and NG in groundwater. Various metals were detected in surface soil, and thallium was detected in subsurface soil above background concentrations. An RFI conducted at SWMU-45 recommended additional investigation to determine the nature and extent of soil, groundwater, surface water, and sediment contamination. The RFI noted that groundwater contamination appeared to be migrating toward the plant boundary. The RFI also recommended removal of building

sumps and underlying soils, as well as any calcium cyanamide-contaminated soil, if present (BMcD 2000q).

SWMU-46: Decontamination Oven

Built in 1970, SWMU-46 decontaminated oversized equipment and materials with explosive contamination. Trace explosives, volatile contaminants, and metals may remain at this SWMU (ATSDR 2002). Surface soil samples were collected at SWMU-46. Surface soil samples contained various metals above background concentrations, including lead, which was detected above its comparison value. An RFI conducted at SWMU-46 recommended institutional controls to prevent worker exposure to lead and removal and remedial actions, where feasible. Soil excavation and disposal is planned for 2005 (BMcD 2000f).

SWMU-47: NQ Production Area Sumps

Production of NQ, calcium cyanamide, and GN took place in the six SWMU-47 buildings from 1981 through 1991. Wastewater from each building's sump potentially contained NQ, GN, calcium carbide, calcium fluoride, nitrogen, nitrates, ammonia, cyanide, nitric acid, and sulfuric acid. Typically, the wastewater was transported by tank truck from the sumps to the South Acid Area LWTP. Wastewater from some sumps was recycled using an ammonia stripper. Groundwater and surface soil samples were collected at SWMU-47. Contaminants identified at concentrations above comparison values included barium, cadmium, manganese, NQ, sulfate, and vanadium in groundwater and arsenic in surface soil. GN was detected in groundwater, and GN and NC were detected in surface soil; however, these compounds do not have comparison values (ATSDR 2002). The RFI recommends additional sampling. SFAAP is scheduled to excavate and backfill 23 sumps by 2003. Additionally, SFAAP is scheduled to install an interceptor trench to collect nitrate-contaminated groundwater by 2004 (Law 1999m).

SWMU-48: NQ Support Area

SWMU-48, built as a pilot-scale production plant, was constructed from 1977 to 1980 and was operational from 1979 to 1984. The main NQ plant began production in 1984. Currently, SWMU-48 is dismantled, with the exception of two buildings that are used periodically for engineering studies. SWMU-48 consists of two buildings, two dryer bays, two 20,000-gallon ASTs, two half tanks, and three sumps. Spills and surface water runoff may contaminate the environment with raw materials, manufacturing intermediates, NQ, by-products, wastes, and environmental degradation products of these materials. Groundwater and surface soil samples collected at SWMU-48 revealed nitrate/nitrite in groundwater and arsenic in surface soil at concentrations above comparison values. Additionally, GN was detected in groundwater, and NC was detected in surface soil; however, these compounds do not have comparison values (ATSDR 2002). An RFI conducted at SWMU-48 recommended NFA; however, the SWMU currently is undergoing a CMS, and long-term monitoring is planned (Law 1999n; ATSDR 2002).

SWMU-49: Road Just Southeast of the Sanitary Landfill

The portion of the road identified as SWMU-49 may have been built over a landfill. Drums, construction rubble, and other refuse were discovered underlying the road (ATSDR 2002). Soil gas and groundwater samples were collected at SWMU-49. Groundwater samples revealed metals concentrations above background, and methylene chloride was detected in one well at a concentration above its comparison value. The methylene chloride detection was attributed to laboratory contamination. An RFI conducted at SWMU-49 recommended additional investigation of surface soil, surface water, and sediment to determine the existence of contamination in these media. The RFI also recommended that groundwater monitoring wells in the vicinity of SWMU-49 be included in future monitoring efforts (BMcD 2000n).

SWMU-50: Disposal Site East of the Classification Yard

SWMU-50 is an abandoned dump site discovered near Kill Creek. The dump contained shingles, drums, and metal slag. Groundwater, surface water, sediment, and surface soil samples were collected at SWMU-50. Contaminants identified at concentrations above comparison values included thallium in surface water; arsenic in sediment; and arsenic, benz(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, cadmium, copper, dibenz(a,h)anthracene, iron, indeno(1,2,3-cd)pyrene, and in surface soil. Acenaphthylene, benzo(g,h,i)perylene, phenanthrene, and NC also were detected in surface soil, but did not have comparison values (ATSDR 2002). Because of the SWMU's proximity to a flood plain, an interim removal was conducted in 1997 to remove debris, including visible asbestos-containing materials. The site was found to be larger than originally identified, and additional removal was deemed to be necessary. A CMS currently is underway at the SWMU (Law 1997a; ATSDR 2002).

SWMU-51: Battery Handling Area

SWMU-51 is the battery storage area of the salvage yard and has been operational for many years. Wastes associated with the batteries include acids and metals such as mercury, lead, and cadmium (ATSDR 2002). Surface soil samples were collected at SWMU-51. Metals detected above background levels in surface soil samples included antimony, beryllium, copper, selenium, thallium, zinc, aluminum, chromium, iron, silver, and lead. An RFI conducted at SWMU-51 recommended additional field investigation to determine horizontal and vertical extent of metals contamination in soils (BMcD 1997).

SWMU-52: Paint Bay Building 542

SWMU-52 was a paint bay within Building 542 that was used to repaint vehicles. Fumes and overspray were vented through the side of the building. Wastes associated with the painting process included volatile organics and metals such as chromium, cadmium, and lead (ATSDR 2002). Surface soil samples were collected at SWMU-52. Metals detected above background levels in surface soil samples included chromium, beryllium, aluminum, zinc, antimony, mercury, and sodium, with chromium being the contaminant most prevalent. The RFI for SWMU-52 recommended NFA, based on risk assessment calculations that indicated no risk to human health (BMcD 2000c).

SWMU-53: Construction Debris Landfill and Waste Pit

Arial photographs from 1941 to 1991 reveal an old waste pile and construction debris landfill located in two quarries. The waste pile and landfill likely were used by farmers and during construction of SFAAP. In 1997, the waste pile remained, but the road was covered with vegetation. Construction debris included concrete rubble, rusted-out drums, glass, broken insulators, pipe pieces, wood scraps, telephone poles, fencing, iron scraps, and asbestos materials. No sampling has been reported for this SWMU. RFI activities began in 2001. Contaminated materials will be excavated and disposed of off site (ATSDR 2002).

SWMU-54: Fluorescent Tube Well

The SWMU-54 well originally was a homestead well prior to SFAAP construction. SFAAP used the well as a fluorescent tube disposal pit until 1976. The concrete-walled well is uncovered and full of water. No sampling has been reported for this SWMU; however, nine monitoring wells were scheduled for installation in 2001 (ATSDR 2002).

SWMU-55: Old Administration Building

SWMU-55 consists of two areas with potential soil contamination in the northeastern corner of SFAAP. Soil near the Old Administration Building is potentially contaminated with lead-based paint (LBP), and soil in the salvage yard is potentially contaminated by activities there. No sampling has been reported for this SWMU; however, an RFI is underway there (ATSDR 2002).

SWMU-56: Well South of Facility 211

Land in the vicinity of SWMU-56 formerly was used for land application of treated wastewaters. Groundwater samples from the SWMU-56 well revealed nitrate/nitrite contamination. No additional sampling has been reported for this SWMU; however, an RFI is underway there (ATSDR 2002).

SWMU-57: Facility 507-2

Chemicals reportedly were disposed of on the ground outside SWMU-57. No sampling has been reported for this SWMU; however, an RFI is underway there (ATSDR 2002).

SWMU-58: Shop Area

The Shop Area consists of 30 facilities, including three offices, the fuel oil unloading station, storage and distribution areas, 12 storehouses, nine shops, and a Heating Plant that was originally the former Tram Repair Shop. These facilities are used for maintenance activities and repairs. No sampling has been reported for this SWMU; however, an RFI is underway there (ATSDR 2002).

SWMU-59: Laundry Area (Facility 214)

The clothing workers wore on site was laundered at SWMU-59 and may have been contaminated with process wastes and propellants. Several sumps and drains were located in the floor of the SWMU-59 building. Additionally, two fuel oil tanks are located outside of the building. No sampling has been reported for this SWMU; however, an RFI is underway there (ATSDR 2002).

SWMU-60: Administration Building 2 (Facility 214)

A photography laboratory was located in Administrative Building 2, and wastes from the laboratory were disposed of in a sink that discharged into the soil behind the building. No sampling has been reported for this SWMU; however, an RFI is underway there (ATSDR 2002).

SWMU-61: Environmental Laboratory (Facility 232)

Waste disposal practices associated with the Environmental Laboratory are unknown; however, several sumps and drains exist within the building. No sampling has been reported for this SWMU; however, an RFI is underway there (ATSDR 2002).

SWMU-62: Transformer Storage Warehouse (Facility 566-5)

Replacement transformers are stored at SWMU-62. The transformers reportedly have been tested and found to contain less than 50 parts per million of PCBs. Some of the transformers were observed to be leaking, and stains were evident on the concrete floor. No sampling has been reported for this SWMU; however, an RFI is underway there (ATSDR 2002).

SWMU-63: Water Towers (Facilities 1271, 127-2, 127-3, and 127-4)

LBP contamination may be present in the area surrounding the water towers, which were sandblasted and repainted several times before 1978. No protective measures were taken to contain and properly dispose of the paint removed from the water towers. No sampling has been reported for this SWMU; however, an RFI is underway there (ATSDR 2002).

SWMU-64: Disposal Area East of Sewage Treatment Plant

Trenches believed to have been the Office Paper Burning Grounds were identified on historical aerial photographs. No sampling has been reported for the SWMU-64 trenches; however, an RFI is underway there (ATSDR 2002).

SWMU-65: Tank Farm

Numerous releases have been documented in the tank farm, which is located in the north-central part of SFAAP. No sampling has been reported for this SWMU; however, an RFI is underway there (ATSDR 2002).

AOCs

AOC-1: Well West of Old Administration Building

A well west of the Old Administration Building revealed nitrate/nitrite contamination. No additional sampling has been reported for AOC-1; however, a RCRA Facility Assessment (RFA) is underway there (ATSDR 2002).

AOC-2: Main Transformer Station (Facility 154-4)

A 1945 fire destroyed a number of PCB-containing transformers stored in the AOC-2 building. No sampling has been reported for AOC-2; however, an RFA is underway there (ATSDR 2002).

AOC-3: Photographic Laboratory (Facility 227-18)

Photography wastes from AOC-3 were disposed of in laboratory sinks. Where the sinks discharge is unknown. No sampling has been reported for AOC-3; however, an RFA is underway there (ATSDR 2002).

AOC-4: Disposal Area Southwest of Sewage Treatment Plant

AOC-4 consists of several trenches southwest of the Sewage Treatment Plant. These trenches were first identified on aerial photographs and are believed to have been the Mess Hall Landfill. No sampling has been reported for AOC-4; however, an RFA is underway there (ATSDR 2002).

AOC-5: Cannon Range Tunnels (Facility 303)

The southern tunnel was used to store 55-gallon drums. However, the most significant soil contamination is expected to be along the cannon firing line, the area from the cannon platforms into the tunnels. Explosives and metals were detected in surface soil samples collected at AOC-5 during a 1988 remedial investigation field program. An RFA of AOC-5 is currently underway (ATSDR 2002).

AOC-6: Thirty-five Process Facilities within F-line Area

No historical information is available about the processes that took place within the following 35 facilities: D120-7, F120-4, F120-8, 181-3, 563, 5815-1, 5815-2, 5815-3, 5816-2, 5822, 5823, 5837, 5850, 5861, 7803-1, 7803-2, 7803-3, 7803-4, 7814, 7815-1, 7816-1, 7816-2, 7816-3, 7826, 7827, 7828, 7832, 7866, 7868-1, 7868-2, 7868-3, 7868-4, 7871-2, 7897, and 7898. No sampling has been reported for AOC-6; however, an RFA is underway there (ATSDR 2002).

AOC-7: Former Truck Maintenance Shop in South Acid Area

A release of methylene chloride was identified outside of the Former Truck Maintenance Shop in the South Acid Area. No sampling has been reported for AOC-7; however, an RFA is underway there (ATSDR 2002).

AOC-8: Former Fuel Oil Storage Tank in South Acid Area

A release of chloroform was identified next to the Former Fuel Oil Storage Tank in the South Acid Area. No sampling has been reported for AOC-8; however, an RFA is underway there (ATSDR 2002).

AOC-9: Oil and Paint House in South Acid Area

A release of methylene chloride was identified outside of the Oil and Paint House in the South Acid Area. No sampling has been reported for AOC-9; however, an RFA is underway there (ATSDR 2002).

AOC-10: Storage Magazines Not Part of SWMUs 15 and 16

AOC-10 consists of 100 storage magazines on the southern end of SFAAP, including the entire Former Munitions Storage Area and portions of the current Temporary Waste Storage Area not already covered under SWMUs 15 and 16. No sampling has been reported for AOC-10; however, an RFA is underway there (ATSDR 2002).

AOC-11: Forced Air Dryers and Rest Houses, Screen Houses, and Can Pack Houses

AOC-11 includes the Forced Air Dryers, Rest Houses, Screen Houses, and Can Pack Houses located in the west-central section of SFAAP. No sampling has been reported for AOC-11; however, an RFA is underway there (ATSDR 2002).

AOC-12: Paste Air Dry Facilities

AOC-12 consists of the Paste Air Dry facilities in the central section of SFAAP. No sampling has been reported for AOC-12; however, an RFA is underway there (ATSDR 2002).

AOC-13: Warehouse with NQ Activities

AOC-13 consists of eight large warehouses used to store NQ drums, acid plant parts and supplies, and contaminated equipment. No sampling has been reported for AOC-13; however, an RFA is underway there (ATSDR 2002).

AOC-14: Robert's Lake

Robert's Lake is located along the western border of SFAAP, west of, and downgradient from, the G-line ditches. No sampling has been reported for AOC-14; however, an RFA is underway there (ATSDR 2002).

AOC-15: Facility 300

Facility 300 contains an indoor firing range. No sampling has been reported for AOC-15; however, an RFA is underway there (ATSDR 2002).

AOC-16: NC Production Lines

AOC-16 consists of NC Production Lines B, C, D, and E, as well as the Solvent Type Propellant Mix and Form Areas. No sampling has been reported for AOC-16; however, an RFA is underway there (ATSDR 2002).

AOC-17: NQ Production Facilities

AOC-17 includes all buildings in the northwestern corner of SFAAP that are potentially contaminated with explosives. No sampling has been reported for AOC-17; however, an RFA is underway there (ATSDR 2002).

AOC-18: Trench Disposal Area West of the Classification Area

AOC-18 was identified in 1948 aerial photographs as a trench disposal area west of the Classification Area. No sampling has been reported for AOC-18; however, an RFA is underway there (ATSDR 2002).

AOC-19: Disposal Site on the Southwest End of the Classification Area

AOC-19 was identified in 1948 aerial photographs as a disposal site on the southwestern end of the Classification Area. No sampling has been reported for AOC-19; however, an RFA is underway there (ATSDR 2002).

AOC-20: Disposal Pit East of the Classification Area

AOC-20 was identified in 1948 aerial photographs as a disposal site on the eastern end of the Classification Area. No sampling has been reported for AOC-20; however, an RFA is underway there (ATSDR 2002).

AOC-21: Disposal Trench South of the Classification Area

AOC-21 was identified in 1948 aerial photographs as a disposal trench south of the Classification Area. No sampling has been reported for AOC-21; however, an RFA is underway there (ATSDR 2002).

AOC-22: Disposal Site South of the Classification Area

AOC-22 was identified in 1948 aerial photographs as a disposal site in a fenced area south of the Classification Area. No sampling has been reported for AOC-22; however, an RFA is underway there (ATSDR 2002).

BACKGROUND

Definition of Environmental Indicators (for the RCRA Corrective Action)

Environmental Indicators (EI) are measures being used by the RCRA Corrective Action program to go beyond programmatic activity measures (e.g., reports received and approved, etc.) to track changes in the quality of the environment. The two EIs developed to date indicate the quality of the environment in relation to current human exposures to contamination and the migration of contaminated groundwater. An EI for non-human (ecological) receptors is intended to be developed in the future.

Definition of "Current Human Exposures Under Control" EI

A positive "Current Human Exposures Under Control" EI determination ("YE" status code) indicates that there are no "unacceptable" human exposures to "contamination" (i.e., contaminants in concentrations in excess of appropriate risk-based levels) that can be reasonably expected under current land- and groundwater-use conditions (for all "contamination" subject to RCRA corrective action at or from the identified facility [i.e., site-wide]).

Relationship of EI to Final Remedies

While Final remedies remain the long-term objective of the RCRA Corrective Action program the EI are near-term objectives which are currently being used as Program measures for the Government Performance and Results Act of 1993 (GPRA). The "Current Human Exposures Under Control" EI are for reasonably expected human exposures under current land- and groundwater-use conditions ONLY, and do not consider potential future land- or groundwater-use conditions or ecological receptors. The RCRA Corrective Action program's overall mission to protect human health and the environment requires that Final remedies address these issues (i.e., potential future human exposure scenarios, future land and groundwater uses, and ecological receptors).

Duration / Applicability of EI Determinations

EI Determinations status codes should remain in RCRIS national database ONLY as long as they remain true (i.e., RCRIS status codes must be changed when the regulatory authorities become aware of contrary information).

2. Are groundwater, soil, surface water, sediments, or air **media** known or reasonably suspected to be **"contaminated"**[1] above appropriately protective risk-based "levels" (applicable promulgated standards, as well as other appropriate standards, guidelines, guidance, or criteria [e.g., Maximum Contaminant Levels (MCLs), the maximum permissible level of a contaminant in water delivered to any user of a public water system under the Safe Drinking Water Act] from releases subject to RCRA Corrective Action (from SWMUs, RUs or AOCs)?

	Yes	No	?	Rationale / Key Contaminants
Groundwater	X			
Air (indoors)[2]		X		
Surface Soil (<2 feet)	X			**Please See**
Surface Water	X			**Description Below**
Sediment	X			
Subsurface Soil (>2 feet)	X			
Air (outdoors)	X			

____ If no (for all media) - skip to #6, and enter "YE," status code after providing or citing appropriate "levels," and referencing sufficient supporting documentation demonstrating that these "levels" are not exceeded.

__X__ If yes (for any media) - continue after identifying key contaminants in each "contaminated" medium, citing appropriate "levels" (or provide an explanation for the determination that the medium could pose an unacceptable risk), and referencing supporting documentation.

____ If unknown (for any media) - skip to #6 and enter "IN" status code.

Rationale and Reference(s):

This assessment of media contamination is based on the 52 SWMUs for which facility investigation information and environmental sampling data have been reported to date. As indicated above, contamination is present in some media for these 52 SWMUs. Complete facility investigation information or environmental sampling data are not available for the remaining 13 SWMUs and 22 AOCs. Twenty one of these SWMUs and AOCs have had preliminary investigation similar to a RCRA Facility Assessment. ***ref Batelle 2003*** Based on that information the 13 SWMUs and 22 AOCs for which complete investigations have not been completed are not expected to be more contaminated than those SWMUs for which information is available.

For each media at the 52 SWMUs investigated, the following information has been assembled.

Surface Water and Sediment

Three perennial streams (Captain Creek, Spoon Creek, and Kill Creek), one ephemeral stream (Hansen's Creek), two lakes (Robert's Lake and an unnamed oxbow lake), and three ponds (Pond A, Pond B, and

Pyott's Pond) are located at SFAAP. The majority of surface drainage from SFAAP travels to the three perennial streams, which discharge into the Kansas River north of SFAAP (ATSDR 2002).

Kill Creek

Kill Creek drains the northeastern corner of SFAAP, which includes Pond A, Pond B, Pyott's Pond, and Hansen's Creek. Kill Creek also receives surface water runoff from the Calcium Carbide Storage Area, the North Acid and Chromate Area, the Boiler Blowdowns, the Sewage Treatment Plant, the Photography Lab, the Nitrocellulose Production Area, the Potable Water Treatment Plant, the Former Koch Area, the NG Areas, and the F-Line Munitions Production Area. In all, 26 SWMUs are located within the Kill Creek watershed, which also receives flow from Spoon Creek. In 1994 and 1995, surface water and sediment from Kill Creek were sampled for volatile organic compounds (VOC), SVOCs, metals, explosives, pesticides, sulfate/sulfide, nitrate/nitrite, fluoride, and total dissolved solids (TDS). Sample results revealed one VOC, one SVOC, 12 metals, one pesticide, sulfate, nitrate/nitrite, and fluoride in surface water, and three VOCs, three SVOCs, 20 metals, one pesticide, nitrate/nitrite, and fluoride in sediment (ATSDR 2002). Table 1 in Appendix 1 summarizes the detections that exceeded risk-based comparison values.

Spoon Creek

Spoon Creek drains the southeastern section of SFAAP, which includes part of the Munitions Storage Area, the Hazardous Waste Storage Magazines, the F- and N-Line Munitions Production Areas, the Paste Area, the Ballistics and Proving Grounds, the Mechanized Roll Area, and 13 square miles of agricultural land. In all, 8 SWMUs are located within the Spoon Creek watershed. In 1994 and 1995, surface water and sediment from Spoon Creek were sampled for VOCs, SVOCs, metals, explosives, pesticides, sulfate/sulfide, nitrate/nitrite, fluoride, and TDSs. Sample results revealed one VOC, four SVOCs, 11 metals, ammonia, sulfate, nitrate/nitrite, and fluoride in surface water, and two VOCs, four SVOCs, 21 metals, one pesticide, NC, and NG in sediment (ATSDR 2002). Table 2 in Appendix 1 summarizes the detections that exceeded risk-based comparison values.

Captain Creek

Captain Creek drains the western section of SFAAP, which includes Robert's Lake and an unnamed oxbow lake. Captain Creek also receives surface water runoff from part of the Munitions Storage and Production Areas, the Burning Grounds, the Solvent Area, the Lead Recovery Area, the southern part of the NQ Production Area, the Contaminated Waste Processor, and the Landfill Area. In all, 16 SWMUs are located within the Captain Creed watershed. In 1994 and 1995, surface water and sediment from Spoon Creek were sampled for VOCs, SVOCs, metals, explosives, pesticides, sulfate/sulfide, nitrate/nitrite, fluoride, and TDSs. Sample results revealed one VOC, one SVOC, 10 metals, sulfate, nitrate/nitrite, and fluoride in surface water; and two VOCs, four SVOCs, 19 metals, two pesticides, and sulfate in sediment (ATSDR 2002). Table 3 in Appendix 1 summarizes the detections that exceeded risk-based comparison values.

Surface and Subsurface Soil

The geology beneath SFAAP consists of about 500 feet of limestones, shales, and stones, overlain by up to 46.5 feet of unconsolidated overburden and a thin layer of organic-rich topsoil. Past land use included production of NC, NG, NQ, propellants, and nitric and sulfuric acids; and administrative, maintenance, and logistic support facilities. SFAAP has been in standby status since 1992. Current land use is primarily agricultural – hay production or cattle grazing (ATSDR 2002).

Surface and subsurface soils from SFAAP were sampled for VOCs, SVOCs, metals, pesticides, PCBs, dioxins/furans, and explosives. Six SVOCs, seven metals, three pesticides, one PCB, dioxins/furans, and one explosive were detected in surface soils above their comparison values. Additionally, three SVOCs, one pesticide, and three explosives were detected in surface soils but did not have comparison values (ATSDR 2002). Table 4 in Appendix 1 summarizes these surface soil detections and their SWMU locations. Although contaminants were detected in subsurface soil above background levels, no concentrations exceeded comparison values (ATSDR 2002).

The status of subsurface soil contamination is unknown for the 13 SWMUs and 22 AOCs without reported facility investigation information or environmental sampling data. However, as stated previously, these SWMUs and AOCs are not expected to be more contaminated than those SWMUs for which information is available.

Groundwater

Groundwater beneath the SFAAP occurs in two principal aquifers: an unconsolidated aquifer and a bedrock aquifer. The unconsolidated aquifer, which consists of upland overburden and tributary alluvium, extends to a depth of 70 to 100 feet below ground surface. Groundwater in the unconsolidated aquifer flows east and west, except in the northwestern portion of the SFAAP, where groundwater flows north. The bedrock aquifer consists of shale and limestone formations within the consolidated bedrock. Groundwater in the unconsolidated aquifer flows to the west-southwest, except in the northern portion of SFAAP, where groundwater flows west-northwest. Limited mixing occurs between the unconsolidated and bedrock aquifers (ATSDR 2002).

Groundwater at SFAAP was sampled for VOCs, SVOCs, metals, pesticides, explosives, sulfate/sulfide, nitrate/nitrite, fluoride, and TDSs. One SVOC, nine metals, two explosives, ammonia, fluoride, nitrate/nitrite, and sulfate were detected above comparison values in groundwater. GN and sulfide also were detected in groundwater but did not have comparison values. Table 5 in Appendix 1 summarizes these detections and their SWMU locations (ATSDR 2002).

Indoor and Outdoor Air

Indoor air sampling has not been reported by the facility. However, indoor air is not expected to pose a hazard to humans working in or visiting SFAAP facilities. For the 52 SWMUs that were investigated, no VOCs were detected in soil or groundwater beneath the remaining facility structures, and inorganic contaminants, such as arsenic, do not pose a volatilization hazard to human receptors.

The status of indoor air contamination is unknown for the remaining SWMUs and AOCs with buildings, because no facility investigation information or environmental sampling data have been reported for those areas. However, as stated previously, these SWMUs and AOCs are not expected to be more contaminated than those SWMUs for which information is available.

Hundreds of buildings contaminated with explosives have been demolished at SFAAP. These buildings were demolished through open burning, because of the potential for explosion. Asbestos shingles and siding were removed prior to burning, and control systems were implemented to contain escaped material. Because some of the burned buildings still contained asbestos and lead, SFAAP monitored air emissions during three test burns. Asbestos was not detected in the smoke from any event; however, lead was detected in two of the events, up to a maximum concentration of 60.63 micrograms per cubic meter ($\mu g/m^3$). EPA's risk-based National Ambient Air Quality Standard for lead is a quarterly averaged concentration of 1.5 $\mu g/m^3$. SFAAP conducted dispersion modeling analysis and determined that the level of lead in air would be no more than 0.1 $\mu g/m^3$, after the plume reached the SFAAP boundary. This modeled concentration is well below the EPA standard (ATSDR 2002). However, no buildings are currently being burned at the facility.

Footnotes:

[1]"Contamination" and "contaminated" describes media containing contaminants (in any form, NAPL and/or dissolved, vapors, or solids, that are subject to RCRA) in concentrations in excess of appropriate "levels" (appropriate for the protection of the groundwater resource and its beneficial uses).

[2] Recent evidence (from the Colorado Dept. of Public Health and Environment, and others) suggest that unacceptable indoor air concentrations are more common in structures above groundwater with volatile contaminants than previously believed. This is a rapidly developing field and reviewers are encouraged to look to the latest guidance for the appropriate methods and scale of demonstration necessary to be reasonably certain that indoor air (in structures located above (and adjacent to) groundwater with volatile contaminants) does not present unacceptable risks.

3. Are there **complete pathways** between "contamination" and human receptors such that exposures can be reasonably expected under the current (land- and groundwater-use) conditions?

Summary Exposure Pathway Evaluation Table

	Potential Human Receptors (Under Current Conditions)						
"Contaminated" Media	Residents	Workers	Day-Care	Construction	Trespassers	Recreation	Food[3]
Groundwater	NO	YES	NO	YES	NO	NO	NO
~~Air (indoors)~~	~~—~~	~~—~~	~~—~~	~~—~~	~~—~~	~~—~~	~~—~~
Soil (surface, e.g.,<2 ft)	NO	YES	NO	YES	YES	NO	YES
Surface Water	NO	YES	NO	YES	YES	NO	YES
Sediment	NO	YES	NO	YES	YES	NO	YES
Soil (subsurface e.g.,>2 ft)	NO	YES	NO	YES	NO	NO	YES
Air (outdoors)	NO	NO	NO	NO	NO	NO	NO

Instructions for Summary Exposure Pathway Evaluation Table:

1. Strike-out specific Media including Human Receptors' spaces for Media which are not "contaminated") as identified in #2 above.

2. Enter "yes" or "no" for potential "completeness" under each "Contaminated" Media – Human Receptor combination (Pathway).

Note: In order to focus the evaluation to the most probable combinations some potential "Contaminated" Media - Human Receptor combinations (Pathways) do not have check spaces ("___"). While these combinations may not be probable in most situations they may be possible in some settings and should be added as necessary.

_____ If no (pathways are not complete for any contaminated media-receptor combination) - skip to #6, and enter "YE" status code, after explaining and/or referencing condition(s) in-place, whether natural or man-made, preventing a complete exposure pathway from each contaminated medium (e.g., use optional Pathway Evaluation Work Sheet to analyze major pathways).

__X__ If yes (pathways are complete for any "Contaminated" Media - Human Receptor combination) - continue after providing supporting explanation.

_____ If unknown (for any "Contaminated" Media - Human Receptor combination) - skip to #6 and enter "IN" status code.

Rationale and Reference(s):

Residents are not present at the facility. Residents are present outside of the facility boundary.

Workers at the facility include security personnel and other personnel responsible for general maintenance and facility environmental monitoring. These workers could come into contact with groundwater, contaminated soil, surface water, or sediment depending on their activity. Workers tending beef cattle could come into contact with contaminated soil, surface water, or sediment.

Day care is not present at the facility. Day care is present outside of the facility boundary.

Construction workers at the facility include City of DeSoto water plant workers and contractors who could come into contact with groundwater, contaminated soil, surface water, or sediment while repairing or installing underground utilities.

Trespassers could come into contact with contaminated soil, surface water, or sediment.

Recreation is not present at the facility. Recreation is present outside of the facility boundary.

Food pathway is limited to onsite grazing of beef cattle. Beef cattle themselves could ingest contaminated soil, surface water, or sediment.

For more information refer to the risk assessment sections of the individual facility investigation reports referenced in this form beginning on page 32.

These pathways are also discussed in the *Public Health Assessment for Sunflower Army Ammunition Plant, DeSoto, Johnson County, Kansas, EPA Facility ID: KS3213820878* dated March 4, 2002.

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[3] Indirect Pathway/Receptor (e.g., vegetables, fruits, crops, meat and dairy products, fish, shellfish, etc.)

4. Can the **exposures** from any of the complete pathways identified in #3 be reasonably expected to be **"significant"**[4] (i.e., potentially "unacceptable" because exposures can be reasonably expected to be: 1) greater in magnitude (intensity, frequency and/or duration) than assumed in the derivation of the acceptable "levels" (used to identify the "contamination"); or 2) the combination of exposure magnitude (perhaps even though low) and contaminant concentrations (which may be substantially above the acceptable "levels") could result in greater than acceptable risks)?

_____ If no (exposures can not be reasonably expected to be significant (i.e., potentially "unacceptable") for any complete exposure pathway) - skip to #6 and enter "YE" status code after explaining and/or referencing documentation justifying why the exposures (from each of the complete pathways) to "contamination" (identified in #3) are not expected to be "significant."

__X__ If yes (exposures could be reasonably expected to be "significant" (i.e., potentially "unacceptable") for any complete exposure pathway) - continue after providing a description (of each potentially "unacceptable" exposure pathway) and explaining and/or referencing documentation justifying why the exposures (from each of the remaining complete pathways) to "contamination" (identified in #3) are not expected to be "significant."

_____ If unknown (for any complete pathway) - skip to #6 and enter "IN" status code.

Rationale and Reference(s):

The facility investigations have identified unacceptable risks for standard exposure scenarios for workers and construction workers at most SWMUs at which facility investigations have been completed. At these SWMUs, contaminated soil and ground water are the media of concern. See summary information in Tables 3 and 4 attached to this form.

For more information refer to the risk assessment sections of the individual facility investigation reports referenced in this form beginning on page 32.

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[4] If there is any question on whether the identified exposures are "significant" (i.e., potentially "unacceptable") consult a human health Risk Assessment specialist with appropriate education, training and experience.

5. Can the "significant" **exposures** (identified in #4) be shown to be within **acceptable** limits?

__X_ If yes (all "significant" exposures have been shown to be within acceptable limits) - continue and enter "YE" after summarizing and referencing documentation justifying why all "significant" exposures to "contamination" are within acceptable limits (e.g., a site-specific Human Health Risk Assessment).

_____ If no (there are current exposures that can be reasonably expected to be "unacceptable")- continue and enter "NO" status code after providing a description of each potentially "unacceptable" exposure.

_____ If unknown (for any potentially "unacceptable" exposure) - continue and enter "IN" status code.

Rationale and Reference(s):

ATSDR completed a public health assessment at Sunflower Army Ammunition Plant. They concluded that no adverse health effects are expected due to site restrictions by the Army. Some highlights follow:

- Kill Creek, Spoon Creek, and Captain Creek drain several contaminated areas at SFAAP. Some of the concentrations of chemicals detected in the surface water and sediment exceeded comparison values, however, after further analyses, the resulting exposure doses were determined to be below levels of health concern. Therefore, recreational exposure to the surface water and sediment in Kill Creek, Spoon Creek and Captain Creek are not expected to cause adverse health effects in children who may play in the creeks.

- Access to SFAAP has always been and still is restricted by fences and an armed guard. No adverse health effects are expected since no one is coming in contact with contaminated soil on a regular basis. Even the occasional trespasser is not contacting potentially contaminated soil often enough or in high enough doses to be a cause for health concern.

- Eating beef from cattle grazed at SFAAP is not expected to cause any adverse heath effects. Specifically, nitroguanidine and asbestos are not expected to accumulate in the parts of the cattle that are eaten and dioxins are not expected to be at a level that would produce adverse health effects in people consuming beef from cattle grazed at SFAAP.

For ATSDR's full analysis please see their report. Their conclusions begin on page 38 of the final study - *Public Health Assessment for Sunflower Army Ammunition Plant, DeSoto, Johnson County, Kansas, EPA Facility ID: KS3213820878* dated March 4, 2002] ***ref ATSDR 2002***

6. Check the appropriate RCRIS status codes for the Current Human Exposures Under Control EI event code (CA725), and obtain Supervisor (or appropriate Manager) signature and date on the EI determination below (and attach appropriate supporting documentation as well as a map of the facility):

_X_ YE - Yes, "Current Human Exposures Under Control" has been verified. Based on a review of the information contained in this EI Determination, "Current Human Exposures" are expected to be "Under Control" at the SFAAP facility, EPA ID #KS3213820878, located in DeSoto, Kansas, under current and reasonably expected conditions. This determination will be re-evaluated when the Agency/State becomes aware of significant changes at the facility.

____ NO - "Current Human Exposures" are NOT "Under Control."

____ IN - More information is needed to make a determination.

Completed by _____ Date 9/18/03
(signature)
Kenneth Herstowski
Project Manager, RCRA Corrective Action & Permits Branch
EPA Region 7

Supervisor _____ Date 9/22/03
(signature)
John Smith
Branch Chief, RCRA Corrective Action & Permits Branch
EPA Region 7

Locations where References may be found:

EPA Region 7 Headquarters
RCRA Files
901 North 5th Street
Kansas City, Kansas 66101

Contact telephone and e-mail numbers:

Ken Herstowski
(913) 551-7631
herstowski.ken@epa.gov

FINAL NOTE: THE HUMAN EXPOSURES EI IS A QUALITATIVE SCREENING OF EXPOSURES AND THE DETERMINATIONS WITHIN THIS DOCUMENT SHOULD NOT BE USED AS THE SOLE BASIS FOR RESTRICTING THE SCOPE OF MORE DETAILED (E.G., SITE-SPECIFIC) ASSESSMENTS OF RISK.

REFERENCES

Agency for Toxic Substances and Disease Registry (ATSDR). 2002. "Public Health Assessment: Sunflower Army Ammunition Plant [SFAAP]." Division of Health Assessment and Consultation, Federal Facilities Assessment Branch. March 4.

Burns and McDonnell Engineering Company, Inc. (BMcD). 1997. "Final Resource Conservation and Recovery Act [RCRA] Facility Investigation [RFI] Report Addendum for Solid Waste Management Unit [SWMU] 51 - Battery Handling Area, SFAAP, DeSoto, Kansas." June 23.

BMcD. 2000a. "Final RFI Report Addendum for SWMU 37 - Sandblast Area, SFAAP, DeSoto, Kansas." March 27.

BMcD. 2000b. "Final RFI Report Addendum for SWMU 38 - Oil Separator, SFAAP, DeSoto, Kansas." March 27.

BMcD. 2000c. "Final RFI Report Addendum for SWMU 52 - Paint Bay, Building 542 and Tire Shop, SFAAP, DeSoto, Kansas." March 27.

BMcD. 2000d. "Final RFI Report Addendum for SWMU 15 - Waste Storage Magazines, SFAAP, DeSoto, Kansas." April 28.

BMcD. 2000e. "Final RFI Report Addendum for SWMU 39 - South Acid Area Drainage Ditch, SFAAP, DeSoto, Kansas." April 28.

BMcD. 2000f. "Final RFI Report Addendum for SWMU 46 - Decontamination Oven, SFAAP, DeSoto, Kansas." April 28.

BMcD. 2000g. "Final RFI Report Addendum for SWMU 20 - Ash Lagoons and Sludge Disposal Area, SFAAP, DeSoto, Kansas." May 31.

BMcD. 2000h. "Final RFI Report Addendum for SWMU 40 - Calcium Carbide Disposal Area, SFAAP, DeSoto, Kansas." May 31.

BMcD. 2000i. "Final RFI Report Addendum for SWMU 43 - Tunnel Dryers, SFAAP, DeSoto, Kansas." May 31.

BMcD. 2000j. "Final RFI Report Addendum for SWMU 44 - Tank T784, SFAAP, DeSoto, Kansas." June 30.

BMcD. 2000k. "Final RFI Report Addendum for SWMU 16 - Temporary Waste Storage Magazines, SFAAP, DeSoto, Kansas." October 3.

BMcD. 2000m. "Final RFI Report Addendum for SWMU 17 - G-Line Area Ditches, SFAAP, DeSoto, Kansas." October 4.

BMcD. 2000n. "Final RFI Report Addendum for SWMU 49 - Road Just Southeast of the Sanitary Landfill, SFAAP, DeSoto, Kansas." October 6.

BMcD. 2000o. "Final RFI Report Addendum for SWMU 25 - Nitrocellulose Area Ditches, SFAAP, DeSoto, Kansas." November 7.

BMcD. 2000p. "Final RFI Report Addendum for SWMUs 41 and 42 - Calcium Carbonate Cake and Temporary Sanitary Landfills, SFAAP, DeSoto, Kansas." November 7.

BMcD. 2000q. "Final RFI Report Addendum for SWMU 45 - Building 9040 Calcium Cyanamide Conveyors and Storage units, SFAAP, DeSoto, Kansas." November 10.

BMcD. 2001a. "Final RFI Report Addendum for SWMUs 7, 8, and 9 - North Acid Area, SFAAP, DeSoto, Kansas." May 31.

BMcD. 2001b. "Final RFI Report Addendum for SWMU 26 - Single Base Area Wastewater Settling Sumps, SFAAP, DeSoto, Kansas." May 31.

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BMcD. 2002a. "Final RFI Report Addendum for SWMUs 33, 34, and 35 - Half Tanks and Settling Ponds, SFAAP, DeSoto, Kansas." April 8.

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BMcD. 2002c. "Final Supplemental RFI Report Addendum and Quality Control Summary Report for SWMU 21 - Contaminated Materials Burning Ground, Supplemental RFI, Volume I, SFAAP, DeSoto, Kansas." April 30.

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Law. 1997b. "Final RFI Report Addendum for SWMUs 22 and 32, SFAAP, DeSoto, Kansas. March 11.

Law. 1997c. "Final RFI Report Addendum for SWMUs 10 and 11, SFAAP, DeSoto, Kansas." March 27.

Law. 1997d. "Final RFI Report Addendum for SWMUs 18 and 19, SFAAP, DeSoto, Kansas." June 1.

Law. 1999a. "Final RFI Report Addendum for SWMU 1, SFAAP, DeSoto, Kansas." February 1.

Law. 1999b. "Final RFI Report Addendum for SWMU 3, SFAAP, DeSoto, Kansas." March 1.

Law. 1999c. "Final RFI Report Addendum for SWMUs 4 and 5, SFAAP, DeSoto, Kansas." March 1.

Law. 1999d. "Final RFI Report Addendum for SWMU 24, SFAAP, DeSoto, Kansas." March 1.

Law. 1999e. "Final RFI Report Addendum for SWMU 13, SFAAP, DeSoto, Kansas." April 1.

Law. 1999f. "Final RFI Report Addendum for SWMU 31, SFAAP, DeSoto, Kansas." April 1.

Law. 1999g. "Final RFI Report Addendum for SWMU 36, SFAAP, DeSoto, Kansas." April 1.

Law. 1999h. "Final RFI Report Addendum for SWMU 6, SFAAP, DeSoto, Kansas." May 1.

Law. 1999i. "Final RFI Report Addendum for SWMU 27, SFAAP, DeSoto, Kansas." May 1.

Law. 1999j. "Final RFI Report Addendum for SWMU 2, SFAAP, DeSoto, Kansas." May 14.

Law. 1999k. "Final RFI Report Addendum for SWMU 12, SFAAP, DeSoto, Kansas." May 18.

Law. 1999m. "Final RFI Report Addendum for SWMU 47, SFAAP, DeSoto, Kansas." May 19.

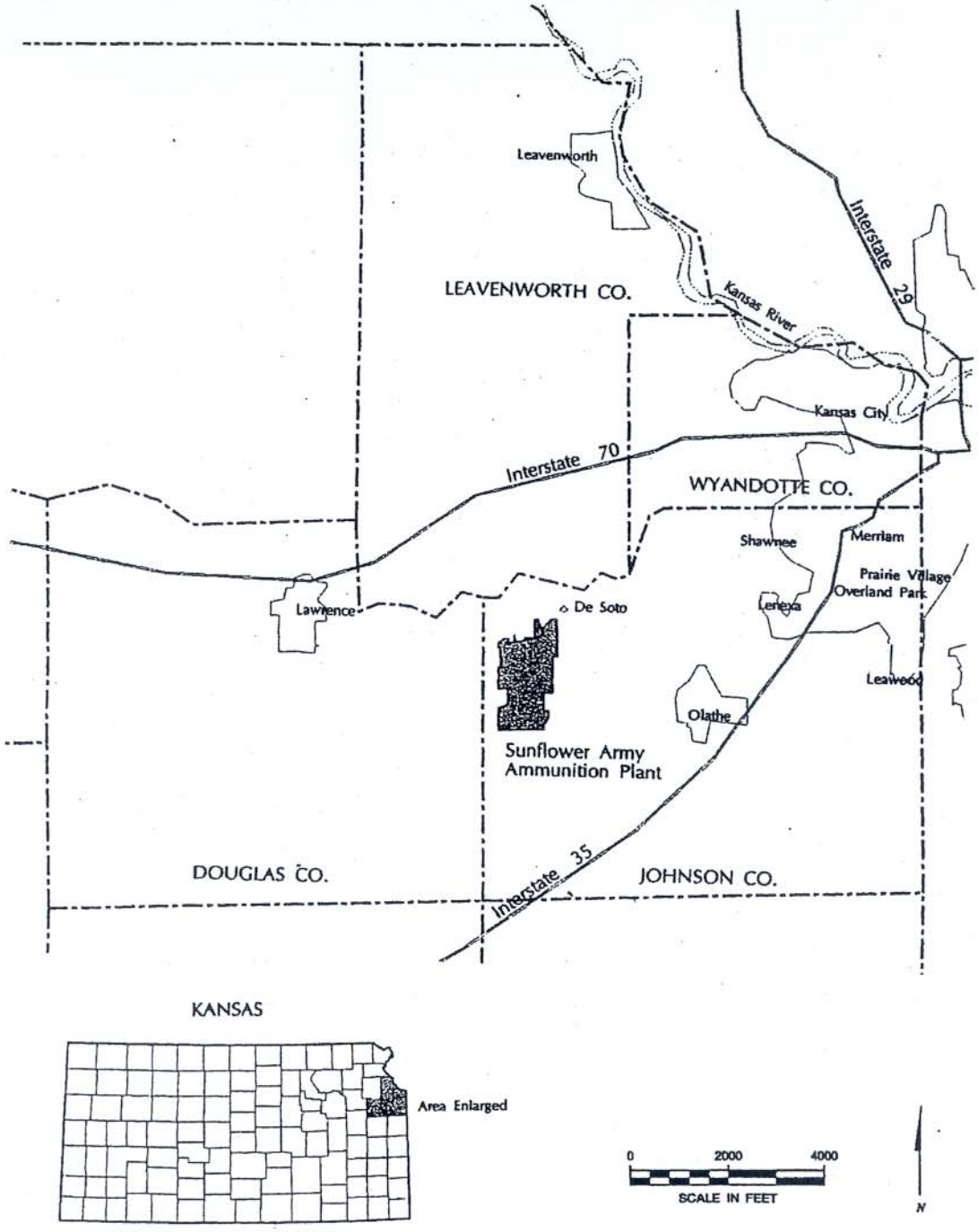
Law. 1999n. "Final RFI Report Addendum for SWMU 48, SFAAP, DeSoto, Kansas." May 20.

MKM Engineers, Inc., and Parsons Engineering Science, Inc. 1999. "Draft Closure Report for SWMU 23 - New Explosive Waste Burning Ground, SFAAP, DeSoto, Kansas." August 31.

ATTACHMENT 1

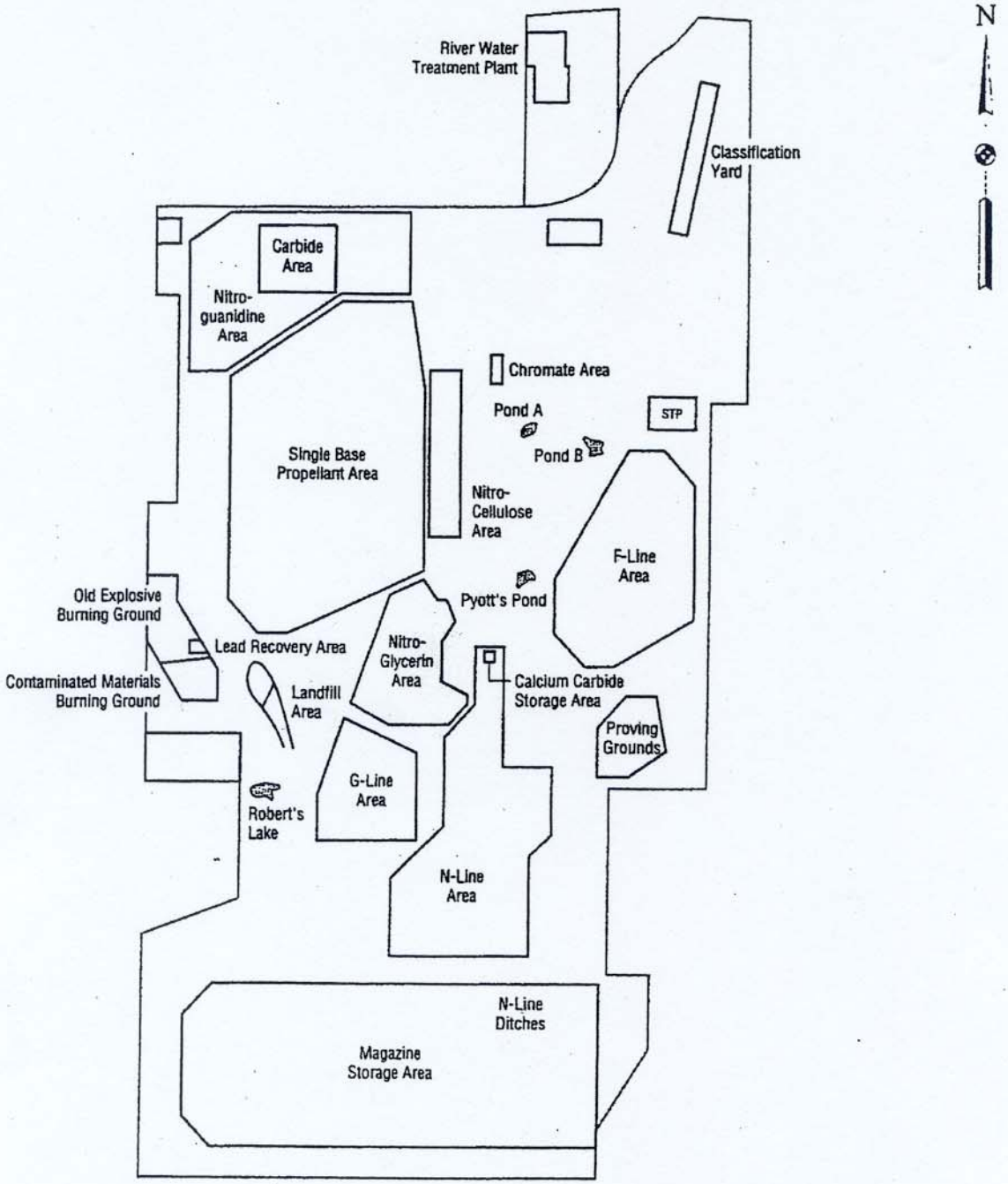
FIGURES

Figure 1. Location of Sunflower Army Ammunition Plant



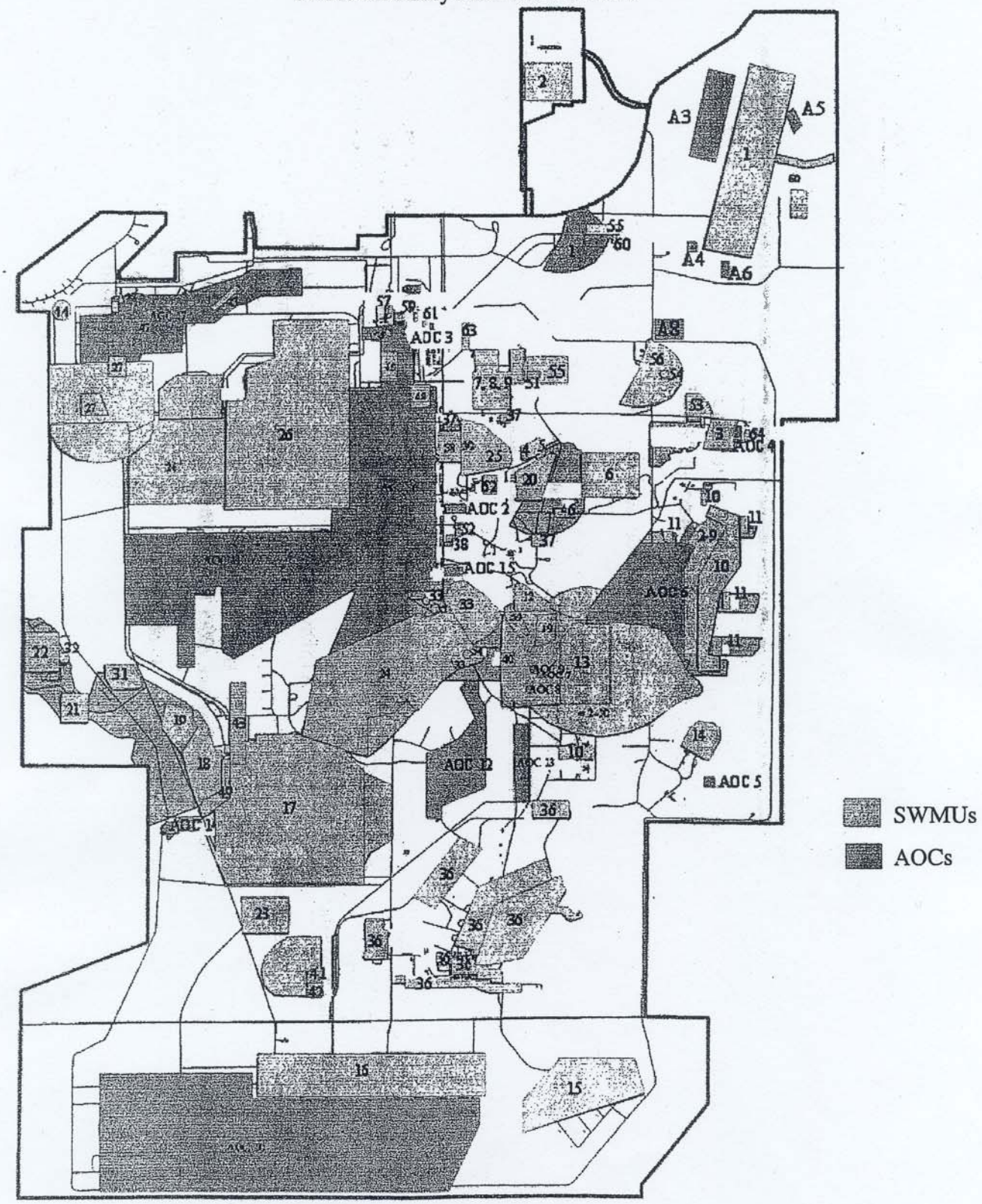
Source: Law 1997

Figure 2. General Layout of Sunflower Army Ammunition Plant



Source: Law 1997

Figure 3. Solid Waste Management Units and Areas of Concern Located at Sunflower Army Ammunition Plant



Source: KDHE

APPENDIX 1

TABLES

TABLE 1. CHEMICALS ABOVE COMPARISON VALUES IN KILL CREEK

Contaminant	Maximum Upgradient Detection	Maximum Downgradient Detection	Comparison Value	Comparison Value Type
Surface Water (ppb)				
Methylene Chloride	**9.1 J**	**60**	5 2,000	CREG C-EMEG
Barium	140	**2,200**	700	RMEG
Chromium	ND	**220**	100	LTHA
Manganese	**690**	**620**	500	RMEG
Nickel	43	**530**	100	LTHA
Thallium	ND	**60**	0.5	LTHA
Dieldrin	ND	**0.07 J**	0.002 0.5	CREG C-EMEG
Sediment (ppm)				
Arsenic	**7.6**	**8.6**	0.5 20	CREG C-EMEG
Iron	22,000	**24,000**	23,000	RBC
Manganese	**4,200**	750	3,000	RMEG

Notes:

Bold	Concentration exceeds comparison value
ATSDR	Agency for Toxic Substances and Disease Registry
CREG	ATSDR Cancer Risk Evaluation Guide
C-EMEG	ATSDR Chronic Environmental Media Evaluation Guide
EPA	U.S. Environmental Protection Agency
J	Estimated value
ppb	Parts per billion
ppm	Parts per million
LTHA	EPA Lifetime Health Advisory for Drinking Water
ND	Not detected
RBC	EPA risk-based concentration
RMEG	EPA Reference Dose Media Evaluation Guide

Source: ATSDR. 2002. "Public Health Assessment: Sunflower Army Ammunition Plant." March 4.

TABLE 2. CHEMICALS ABOVE COMPARISON VALUES IN SPOON CREEK

Contaminant	Maximum Upgradient Detection	Maximum Downgradient Detection	Comparison Value	Comparison Value Type
Surface Water (ppb)				
Methylene Chloride	**18 J**	**19 J**	5 2,000	CREG C-EMEG
Manganese	**780**	**580**	500	RMEG
Ammonia	NS	**4,200**	3,000	I-EMEG
Sediment (ppm)				
Arsenic	**21**	**73**	0.5 20	CREG C-EMEG
Iron	**37,000**	**52,000**	23,000	RBC
Lead	69	**1,700**	400	SSL
Manganese	**3,300**	**4,700**	3,000	RMEG
Dieldrin	**1.8 J**	ND	0.04 3	CREG C-EMEG
Nitrocellulose	NS	1,300	NA	NA
Nitroglycerin	NS	**97 J**	46	RBC

Notes:

Bold	Concentration exceeds comparison value
ATSDR	Agency for Toxic Substances and Disease Registry
CREG	ATSDR Cancer Risk Evaluation Guide
C-EMEG	ATSDR Chronic Environmental Media Evaluation Guide
EPA	U.S. Environmental Protection Agency
I-EMEG	ATSDR Intermediate Environmental Media Evaluation Guide
J	Estimated value
LTHA	EPA Lifetime Health Advisory for Drinking Water
NA	Not applicable
ND	Not detected
NS	Not sampled
ppb	Parts per billion
ppm	Parts per million
RBC	EPA risk-based concentration
RMEG	EPA Reference Dose Media Evaluation Guide
SSL	EPA soil screening level

Source: ATSDR. 2002. "Public Health Assessment: Sunflower Army Ammunition Plant." March 4.

TABLE 3. CHEMICALS ABOVE COMPARISON VALUES IN CAPTAIN CREEK

Contaminant	Maximum Upgradient Detection	Maximum Downgradient Detection	Comparison Value	Comparison Value Type
Surface Water (ppb)				
Methylene Chloride	**11 J**	**16 J**	5 2,000	CREG C-EMEG
Sediment (ppm)				
Arsenic	**6.1**	**2.3**	0.5 20	CREG C-EMEG
Aldrin	**0.24**	ND	0.04 2	CREG C-EMEG
delta-BHC	ND	0.97 J	NA	NA

Notes:

Bold	Concentration exceeds comparison value
ATSDR	Agency for Toxic Substances and Disease Registry
BHC	Benzenehexachloride
CREG	ATSDR Cancer Risk Evaluation Guide
C-EMEG	ATSDR Chronic Environmental Media Evaluation Guide
J	Estimated value
NA	Not applicable
ND	Not detected
ppb	Parts per billion
ppm	Parts per million

Source: ATSDR. 2002. "Public Health Assessment: Sunflower Army Ammunition Plant." March 4.

TABLE 4. CHEMICALS ABOVE COMPARISON VALUES IN SURFACE SOIL

Contaminant	Maximum Detection	Location (SWMU)	Comparison Value	Comparison Value Type
Metals (ppm)				
Antimony	29	21	20	RMEG
Arsenic	30.2	21	0.5	CREG
Cadmium	1,700	14	10	C-EMEG
Copper	12,000	50	3,100	RBC
Iron	99,000	50	23,000	RBC
Lead	22,000	50	400	SSL
Manganese	15,000	36	3,000	RMEG
Semivolatile Organic Compounds (ppm)				
Acenaphthylene	0.021	50	NA	NA
Benz(a)anthracene	2.7	50	0.87	RBC
Benzo(a)pyrene	2.9	50	0.1	CREG
Benzo(b)fluoranthene	3.6	50	0.87	RBC
Benzo(g,h,i)perylene	1.6	50	NA	NA
bis(2-Ethylhexyl)phthalate	140	14	50	CREG
Dibenz(a,h)anthracene	0.45	50	0.087	RBC
Indeno(1,2,3-cd)pyrene	1.5	50	0.87	RBC
Phenanthrene	3.4	1	NA	NA
Pesticides (ppm)				
Aldrin	1.2	21	0.04	CREG
Chlordane	4.6	3	2	CREG
Dieldrin	1.1	3 and 21	0.04	CREG
Endrin Ketone	0.017	21	NA	NA

TABLE 4. CHEMICALS ABOVE COMPARISON VALUES IN SURFACE SOIL (Continued)

Polychlorinated Biphenyls and Dioxins/Furans (ppm)				
Aroclor-1260	1.4	3	0.32	RBC
Dioxins/Furans	0.355	18 and 19	0.00005	C-EMEG
Explosives (ppm)				
Guanidine Nitrate	56	47	NA	NA
Nitrocellulose	16,000	10 and 11	NA	NA
Nitroglycerine	970	10 and 11	46	RBC
Pentaerythritol Tetranitrate	2.7	22 and 32	NA	NA

Notes:

ATSDR	Agency for Toxic Substances and Disease Registry
CREG	ATSDR Cancer Risk Evaluation Guide
C-EMEG	ATSDR Chronic Environmental Media Evaluation Guide
EPA	U.S. Environmental Protection Agency
NA	Not available
ppm	Parts per million
RBC	EPA risk-based concentration
RMEG	EPA Reference Dose Media Evaluation Guide
SSL	EPA soil screening level
SWMU	Solid waste management unit

Source: ATSDR. 2002. "Public Health Assessment: Sunflower Army Ammunition Plant." March 4.

TABLE 5. CHEMICALS ABOVE COMPARISON VALUES IN GROUNDWATER

Contaminant	Maximum Detection	Location (SWMU)	Comparison Value	Comparison Value Type
Semivolatile Organic Compounds (ppb)				
bis(2-Ethylhexyl)phthalate	5.1	24	3	CREG
Metals (ppb)				
Antimony	9.9	21	3	LTHA
Arsenic	12	21	0.02	CREG
Barium	840	47	700	RMEG
Beryllium	10	40	4	MCL
Cadmium	6	10, 11, 36, and 47	2	C-EMEG
Manganese	8,900	6	500	RMEG
Nickel	640	47	100	LTHA
Thallium	1	24	0.5	LTHA
Vanadium	530	47	30	I-EMEG
Explosives (ppb)				
Guanidine Nitrate	44,000	47	NA	NA
Nitroglycerine	83	10 and 11	5	LTHA
Nitroguanidine	27,000	47	700	LTHA
Other Parameters (ppb)				
Ammonia	11,000	10 and 11	3,000	I-EMEG
Fluoride	1,100	2	600	RMEG
Nitrate/Nitrite	680,000	13	10,000	MCL
Sulfate	1,300,000	13	250,000	SMCL
Sulfide	15,000	18 and 19	NA	NA

TABLE 5. CHEMICALS ABOVE COMPARISON VALUES IN GROUNDWATER (Continued)

Notes:

ATSDR	Agency for Toxic Substances and Disease Registry
CREG	ATSDR Cancer Risk Evaluation Guide
C-EMEG	ATSDR Chronic Environmental Media Evaluation Guide
EPA	U.S. Environmental Protection Agency
I-EMEG	ATSDR Intermediate Environmental Media Evaluation Guide
LTHA	EPA Lifetime Health Advisory for Drinking Water
MCL	EPA Maximum Contaminant Level
NA	Not Available
ppb	Parts per Billion
RMEG	EPA Reference Dose Media Evaluation Guide
SMCL	EPA Secondary Maximum Contaminant Level
SWMU	Solid Waste Management Unit

Source: ATSDR. 2002. "Public Health Assessment: Sunflower Army Ammunition Plant." March 4.