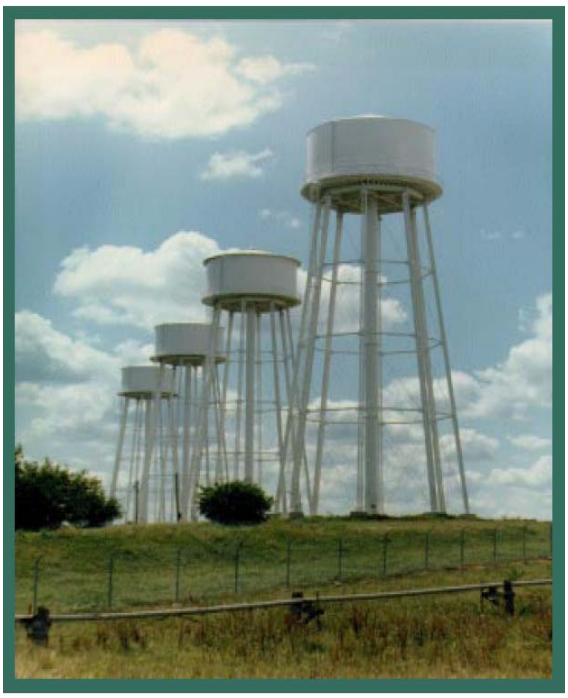
DRAFT FINAL

Five Year Review Report

Sunflower Army Ammunition Plant

DeSoto, Kansas



October 2005

Prepared by:

US Army Corps of Engineers ®
Kansas City District

For
Sunflower Army Ammunition Plant

Approved _____ Date _____

Tony Spaar
Sunflower AAP Commander's Representative

TABLE OF CONTENTS

TABLE OF CONTENTS (Cont.)

Five-Year Review Summary Form

SITE IDENTIFICATION		
Site name: Sunflower Army Ammunition Plant (SFAAP)		
EPA ID : KS3213820878 (RCRA)		
Region: 7	**State:** KS	**City/County:** DeSoto/Johnson
SITE STATUS		
NPL status: Proposed		
Remediation status: Some SWMUs are complete and other are under construction		
Multiple OUs?* No (SWMUs)	**Construction completion date:** NA	
Has site been put into reuse? Yes		
REVIEW STATUS		
Lead agency: U.S. Army		
Author name: U.S. Army Corps of Engineers, Kansas City District		
Author title: NA	**Author affiliation:** NA	
Review period: July 2004 through October 2005		
Date(s) of site inspection: July 26, 2004		
Type of review: Non-NPL Federal Facility		
Review number: 1		
Triggering action: The trigger date for this review at SFAAP has been determined to be the initiation of a remedial action completed for solid waste management unit 13 and 27.		
Triggering action date: August 1999		
Due date *(five years after triggering action date)*: August 2004		

- ["OU" refers to operable unit. SWMU refers to Solid Waste Management Unit]

Five-Year Review Summary Form, cont'd.

Issues:

Actions to date have been to eliminate risks from contact with contaminated soil. Remedial decisions for groundwater will be made after completion of the respective investigations. With the establishment of Groundwater Operable Unit GWOU 1 and 2, groundwater at SWMU 10/11, 13, 27 and 33/35 may be monitored under an operable unit approach.

Additional contamination is expected to require removal beneath explosive sewers and building foundations at SWMU 10/11.

Institutional controls have not been established at SWMUs 13, 27, 41/42 and 50 to address restrictions required based on remaining contamination.

Recommendations and Follow-up Actions:

Due to the development of the groundwater operable unit concept, a mechanism should be investigated to designate no further action of a SWMU while deferring groundwater issues relating to that SWMU to the groundwater operable unit.

Protectiveness Statement:

The current and future protectiveness resulting from remedies at SFAAP and specifically with regards to SWMU's 10, 11, 13, 27, 33/35, 41/42, and 50 are protective of human health and the environment and exposure pathways that could result in unacceptable risk are being controlled.

LIST OF ACRONYMS AND ABBREVIATIONS

ACM	Asbestos Containing Material
AOC	Area of Concern
CCC	Calcium Carbonate Cake
CMS	Corrective Measures Study
COC	Chemical of Concern
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
EPA	Environmental Protection Agency, Region VII
GN	Guanidine Nitrate
GWOU	Groundwater Operable Unit
gpm	gallons per minute
IOC	Installation Operations Command
IRA	Interim Removal Action
IRG	Interim Remedial Guideline
JCPRD	Johnson County Parks and Recreation District
KDHE	Kansas Department of Health and Environment
LWTP	Liquid Waste Treatment Plant
MCL	Maximum Contaminant Level
mg/L	milligram per Liter
mg/Kg	milligram per Kilogram
NC	Nitrocellulose
NG	Nitroglycerine
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
NQ	Nitroguanidine
OSC	Operational Support Command
OU	Operable Unit
RCRA	Resource Conservation and Recovery Act
RFI	RCRA Facility Investigation
RSKs	Risk-Based Standards for Kansas
SAC	Sulfuric Acid Concentrate
SFAAP	Sunflower Army Ammunition Plant
SAR	Sulfuric Acid Regulation
SVOC	Semi-Volatile Organic Compound
SWMU	Solid Waste Management Unit
TDS	Total Dissolved Solids
TMCL	Target Media Cleanup Levels
USACE	U.S. Army Corps of Engineers

Executive Summary

Sunflower Army Ammunition Plant (SFAAP) encompasses approximately 9,065 acres located near Desoto, Kansas in the northeast corner of Johnson County. The facility is located approximately 20 miles southwest of Kansas City, Kansas and 16 miles east of Lawrence, Kansas along Kansas Highway 10. The surrounding area consists of sparsely populated, rural residences with primarily agricultural land use. The installation began operations in 1942 to manufacture smokeless powder and propellants for small arms, cannons, and rockets. Additional facility operations included the manufacture and regeneration of nitric and sulfuric acids and ammunitions proving. Since 1971, the majority of the installation has been in a standby, inactive status, with the last production operation Nitroguanidine (NQ), ceasing in 1992.

A Five-Year Review Report is required by the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) when hazardous substances, pollutants, or contaminants remain at a site. Although remediation at SFAAP is covered under Resource Conservation and Recovery Act (RCRA) authority, Environmental Protection Agency (EPA) policy allows the deferral of action at sites eligible for the NPL to other EPA cleanup programs. The EPA believes the requirements in Part II of the RCRA permit are sufficient to clean up this site. A Five-Year Review Report to ensure the protection of human health and the environment is due no less than five years after a specific trigger date that depends on what has occurred at the site. The Army has directed a review be conducted for any action that left hazardous substances, pollutants, or contaminants above levels that allow for unlimited use and unrestricted exposure no less than every five years. The trigger date for the review and this subsequent report at SFAAP has been determined to be the initiation of a remedial action completed for solid waste management unit (SWMU) 13 and 27.

The SFAAP property includes 67 SWMUs and 22 Areas of Concern (AOC)s. Remedial Actions or Interim Remdial Actions have been completed at 14 sites of these sites including nine sites where contamination remains above levels allowing unrestricted use of the property. The nine sites, some of which are co-located, include SWMU 10- F-Line ditches, SWMU 11-F-Line settling Ponds, SWMU 13- South Acid Evaporative Ponds, SWMU 27-Nitroguandine Area SAC Evaporative Lagoons, SWMU 41/42-CaCO3 Cake Landfill and Temporary Sanitary Landfill, SWMU 50- Disposal Site East of the Classification Yard and SWMU 33/35- Paste Area Half Tanks and Nitroglycerin Area Settling Ponds are the subjects of this report.

Based on the data and analyses contained in this report and the review of all associated documentation, it was determined that the current and future protectiveness of the remedies in place at SFAAP continue to safeguard human health and the environment.

I. INTRODUCTION

A. The Purpose of the Review

The purpose of five-year reviews is to determine whether the remedy at a site is protective of human health and the environment. The methods, findings, and conclusions of reviews are documented in Five-Year Review reports. In addition, Five-Year Review reports identify issues found during the review, if any, and recommendations to address them.

B. Authority for Conducting the Five-Year Review

Environmental Protection Agency (EPA) policy allows the deferral of action at sites eligible for the National Priorities List (NPL) to other EPA cleanup programs. Sunflower Army Ammunition Plant (SFAAP) was issued a RCRA hazardous waste storage permit on September 30, 1991. That permit consisted of two parts. Part I was issued by the KDHE to authorize the storage of certain hazardous wastes for greater than 90 days. Part II was issued by the EPA for regulations which Kansas Department of Health and Environment (KDHE) has not been authorized to implement such as those requiring investigation and cleanup of releases of hazardous waste and hazardous constituents from SWMU's. The EPA believes the requirements in Part II of the RCRA permit are sufficient to clean up this site. Various SWMUs have been investigated and remedial action has been taken under the requirements of the RCRA permit. The Army has determined if remedial action results in any hazardous substances, pollutants, or contaminants remaining at SFAAP, a review shall be done to assure the continued protection of human health and the environment no less than each five years after the initial remedial action. In general, any such actions that left hazardous substance, pollutants, or contaminants above levels that allow for unlimited use and the remedy relies on restricted use for protection of human or ecological populations requires a five year review is required by the Army.

C. Review Participants

The Army conducted a five-year review at SFAAP with an emphasis on the removal actions implemented under DERA at nine sites (SWMU's 10/11, 13, 27, 33/35, 41/42, & 50). The review was completed by The United States Army Corps of Engineers (USACE) on behalf of SFAAP. The review was conducted in from July 2004 to July 2005 and the results of the review are the basis of this report.

II. BACKGROUND

A. Physical Characteristics and Land Use

SFAAP encompasses approximately 9,065 acres located near Desoto, Kansas in the northwest corner of Johnson County. The facility is located approximately 20 miles southwest of Kansas City, Kansas and 16 miles east of Lawrence, Kansas along Kansas Highway 10. The facility is situated on a broad ridge, with most of the installation lying between two streams: Captain Creek on the west and Kill Creek on the east. The state of Kansas has designated Kill Creek as a fishery downstream of the installation, and the creek is a tributary of the Kansas River, a state designated drinking water supply. The plant is bound on the east by Spoon and Kill Creeks and on the west by Captain Creek. The Kansas River is located approximately 3 miles north of the plant.

The area immediately surrounding the plant is primarily agricultural land or rural residential, which is privately owned and sparsely populated. All SFAAP property was transferred to Sunflower Redevelopment LLC in August 2005. Long-term plans for the site include a mixed use of residential, commercial and light industrial properties. Johnson County has previously stated the property would initially be zoned rural residential.

B. History

The SFAAP is a government-owned, contractor-operated military installation. The installation began operations in 1942 to manufacture smokeless powder and propellants for small arms, cannons, and rockets. Additional facility operations included the manufacture and regeneration of nitric and sulfuric acids and ammunitions proving. Since 1971, the majority of the installation has been in a standby, inactive status, with the last production operation NQ, ceasing in 1992. Following production, many of the areas of the property were leased for non-military uses, such as livestock grazing, agricultural research, commercial wastewater treatment, sulfuric acid production, potable water production and cell phone communication.

The Department of the Army declared the installation excess in early 1998. Under the direction of the Operations Support Command (OSC) the facility operating contractor, Alliant Techsystems, Inc. and subsequently SpecPro, Inc were tasked with decommissioning the facility infrastructure, including explosives manufacturing, mixing and storage areas, contaminated structures, and equipment. Sunflower Redevelopment LLC became the owner of SFAAP in August of 2005.

As a result of propellant manufacturing carried out at SFAAP since 1943, hazardous and toxic substances were used and solid and hazardous wastes were generated, stored, and disposed at various sites on the installation. The SWMU's and AOC's described below were a result of the

manufacturing processes and include surface impoundments, ditches, sumps, ammunitions proving ranges, burning grounds, and landfills (see Figure 1-1 in Attachment A).

SWMU 1Classification Yard
SWMU 2 River Water Treatment Plant, Lagoons
SWMU 3 Main Sewage Treatment Plant Drying Beds
SWMU 4 Pond A Sludge Disposal Area
SWMU 5 Pond A Neutralization Area
SWMU 6 Pond B and Sludge Disposal Area
SWMU 7 North Acid Area-Chromate Area
SWMU 8 North Acid Area-Chromate Concentration Pond
SWMU 9 North Acid Area-Wastewater Treatment Lagoon
SWMU 10 F-Line Area Ditches
SWMU 11 F-Line Area Settling Ponds
SWMU 12 Pyotts Pond and Sludge Disposal Area
SWMU 13 South Acid Area LWTP and Evaporative Lagoons
SWMU 14 Static Rocket Test Area
SWMU 15 Waste Storage Magazines
SWMU 16 Temporary Waste Storage Magazines
SWMU 17 G-Line Area Ditches
SWMU 18 Old/New Sanitary Landfills
SWMU 19 Ash Landfill
SWMU 20 Ash Lagoons and Sludge Disposal Area
SWMU 21 Contaminated Materials Burning Ground
SWMU 22 Old Explosive Waste Burning Ground
SWMU 23 New Explosive Waste Burning Ground
SWMU 24 Nitroglycerine Area Ditches
SWMU 25 Nitrocellulose Area Ditches
SWMU 26 Single Base Propellant Area Waste Water Settling Sumps
SWMU 27 NQ Area SAC & LWTP Evaporative Lagoons
SWMU 28 Waste Calcium Carbide Treatment Area
SWMU 29 Industrial Wastewater Treatment Lagoons
SWMU 30 Pesticide Handling Area
SWMU 31Contaminated Waste Processor - Evaporative Lagoon
SWMU 32 Lead Decontamination and Recovery Unit
SWMU 33 Paste Area Half Tanks and Ditches
SWMU 34 Five Corners Settling Ponds
SWMU 35 Nitroglycerin Area Settling Ponds
SWMU 36 N-Line Area
SWMU 37 Sandblast Areas

SWMU 38 Oil Water Separator
SWMU 39 South Acid Area Ditches
SWMU 40 Calcium Cyanmide Disposal Area
SWMU 41 Calcium Carbonate Cake Landfill
SWMU 42 Temporary Sanitary Landfill
SWMU 43 Tunnel Dryers (CCC Storage)
SWMU 44 Tank T784
SWMU 45 Building 9040 and Calcium Cyanamide Conveyor/Storage Unit
SWMU 46 Decontamination Oven
SWMU 47 Nitroguanidine Production Area (25) Sumps
SWMU 48 Nitroguanidine Support Area
SWMU 49 Road Just Southeast of the Sanitary Landfill
SWMU 50 Abandoned Dump Site Near Kill Creek
SWMU 51 Battery Handling Area
SWMU 52 Paint Bay Building 542
SWMU 53 Burn and Debris Area North of STP
SWMU 54 Fluorescent Tube Wells
SWMU 55 Old Administrative Buildings
SWMU 56 Monitoring Well South of Facility 211
SWMU 57 Chemical Preparation House
SWMU 58 Combined Shops Area
SWMU 59 Laundry Facility
SWMU 60 Old Photographic Laboratory
SWMU 61 Environmental Laboratory (Facility 232)
SWMU 62 Transformer Storage Warehouse (Facility 566-5)
SWMU 63 Water Towers
SWMU 64 Paper Burning Ground
SWMU 65 Tank Farm
SWMU 66 Installation-Wide Stream Study
SWMU 67 South Acid Area
AOC I Monitoring Well West of Old Admin Area
AOC 2 Main Electrical Switch Yard
AOC 3 New Photographic Laboratory (Facility 227-18)
AOC 4 Disposal Area Southwest of STP
AOC 5 Cannon Range Tunnels (Facility 303)
AOC 6 35 Process Facilities Within F-Line Area
AOC 7 Former Truck Maintenance Shop in South Acid Area
AOC 8 Former Fuel Oil Storage Tank in South Acid Area
AOC 9 Oil and Paint House in South Acid Area
AOC 10 Storage Magazines Not Part of SWMU 15 & 16

AOC 11 Forced Air Dryers and Rest, Screen and Can Pack Houses
AOC 12 Paste Air Dry Facilities
AOC 13 General Warehouses (8037 Series)
AOC 14 Robert's Lake
AOC 15 Hazardous Analysis Testing Lab
AOC 16 NC Production Lines
AOC 17 NQ Production Facilities
AOC 18 Trench Disposal Area A3
AOC 19 Trench Disposal Area A4
AOC 20 Trench Disposal Area A5
AOC 21 Trench Disposal Area A6
AOC 22 Old Reclamation Yard

Clean closure of SWMU 23, New Explosive Waste Burning Ground, SWMU 28, Waste Calcium Carbide Treatment Area and SWMU 29, Industrial Wastewater Treatment Lagoons has occurred through KDHE Bureau of Waste RCRA closure requirements. Closure requirements have also been fulfilled for SWMU 32, Lead Decontamination Area and SWMU 34, Five Corners Settling Ponds that would allow unrestricted use of the sites. Remedial action at SWMU 22, Old Explosive Waste Burning Ground involving removal and disposal of contaminated soils in accordance with the corrective measures approved by EPA is complete and all sampling results indicate unrestricted use will be allowed but the remedial action report has yet to be finalized.

Remedial Actions have been completed at SWMU 10, F Line Ditches and SWMU 11, F Line Settling Ponds in accordance with the corrective measures approved by EPA. Additional contamination is expected to require removal beneath explosive sewers and building foundations at SWMU 10/11. Interim removal actions have been taken at SWMU 33, Paste Area Half Tanks and Settling Ponds, SWMU 35, Nitroglycerine Area Settling Ponds, and SWMU 50, Abandoned Dump Site Near Kill Creek. SWMU 13, South Acid Area Liquid Waste Treatment Plant and Evaporative Lagoons and SWMU 27, Nitroguanidine Area Sulfuric Acid Concentrator Liquid Waste Treatment Plant have been closed in accordance with KDHE Bureau of Water requirements.

Of the properties discussed above where remedial action and closures have occurred, 9 sites were identified where pollutants or contaminants remain in the soils or groundwater above levels that allow for unlimited use. Those sites are SWMU's 10/11, 13, 27, 33/35, 41/42, and 50.

III. SITE CHRONOLOGY

The following are site chronologies for the 9 sites (3 are collocated) that are the primary focus of this review.

SWMU 10/11	**F-Line ditches and F-Line settling Ponds**
March, 1943	Production operations began
August, 1971	Production operations ceased.
March, 1997	RFI Report /RFI Addenda Report
Feb, 1999	Final Corrective Measure Study Report
Jan, 2000	Corrective Measure Decision
February, 2001	Remedial actions began
October, 2001	Remedial Action Report
August, 2004	Additional Characterization Report and CMS for uncharacterized areas
Feb, 2005	Remedial action begin for uncharacterized area
SWMU 13	**South Acid Area Liquid Waste Treatment Plant (LWTP) and Evaporative Lagoons**
1978	Lagoons constructed
1994	Ponds cease receiving water
Sept, 1994	RFI field work began
May, 1995	Lagoons dewatered
March, 1996	Closure Plan approved by KDHE Bureau of Water
April, 1999	RFI Report
August, 1999	Closure activities complete
June, 2000	Final Closure Report submitted
SWMU 27	**Nitroguandine Area SAC and LWTP Evaporative Lagoons**
June, 1984	Lagoons constructed and operations began
1994	Ponds cease receiving water
Oct, 1994	RFI field work began
May, 1995	Lagoons dewatered
March, 1996	Closure Plan approved by KDHE Bureau of Water
May, 1999	RFI Report
August, 1999	Closure activities complete
June, 2000	Closure Report
SWMU 33/35	**Paste Area Half Tanks and Nitroglycerin Area Settling Ponds**
1950s	Ponds begin operations
1971	Ponds cease operations
March, 1997	RFI Report /RFI Addenda Report
2001	Interim remedial measures begin

Sept., 2003	Interim Remedial Action Report

SWMU 41/42 Calcium Carbonate Cake Landfill and Temporary Sanitary Landfill

May, 1986	Calcium Carbonate Cake Landfill began operations
June,1988	Temporary Sanitary Landfill began operations
1994	Both landfills stop receiving waste
June, 1996	Landfill cover deficiencies noted by KDHE BWM
1997	RFI field work conducted
Sept, 1997	Landfill closure plan approved by KDHE BWM
1997-1998	Landfill cover reconstructed
Sept, 1998	Closure approved by KDHE BWM
Nov, 2000	RFI Report

SWMU 50 Disposal Site East of the Classification Yard

1940s –1950s	Site used for disposal of debris
March, 1991	Disposal site discovered during inspection for proposed lease
February, 1997	RCRA Facility Investigation Report
April, 1997	Interim measures began by Bay West
May, 1999	Additional interim actions began by ECC
March, 2002	Project Report for the interim measures completed

IV. BASIS OF ACTION

A. SWMUs 10/11 – F-Line Ditches and Settling and Blender Ponds

Solid Waste Management Units 10 and 11 are located in the east-central portion of SFAAP. The study area is a combination of buildings, roads, grasslands, and woods. N-5 propellant was produced in the F-Line, which is located in the east central portion of the plant. The F-Line consisted of a blender house in which propellant was received and blended with lead salicylate. Then it was rolled into sheets, wound into carpet rolls, and extruded into solid propellant grains by hydraulic presses. Within the F-Line area there was also a roll house that converted carpet rolls from the N-line into sheet stock. This sheet stock was then incorporated into the F-Line. The equipment and floors in these buildings were frequently washed to remove any propellant. Airborne particulate propellant was also collected by a water scrubber in the ventilation system. The resulting wastewater was combined with the floor and equipment wash waters, which were discharged into ditches and then into the settling ponds.

SWMU 10 contains 21 unlined ditches. The ditches run eastward from the F-Line production facilities and discharged to either the former settling ponds (SWMU 11) or lowlands. The ditches collected doublebase propellant wastewater from the manufacturing operations. Ditches were used from the early 1950s to 1971. Soils were contaminated with propellant components and pieces of propellant were found in the ditches.

SWMU 11 consisted of six unlined settling ponds (1A, 1B, 2A, 2B, 3A, and 3B) and two unlined blender ponds (4A and 4B). These ponds operated from 1943 to 1971. Ponds 1A, 1B, 2A, and 2B received wastewater from the manufacturing operations and storm water from the F-Line area. Their effluent discharges into Spoon Creek. Ponds 4A and 4B received wastewater from the F-Line Blender House and storm water drainage. Their effluent discharged into a tributary of Pyott's Pond. Ponds 3A and 3B received wastewater from the manufacturing operations and storm water from the F-Line area. Their effluent discharges into Kill Creek. Soils were contaminated with propellant components and pieces of propellant were found in the ponds.

Law Environmental, Inc. conducted a RCRA Facility Investigation (RFI) for SWMU 10 and 11 in 1997. Most of the RFI fieldwork at SWMUs 10/11 was conducted between February and May 1995, and included installation of monitoring wells, and collection of surface-water, sediment, surface and subsurface soil, and ground-water samples. Additional information regarding this site was obtained using analytical results from surface-water and sediment samples collected for the Ecological Risk Assessment. One surface-water sample was also collected in September 1995. The RFI recommended removal of propellant solids and/or control of further releases from contaminated soil may be warranted. In their comments on the Draft RFI Report for SWMUs 10/11, both KDHE and USEPA requested that a CMS be conducted to evaluate the options for remediating and/or removing the physical and chemical hazards at SWMUs 10/11. The risk assessment evaluated commercial/industrial worker, construction worker, and excavation utility worker exposures to COPCs in soils. Also evaluated were exposures to COPCs in groundwater that may potentially be used in a residential setting. In soil, the cumulative carcinogenic risk for a commercial/industrial worker exposed to surface soil exceeded the target risk range, with most of this risk posed by nitroglycerine. The exposure point concentration for lead in surface/subsurface soil was calculated to be 5,800 mg/kg, a level that could pose an unacceptable risk to a pregnant worker. COPCs in groundwater did not pose unacceptable risks. There were no significant risks associated with a construction worker or a recreational visitor exposed to surface water or sediments in the on-site pond or creek.

Burns and McDonnell prepared a CMS in 1999 which recommended that ex-situ stabilization be implemented to treat soils and sediments contaminated with N-5 propellant at SWMUs 10/11 prior to disposal. This alternative was capable of meeting the corrective measures objectives and was reliable and implementable.

In 2002, the Army and regulatory agencies agreed that the SWMU 10 boundary should be expanded to the west (Area of Concern 6), south (New Mechanized Roll Area), and north (Old Mechanized Roll Area) based on common production practices associated with these areas. In 2003, in accordance with the Environmental Restoration Installation Action Plan, the Army expanded the remediation of contaminated soils at SWMU 10, F-Line Uplands Building Foundations, New Mechanized Roll Area, and Old Mechanized Roll Area, referred to as the SWMU 10, F-Line Production Area (Upland Area).

B. SWMU 13 - South Acid Area LWTP and Evaporator Lagoons

SWMU 13 is located in the east-central portion of SFAAP. The Liquid Wastewater Treatment Plant (LWTP) consisted of five above-ground tanks: three for treating wastewater, one for slurrying lime, and one for transfer of wastewater to be treated. East of the LWTP were four earthen cells utilized as evaporative lagoons for the LWTP, numbered Lagoons 1, 2, 6, and 7. Nine lagoons were originally planned, but only these four were constructed. According to the facility personnel, the lagoons were lined with 1.5 feet of recompacted clay overlain by approximately 5 inches of compacted bentonite. Because this area was known as the Sulfuric Acid Regeneration (SAR) area, these lagoons are referred to as the SAR Lagoons. The SAR Lagoons were constructed in 1978 as nondischarging lagoons. They went into operation in 1979 to store treated wastewater from LWTP and sump water from the Nitroguanidine (NQ) area.

Use of the LWTP varied with the need of production operations. The plant treated up to 1.5 million gallons of corrosive wastewater each month. In the summer of 1986, the lagoons were reportedly nearing their effective capacity, and the wastewater from the lagoons was applied to land within the plant boundaries. Land application of wastewater was performed in many areas of SFAAP, including the open areas in the western and southern portions of the NQ production area.

The RFI field investigation activities for this site were conducted by LAW from September through October 1994. The RFI was published in 1999. Six groundwater samples, four surface-water samples, four sludge samples, and six subsurface soil boring samples were collected during the RFI. The groundwater and subsurface soil samples were collected from the six new monitoring well locations.

The monitoring wells were installed in the overburden to obtain samples from the shallow aquifer. Depth to bedrock ranged from 15 feet on the west side of the lagoons to 8 feet on the east side. In the period immediately following installation, one well was dry and one well did not recharge sufficiently to obtain samples. Following substantial rainfall in May 1995, both of these wells contained sufficient water to be sampled. One soil boring sample was collected from each

of the six well borings.

One composite sludge sample and one surface-water sample were collected from each lagoon.

The following analytes were detected above background (for inorganic compounds) or above the method detection limits (for organic compounds) at one or more of the monitoring wells: nitroguanidine, aluminum, calcium, copper, iron, magnesium, manganese, selenium, silver, sodium, nitrate/nitrite, sulfate, total dissolved solids (TDS), and chlorine. Migration of groundwater contaminants from the lagoons was indicated as primarily to the northwest, north, and northeast, and to a lesser extent to the southeast. The extent of migration was not determined, particularly to the northeast. The results of the RFI at SWMU 13 indicate that contamination, where present, is consistent with past lagoon use. With the exception of metals, the compounds detected in the site media at elevated concentrations appear to correlate with constituents historically present in the sludge discharged into the lagoons.

Based on the available RFI data and the results of the human health risk assessment, the conclusions for SWMU 13 were as follows:

- The levels of nitrate+nitrite nitrogen in groundwater are a concern for a residential scenario. However, the RFI stated that given the low yield and poor potable quality of the shallow aquifer, it was highly unlikely that it will be used as a ground-water source for residents
- The horizontal extent of contamination has not been defined. However, the nitrate+nitrite nitrogen concentrations are expected to decrease naturally over time as the sludges undergo in-situ denitrification.
- COPCs selected for sludge included four metals and sulfate. Eleven metals and sulfate were selected as COPCs in subsurface soil. No COPCs were identified in surface water. The risk assessments results found no significant risks posed by COPCs in sludge or soil to any workers on the site or to recreational visitors.

The lagoons were emptied in 1995 and their contents transferred to the Industrial Waste Water Treatment Plant at SFAAP. During 1995, SFAAP developed closure plans for the SWMU 13 lagoons, which were approved by KDHE in 1996. The plans included land application of rainwater that had collected in the lagoons, followed by dismantling of the lagoons by combining a soil/vegetation mixture with the sludge, regrading area for proper drainage after bioremediation complete, and seeding with perennial grasses. Groundwater is to be monitored until there have been four consecutive samples at or below the proposed primary drinking water standard for sulfate and maximum contaminant level for nitrate/nitrite.

Since lagoon closure was occurring simultaneously with the development of the RFI, the RFI concluded that due to closure activities, the potential migration pathways existing at this SWMU were being eliminated and the site was being properly closed.

C. SWMU 27 - Sulfuric Acid Concentrator and LWTP Evaporator Lagoons

SWMU 27 is comprised of the sulfuric acid concentrator (SAC) LWTP and two SAC evaporative lagoons, which are part of the Nitroguanidine (NQ) production area located in the northwestern portion of SFAAP.

The SAC LWTP, which went into operation in 1984, received corrosive distillate from the SAC and some corrosive wastewaters from the NQ production processes. The LWTP consisted of a 45,000-gallon tank, which received the SAC distillate, and a 17,000-gallon tank, which received the NQ corrosive production wastewater. As part of the waste treatment process, the acidic wastewater was neutralized with lime. In neutralized wastewater containing elevated NQ concentrations, an alkaline hydrolysis process was used to reduce the NQ to concentrations below 50 parts per million by degrading the NQ. When NQ was reduced to 50 parts per million or less, weak acidic wastewater recycled from the Sulfuric Acid Regeneration (SAR) process was added to decrease the pH to normal range. The wastewater was then pumped to the two SAC Evaporative Lagoons, located south of the LWTP, through underground wastewater transfer lines.

The northernmost of the two SAC lagoons was rectangular in shape with dimensions of 380 feet by 760 feet and 10 feet in depth, with a total area of 6.6 acres and a volumetric capacity of 16.4 million gallons. The southern lagoon was trapezoidal in shape, with an area of approximately 5.2 acres, a depth of 10 feet and a capacity of about 13.5 million gallons. Because evaporation was not able to keep up with the influent rate, a land application program for the treatment of wastewater was established with approval from KDHE and EPA, Region VII.

The permit application for the lagoons indicated that they were to be constructed with a minimum of 3 feet of soil overlying limestone bedrock and with a bentonite clay liner. The bentonite liner ranged in thickness from 4 to 8 inches. The lagoons were constructed in 1984 and were used continuously from late 1984 until NQ production ceased in late 1992. Average inflow to the lagoons during a four-month period in late 1987 and early 1988 was 39 gallons per minute (gpm). It is noted that these inflow values represent peak volumes for the facility. In subsequent years, as a result of increased efficiency, inflow to the lagoons was reduced to a fraction of the peak volume.

The waste streams from the SAC and NQ areas contained NQ and may have contained Guanidine Nitrate, as well as lime sludge and acids.

Since NQ production ceased, wastewater was no longer discharged to the SAC lagoons, and an Industrial Wastewater Treatment Facility began to treat the remaining wastewater in May 1994. In July 1994, the IWTF began treating wastewater from the SAC lagoons and the evaporative lagoons from SWMU 13. As of April 27, 1995, according to the guidance and in concurrence with the KDHE, the SAC lagoons were confirmed to be dewatered of process wastewater.

Although the lagoons were emptied of wastewater in early 1995, they continued to collect rainwater. During 1995, SFAAP and KDHE developed closure plans for the lagoons, which were approved in February 1996. The plan included release of the rainwater, followed by dismantling of the lagoons. This included in-situ remediation/denitrification of the lagoons by leveling the lagoons, combining a soil/vegetation mixture with the sludge, regrading the area for proper drainage after bioremediation was complete, and seeding with perennial grasses. Per the plan, the sludge/soil mixture in the lagoons were to be monitored until the mixture reached a nitrate nitrogen content of 50 milligrams per liter (mg/L). In addition, groundwater was to be monitored until four consecutive samples were at or below the proposed primary drinking water standard for sulfate (400 mg/L) and the maximum contaminant level (MCL) for nitrate plus nitrite as nitrogen (10 mg/L).

According to the RFI completed in 1999, the compounds detected above background were primarily concentrated in monitoring wells 27MW001/94-05, 27MW002A/94-36, and MW88-12. This correlates with the local groundwater flow in the overburden, which is to the south-southeast, and reflects the site surface and bedrock topography, both of which slope in the same direction.

Based on the available RFI data and the results of the human health baseline risk assessment, the conclusions for SWMU 27 were as follows:

- The extent of contamination in the groundwater had not been defined at this SWMU. However, the primary source of contamination at this SWMU (sludge in the lagoons) is undergoing in situ denitrification and long-term monitoring of the groundwater had begun.
- The results of the human health baseline risk assessment for groundwater indicated that nitrate+nitrite nitrogen is the primary contributor to unacceptable risk at this SWMU. However, the source of the contamination was undergoing treatment and the groundwater was undergoing long-term monitoring at the time the RFI was developed. No additional action was recommended in the RFI for this SWMU.
- While various metals and sulfate, nitroguanidine and guanidine nitrate were identified as COPCs in surface soil/sludge or in mixed soil/sludge, none posed significant

risk for commercial/industrial worker, construction worker or excavation/utility worker scenarios.

D. SWMU 33/35 - Paste Area Half Tanks and Nitroglycerin Area Settling Ponds

Two operating lines in the nitroglycerine (NG) Area provided nitrated glycerine for use in the Paste Area Upon completion of nitration, the spent acid was stored prior to dilution and shipment to the Acid Area for reclamation. The NG was washed with fresh water and neutralized using a soda ash solution. The settling ponds received wastewater resulting from the wash down of equipment and buildings and from sprinkler trips. During NG production, propellant solids and sludge were removed periodically and burned at the burning grounds.

Wastewater would accumulate in the ponds (SWMU 35) until the water reached the level of the standpipe installed in each pond. The wastewater would then spill over the top and flow into the intermittent stream to the south of the ponds.

SWMU 33 was comprised of two separate half tank areas: the Five Corners Half Tank which is associated with SWMU 34, and the NG Paste Area Half Tank which is associated with SWMU 35. The Five Corners Half Tank (SWMU 33) received wastewater through metal flumes from wash down of propellant processing equipment and buildings in the Paste Area, and possibly from buildings in the NG Area as well. The half tank was used from 1965 through 1971. The half tank was actually a cylindrical tank cut in half lengthwise so that when laid on its side it formed a trough-like vessel.

The NG Half Tank Area (SWMU 33) was just northwest of the Paste Area and up gradient from the NG Area Settling Ponds (SWMU 35). The system was designed to transport wastewater from the production areas, through the half tank and into the NG Settling Ponds. The half tank was used from 1965 through 1971.

The NG Area Settling Ponds (SWMU 35) were located at the northeastern edge of the NG Area just north of the Paste Area. There were two earthen, unlined ponds, each approximately 40 ft X 40 ft square with 2 to 3 foot high berms. The ponds were adjacent to each other and shared a common berm, which separated them. The ponds used a diverter system, which served to rotate the flow from one pond to the other periodically to allow for removal of sludge. Wastewater would accumulate until the water reached the level of the standpipe in each pond. The wastewater would then spill over the top and flow into the intermittent stream south of the ponds.

The ponds were used periodically from 1951 to 1971 to receive wastewater resulting from the wash down of equipment, and from sprinkler trips. The propellant solids and sludge, which settled in the ponds were occasionally removed during production and burned at the Explosive Waste Burning Ground (SWMU 22).

Groundwater was sampled by the Army in 1982 and 1983 and pond sediment was sampled in 1985. Groundwater indicated several metals were slightly elevated, most of which was thought to reflect natural conditions. Pond sediment test results indicated elevated concentrations of lead. Final General RCRA Facility Investigation (RFI) Report dated February 1997 and Final RFI Addenda dated April 2002, provides a detailed report of the contamination related to releases at the sites. Results of the collected samples indicate that the site-elevated constituents were detected in surface water (collected from ponds/tanks and intermittent stream), sediment (collected from ponds/tanks and intermittent stream), surface soil, subsurface soil, soil collected beneath the ponds, and groundwater. The surface water samples collected at SWMU 33/35 had a large number of detections of metals in the ponds, half tanks, and intermittent stream. The sediment samples collected in the ponds, half tanks, and intermittent creeks had a large number of detections of metals above background. Nitrocellulose (NC) was detected in all of the sediment samples collected from the ponds and half tanks. Several SVOCs were detected above background in one sample. The surface soil samples collected in the ponds at SWMU 33/35 had detections of NC and several metals above background. The groundwater samples collected during Phase II activities had detections of several metals at concentrations exceeding background levels.

The RFI risk assessment evaluated on-site commercial/industrial worker exposed to surface soil/sediment and construction and maintenance/utility workers exposed to surface soil/subsurface soil/sediment mixture. Arsenic, detected at background levels, was found to potentially pose risk. However, based on a 1×10^{-5} acceptable cancer risk level, it did not. Exposure to benzo(a)pyrene in ditch sediment was found to pose potentially unacceptable cancer risk for a recreational visitor, but did not at the 1×10^{-5} cancer target level. COPCs in groundwater did not pose risks to potential residential users. The concentrations of lead reported for sediment samples collected from the Settling Ponds at SWMU 35 exceeded the Interim Remedial Guideline (IRG) of 1,000 mg/kg. The KDHE IRG screening level for lead of 1,000 mg/kg is the same screening level implemented under the Risk-Based Standards for Kansas. Based on these findings, the RFI recommended that remedial actions at SWMUs 33/35 be further evaluated.

E. SWMU 41/42 - Calcium Carbonate Cake Landfill and Temporary Sanitary Landfill

SWMU 41 is located in the south central portion of SFAAP site. SWMU 41, the Calcium Carbonate Cake (CCC) Landfill, measures approximately 350 by 315 feet. SWMU 42, a temporary sanitary landfill, adjoins SWMU 41 on the south side. Both landfills were operated under Kansas State Solid Waste Permit No. 340.

The CCC Landfill (SWMU 41) was operated from May 1986 through June 1988. Between May 1988 and December 1991, CCC was provided to farmers rather than land filled. This practice was discontinued in December 1991. The landfill was reopened in January 1992, but activity ceased again by 1994. CCC was the only waste reported to be disposed of at this area. Initially, containerized CCC was disposed of in the CCC Landfill, but later, non-containerized CCC was deposited there. The source of the CCC was nitroguanidine (NQ) production. CCC is a byproduct of guanidine nitrate (GN) manufacturing, which is an intermediate product of NQ. Constituents present in CCC include calcium carbonate, calcium cyanamide, ammonium nitrate, sulfate, GN, metals, and fluoride. The temporary sanitary landfill (SWMU 42) was used for the disposal of non-hazardous solid waste from facility operations, consisting of general office trash with very little sanitary (food) waste. When landfill activity was halted for both landfills in 1994, the landfills were covered with native clay and topsoil. The CCC landfill is equipped with a leachate collection system.

Following a visit to the CCC Landfill in June 1996, KDHE reported concerns that infiltration through the soil cap was excessive and that cap integrity was being impacted by sloughing, settlement, and animal burrows. The KDHE inspection also noted that exposed CCC and standing water was present in a trench on the east side of the landfill. KDHE requested a plan to correct these items. KDHE did not indicate any concerns regarding the Temporary Sanitary Landfill.

The RFI Addendum for SWMUs 41 and 42 states that, during 1996-1997 sampling, several volatile organic compounds (VOCs) (including trimethysilanol and unknown hydrocarbons) were detected in groundwater samples, as well as the semivolatile organic compound (SVOC) bis(2-ethylhexyl)phthalate. The metals aluminum, copper, iron, selenium, sodium, and zinc exceeded background levels in at least one groundwater sample, with sodium the most frequently detected metal. Sulfate and TDS were detected above background. Selenium was detected more frequently in down gradient groundwater samples than in up gradient samples. Acetone was detected in one subsurface soil sample. SVOCs, explosives, metals, cyanide, and sulfate were either not detected or were not detected above background levels in subsurface soil.

The RFI Addendum risk assessment did not identify COPCs in soil. COPCs for groundwater were limited to aluminum and bis(2-ethylhexyl)phthalate. The results indicated an unacceptable risk for dermal exposure to bis(2-ethylhexyl)phthalate in groundwater in a residential use setting. The two detections of this compound were in down gradient wells. Although the plant does not

have a history of use for this chemical, the containers of CCC that were placed in the CCC Landfill were plastic and may be a source of bis(2-ethylhexyl)phthalate. The RFI Addendum recommended evaluation of a groundwater monitoring program.

F. SWMU 50 - Disposal Site East of the Classification Yard

SWMU 50 is located within the flood plain of Kill Creek along two unnamed tributaries, in the northeast portion of SFAAP. Sometime prior to 1954, the area was used for the disposal of solid waste including shingles, building materials, drums and metal slag. Two separate disposal areas within SWMU 50 are identified as Tract One and Tract Two. For clarification, Tract One is also known as SWMU 50 South, while Tract Two is SWMU 50 North. SWMU 50 South is approximately 139,201 square feet (3.2 Acres), and SWMU 50 North encompasses an area of about 281,288 square feet (6.5Acres).

The disposal sites were discovered in 1991 during a site inspection for a proposed site lease. A RFI was completed for SWMU 50, by LAW Engineering and Environmental Services in February, 1997. The site investigation consisted of the installation of three ground-water monitoring wells, the collection of three soil samples from the borings, and the collection of ground-water samples from the wells. Fifteen surface soil samples were collected in the vicinity of the debris piles, and surface-water and sediment samples were collected from two locations in Kill Creek. Additionally, a site geophysical survey was conducted to help define the physical boundary of the debris piles.

A magnetometer survey indicated that a dump site was present. The visible debris on the ground surface included drums containing cement-like material and general construction rubble such as shingles, bricks, barbed wire fencing, and asbestos containing material (ACM). Contamination, where present, appears to be associated with the existing debris piles. This is reflected mainly in the surface soils adjacent to the debris piles where some metals were detected an order of magnitude or more above background. Lead was detected in two surface soil samples adjacent to the piles at concentrations of 22,000 mg/kg and 1,600 mg/kg. Elevated concentrations of several semi-volatiles, primarily PAHs, were also detected in surface soils near the debris piles. Nitrocellulose was detected in 12 of 15 surface soil samples, at concentrations ranging from 2.8 to 9.0 milligrams per kilogram (mg/kg). Also, although not specifically analyzed for, asbestos-containing material appears to be present throughout the debris piles.

The RFI concluded that the existing dump site, given its current physical extent, did not exhibit unacceptable carcinogenic or noncarcinogenic risks for the present future land use scenario, i.e., development of a trail through the area for the Johnson County Park lease. However, if alternate future use plans are anticipated, some carcinogenic risks may be present as detailed earlier. Additionally, if the debris was left in place, it will be accessible to recreational visitors, and was also situated in a flood plain area, both of which could present future liability for SFAAP.

Due to the SWMU's proximity to the flood plain, KDHE and USEPA requested that Interim Measures be taken to remove the debris, including all visible asbestos containing material.

V. REMEDIAL ACTIONS

This initial 5-year review is to evaluate the performance of the remedial actions taken at SFAAP where hazardous substance, pollutants, or contaminants above levels that allow for unlimited and the remedy relies on restricted use for protection of human or ecological populations remain. The remedial actions which are the focus of this five-year review are associated with SWMUs -10, 11, 13, 27, 33, 35, 41, 42, & 50.

A. SWMU 10/11

A removal action was implemented consistent with the Statement of Basis and Corrective Measures Decision issued by EPA in 2000; the recommendations presented in the Final Corrective Measures Study for the Remediation of SWMUs 10/11, Sunflower Army Ammunition Plant, DeSoto, Kansas developed by Burns and McDonnell in 1999; and the Final RCRA Facility Investigation Report for SWMU's 10/11, Sunflower Army Ammunition Plant, DeSoto, Kansas performed by Law in 1997.

At SWMUs 10 and 11, the primary contaminant of concern was the residual components of N-5 propellant. Physically, the N-5 propellant consisted of variable size, orange-colored chips/fragments, containing nitroglycerin, nitrocellulose, diethyl phthalate, 2-dinitrophenylamine, lead 2-ethylhexoate, lead salicylate, and candelilla wax. Based on site characterization data, the contaminants identified for removal below Target Media Cleanup Levels (TMCL) were nitroglycerin, bis(2-ethylhexyl)phthalate, and lead compounds. Subsequently, nitrocellulose was added to the TMCL list. The TMCLs for these compounds were:

- Lead (1,000 milligrams per kilogram [mg/kg})
- Nitroglycerin (405 mg/kg)
- Nitrocellulose (1,000 mg/kg)
- Bis(2-ethylhexyl)phthalate (3.6 mg/kg)

The remedial action objective for SWMU's 10 and 11 was to excavate, treat and dispose of propellant contaminated soils from designated drainage ditches, soils surrounding building foundations and settling ponds at an approved off-site landfill facility. This objective was achieved by IT Corporation in 2000 by removal and off-site disposal of approximately 45,848 tons of treated soils from the area within SWMU's 10 and 11.

The major work elements completed included:

- Formulate treatment admixture to immobilize lead and to eliminate future leachability
- Develop engineering and safety controls to minimize potential explosive hazards
- Produce execution plans and obtain necessary permits
- Erect temporary facilities and site infrastructure
- Excavate and transport affected soils for processing
- Mechanically screen, stabilize, and stockpile
- Transportation and off-site disposal
- Site grading and restoration

Based on characterization data and site topography, SFAAP sub-divided the site into three work areas: uplands building foundation area, drainage ditches, and settling/blender ponds. Each of the areas was demarcated and land surveyed to identify the lateral limits of the excavation area. A centrally located area was selected to erect contaminated soil stockpile, screening/blending, and pug mill treatment and treated waste stockpile areas, hereinafter referred to as the materials processing area. The progression of work was developed to remove the up-gradient contaminants first, working from the uplands, down gradient along each of the ditches until all contaminants were removed from the ponds. From the uplands and ditch areas, soils were removed to a minimum depth of 6 inches, loaded into dump trucks, and transported to the materials processing area. If propellant fragments were detected at or below the 6-inch interval, the soils were removed to a visual clean standard. Pond excavation proceeded to design depth and extended laterally beyond the sidewall berms.

Approximately 29,319 tons of contaminated soil were excavated, screened, and processed for treatment from 62 uplands building foundations, resulting in 22,000 tons of treated soils requiring off-site disposal. Approximately 21,000 tons of contaminated soil were excavated, screened, and processed for treatment from 28 drainage ditches, resulting in 19,000 tons of treated soils requiring off-site disposal. Similarly, approximately 6,373 tons of contaminated soil were excavated, screened, and processed for treatment from eight settling/blending ponds, resulting in 4,848 tons of treated soil requiring off-site disposal. A total of 45,848 tons of material were transported off-site to Johnson County Landfill, Shawnee Mission, Kansas for disposal as non-hazardous special waste. During removal operations, concrete and building demolition debris, vegetative debris, and rock (greater than 2 inches) was encountered. As contaminated soils were segregated, this material was mechanically separated and stockpiled. This material was inspected for potential residual contaminants and staged at designated locations for ultimate disposal by the facility contractor.

Excavated material was transported to the materials processing area for treatment by pug mill stabilization. The technology required pulverization, screening, and blending of soils to attain an

optimum particle size of less than 2-inches for all materials requiring treatment. This size facilitated uniform and complete mixing with a 4 percent admixture of Portland cement and water. Soils were blended using a Findlay 393 Hydra Screen equipped with a pre-cutter pulverization unit. Once the material was screened to optimum sieve size, the material was loaded into a Rapid Mix 400 pug mill. The treated soil was stockpiled each day for treatment confirmation analysis to verify that waste profile and Land Disposal Requirements were met. All treated materials were transported to the Johnson County Landfill in Shawnee, Kansas. Post-excavation confirmation sampling and analysis were performed at excavation locations at designated frequencies to verify that the excavated/treated soils met the remediation cleanup goals established by U.S. Environmental Protection Agency and Kansas Department of Health and the Environment in the Final Corrective Measures Study for this site. Final elevation surveys were performed to verify that a minimum of 6-inches of material was removed and to document the final elevations of the designated excavation areas. Upon completion of confirmation analysis, the site was re-vegetated to restore the area with indigenous and bovine friendly grasses. First, disturbed areas were graded to blend into natural contours, then they were hydro-seeded with Orygun (endophyte-free fescue) to prevent adverse erosion of sediments into surface water tributaries and sensitive ecological areas along Kill Creek.

In 2002, the Army and regulatory agencies agreed that the SWMU 10 boundary should be expanded to the west (Area of Concern 6), south (New Mechanized Roll Area), and north (Old Mechanized Roll Area) based on common production practices associated with these areas. A delineation sampling effort was completed in April 2004 to quantify the extent of additional contamination in the new area.

Initially, the Statement of Basis developed by EPA in 2000 identified industrial, future land-use cleanup TMCLs for SWMU 10 and according to these cleanup standards a previous removal action was completed by IT Corporation in 2000. Since the completion of this removal action the intended future land-use of the site has changed from industrial to residential. The new TMCLs in which all sample results will be compared to are 400 mg/kg for lead, 3.6 mg/kg for bis(2-ethylhexyl)phthalate, and 35 mg/kg for nitroglycerine. These TMCLs have been adopted from the Kansas Department of Health and Environment residential Risk-Based Cleanup value. The Kansas Department of Health and Environment identified several areas, which previously did not meet this new future land-use standard in areas previously remediated.

In early 2005, Shaw Environmental began remedial activities to remove all contaminants above TMCLs to residential land use standards. The final Corrective Measures Decision, Statement of Basis approves excavation, treatment, and off-site transportation and disposal of impacted soils as the preferred remedy for SWMU 10. Approximately 6,000 tons of contaminated soils were excavated. A Finlay 393 Hydrascreen with a precutter pulverization unit was used to pulverize,

screen, and blend contaminated soils into a homogenous, less than 2-inches minus sieve material prior to disposal at the Johnson County Landfill

All soils in open areas are believed to have been remediated to residential use standards based on initial data. However, additional contamination is expected to require removal beneath explosive sewers and building foundations at SWMU 10/11.

B. SWMU 13

In accordance with NPDES permit requirements, KDHE was notified as the lagoons were emptied. The SAR Lagoons were declared dewatered by KDHE in 1995. Although the lagoons were emptied of wastewater, they continued to collect rainwater. During 1995, SFAAP and KDHE developed closure plans for the lagoons. In a letter dated March 11, 1996, KDHE approved a schedule of work for remediation of the lagoon sludge and dismantlement of the lagoons. This action partially fulfilled KDHE requirements for lagoon closure. This work was completed in August 1999. The work consisted of:

- Excess water was land applied in accordance with (National Pollutant Discharge Elimination System (NPDES) requirements established by KDHE) approved land application plan requirements. This phase may be an on-going process as excess water collects in the lagoons.

- In-situ remediation/denitrification of the sludge when black dirt with vegetation is mixed with the sludge.

- The sludge/soil mixture in the lagoons was monitored until the mixture reaches a nitrate plus nitrogen content of 50 milligrams per Kilogram (mg/Kg).

- The clay berms were dismantled and spread over the lagoon floor.

- Additional topsoil was brought in to cover and finish-grade the lagoon area so that rainfall ran off the area, limiting the infiltration at the site.

- The graded lagoon site and soil borrow areas were seeded with perennial grasses.

Additional requirements to complete closure of the lagoons include groundwater monitoring at selected sites down-gradient of the lagoons for a period of not less than five years, and submittal of a final work plan for closure activities consistent with KDHE's pond closure/sampling verification plan. In addition, groundwater was to be monitored until four consecutive samples showed concentrations at or below the proposed primary drinking water standard for sulfate (400

mg/L) and maximum contaminant level (MCL) for nitrate plus nitrite as nitrogen (10 mg/L). The Army is currently determining the full nature and extent of groundwater impacts in groundwater Operable Unit (GWOU) 2 (SAAP-003, 004, 005, 006, 007, 008, 009, 010, 011, 012, 013, 020, 024, 025, 030, 033, 034, 035, 037, 038, 039, 040, 046, 048, 052, 053, 058, 062, 063, 064, 067, 102, 104, 107, 108, 109, 112, 113, 115, 116). Future groundwater monitoring at SWMU 13 as a component of GWOU 2 sampling.

C. SWMU 27

Although the lagoons were emptied of wastewater in early 1995, they continued to collect rainwater. During 1995, SFAAP and KDHE developed closure plans for the lagoons. In a letter dated March 11, 1996, KDHE approved a schedule of work for remediation of the lagoon sludge and dismantlement of the lagoons. This action partially fulfilled KDHE requirements for lagoon closure. This work was completed in August 1999. The work consisted of:

- Excess water was land applied in accordance with (NPDES requirements established by KDHE) approved land application plan requirements. This phase may be an on-going process as excess water collects in the lagoons.

- In-situ remediation/denitrification of the sludge when black dirt with vegetation is mixed with the sludge.

- The sludge/soil mixture in the lagoons was monitored until the mixture reaches a nitrate plus nitrogen content of 50 milligrams per Kilogram (mg/Kg).

- The clay berms were dismantled and spread over the lagoon floor.

- Additional topsoil was brought in to cover and finish-grade the lagoon area so that rainfall runs off the area, limiting the infiltration at the site.

- The graded lagoon site and soil borrow areas were seeded with perennial grasses.

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The Army is currently determining the full nature and extent of groundwater impacts within GWOU 1. Future groundwater monitoring at SWMU 27 will be a component of GWOU 1 sampling.

Confirmation soil samples were collected in 2002 along the LWTP transfer line and showed cleanup standards were met. Groundwater monitoring will continue.

D. SWMU 33/35

An Interim Removal Action (IRA) was performed by IT Corporation in 2002 under the authority of the Department of the Army. The IRA was executed in accordance with the Army, KDHE, and EPA Region VII approved execution plans using procedures consistent with the Statement of Basis developed by EPA in 2000.

Primary COCs detected 33/35, above the remediation goal, were the contaminants that required remediation. At SWMUs 33 and 35, the primary COC was residual nitroglycerine. Other COCs detected above background levels in soil and pond/ditch sediments included diethyl phthalate, 2-dinitrophenylamine, lead 2-ethylhexoate, and lead salicylate. The TTMCLs for the primary COCs were:

- Lead (400 milligrams per kilogram [mg/kg])
- Nitroglycerine (405 mg/kg)
- Nitrocellulose (1,000 mg/kg)

For SWMUs 33/35, the remedial action objective was to excavate pond sediment and ditch soils, perform treatment and off-site transportation, and disposal of “Special Waste” soils to a Subtitle D Landfill. The objective required removal of soils exhibiting COCs above the TMCLs to residential cleanup standards. Although the Johnson County Conceptual Land Use Plan identifies this area of the plant as light industrial and commercial future land-use, the Army achieved residential standards because of the potential impacts of surface water drainage on future residential areas located down gradient of SWMUs 33/35.

Combined dimensions of the SWMU 35 Ponds were approximately 50 feet by 100 feet. The ponds were suspected to contain suspended globules of nitroglycerine. Consequently, several engineering controls and practices were implemented to protect site workers from potential explosion hazards. The excavator was equipped with a lexan blast protection shield over the machine windshield and was outfitted with an extended boom to increase the distance between the operator and the excavation. Operationally, the areas were saturated with water to minimize ignition hazards, and the excavator bucket was used to apply gradual pressure to the surface to

probe for potentially shock sensitive crevasses that were thought to have potential to contain nitroglycerine globules.

Once cleared, the depth of material removed was approximately 3 feet below the pond sediment elevation. The amount of sediment removed was approximately 1,000 tons. At this location, further removal was not necessary, as excavation had clearly entered the underlying clay liner. Lateral excavation was approximately 6 inches in sidewalls. Vertical and lateral excavation limits were confirmed by post-excavation samples across the pond bottom and along the sidewalls.

Following sediment removal, the half tank was removed from their earthen basins, triple rinsed, and staged, for future disposal in accordance with flash decontamination procedures for scrap metal by the facility contractor. After each half tank was removed samples were taken to verify that the soils underneath and adjacent to the area were clean. Two locations were sampled underneath the tank to a depth of 2 feet, these samples showed lead concentrations below 400-milligrams per kilogram. The excavated soil was stabilized with a formulation that included a 5 percent mix ratio of Portland cement-to-soil was necessary to achieve chemical fixation of lead salts, lead-2-ethyl hexoate, and lead salicylate. The Army authorized mechanical mixing of the soils using a track hoe excavator. After cement was added, soil was mixed with a track hoe excavator as water was applied via a spray bar or hose nozzle. Approximately 1,000 tons of soil was removed from this area and stabilized prior to offsite disposal at Johnson County Landfill.

E. SWMU 41/42

Although the landfills were covered with native clay and topsoil when they were closed in 1994, following a visit to the CCC Landfill in June 1996, KDHE reported concerns that excessive infiltration was occurring through the soil cap and that cap integrity was being impacted by sloughing, settlement, and animal burrows. The KDHE inspection also noted that exposed CCC and standing water was present in a trench on the east side of the landfill.

KDHE approved plans for interim corrective action at the CCC landfill in 1997. In 1998, the landfill cover was repaired by constructing a 36-inch low permeability clay layer, and a vegetated protective layer. All work was inspected and accepted by KDHE representatives in 1998.

Groundwater monitoring is on-going.

F. SWMU 50

In the spring of 1997, Bay West Inc. performed interim removal action at SWMU 50 South to eliminate the potential for direct contact with hazardous materials at the site, and to prevent further erosion of the disposal area. These activities consisted of debris and lead-contaminated soil removal and stream bank stabilization. Primary contaminants of concern included Asbestos Containing material (ACM) in surface debris identified during the RFI. No soil cleanup criterion exists for asbestos; however, the standard definition of ACM was applied. Soil containing asbestos in excess of 1% by volume was considered ACM, thereby requiring off-site disposal. The action level for lead was identified as 1,000 mg/kg.

A total of 790.28 tons of ACM surface debris and 6 drums of non-hazardous waste were removed from the site and disposed at the Johnson County Landfill. Excavation depths were 18 inches in all debris removal areas, except one location that extended to a depth of 30 inches due to the existence of debris. An estimated 15% of the debris was friable ACM. All ACM debris was placed in roll-off containers. All five verification samples exhibited lead at concentrations below the action level. Also, 240 feet of stream bank was stabilized with rock riprap to prevent further erosion of the disposal area.

ECC performed interim removal action at SWMU 50 North in 1999. Tasks consisted of permitting and notification, access road construction, tree and shrub removal, asbestos abatement, soil excavation, and site restoration. Tree and shrub removal was kept to a minimum. Only those trees that affected access to the stream channel, had trunks less than three inches in diameter, or had shallow roots that presented a danger to the work crews were removed and stockpiled on-site.

Broken transite panels that were scattered on the surface of the work area were removed using hand tools. Water was poured over transite debris prior to removal. The removed material was placed in 6-mil polyethylene disposal bags, double bagged, appropriately labeled, and transported in lined roll-off containers for disposal. Approximately five cubic yards of asbestos debris was removed form the project site and transported to the Johnson County Landfill. The areas of excavation extended approximately 15 feet on either side of the unnamed tributary of Kill Creek and along the eastern boundary of the project site adjoining the Kill Creek. A total of 1,500 cubic yards of soil was excavated from the project site, and stockpiled adjacent to the site for subsequent sampling and disposal at the Johnson County Landfill.

Excavation activities did not cause erosion along the stream banks or channel beds. Therefore, further stream bank and channel bed stabilization was not necessary. Excavation activities were followed by site restoration.

Shafer, Kline & Warren conducted a final survey of the SWMU 50 North and South areas in January 2001. The purpose of the survey was to provide a legal description of the two properties for use in a restrictive covenant at the time of property transfer by SFAAP at some point in the future. A survey map of the SWMU 50 sites, with the SWMU South (Tract I) and SWMU North (Tract II), legal descriptions was developed.

Annual inspections were conducted at the site in 2002 and 2003. In April 2003, approximately 8 cubic yards of soil was excavated and reshaped to fill in an erosional gully noted in the 2003 inspection. Approximately 55 square yards of geotextile fabric was placed over the entire sub grade of the area. Approximately 19 cubic yards of shot rock riprap were placed to an approximate depth of 1 foot over the disturbed area. No other areas requiring immediate repair were noted in the 2004 and 2005 annual inspections.

VI. FIVE-YEAR REVIEW PROCESS

The Army conducted a five-year review of the removal actions implemented at SFAAP at DeSoto, Kansas with an emphasis on SWMU's 10/11, 13, 27, 33/35, 41/42, & 50. The review was conducted by USACE on behalf of SFAAP. The five year review consisted of the review of relevant documents, review of recent groundwater sampling and comparison to current standards, conducting limited interviews and conducting site inspections to determine if the site remedies were functioning as intended. In general, the report was written following EPA Comprehensive Five-Year Review Guidance. The guidance was prepared for use at CERCLA sites, not sites closed under RCRA requirements such as SFAAP. Therefore, some deviations from the guidance's outline were required to accommodate the unique actions at individual SWMUs and improve the coherence of the document when explaining remedial decisions at each SWMU.

VII. FIVE-YEAR REVIEW FINDINGS

A. Document Review

The review of relevant documents including RFIs, CMSs, closure reports, and correspondence was conducted. A list of the documents is included as Appendix B. The review concluded that the Target Media Cleanup Levels established for soils and the required site restoration for each site had been achieved. Final documentation and conformation for excavation to meet the revised TMCL for residential use at SWMU 10 has yet to be completed so the evaluation was based on preliminary data. The documents reviewed also outlined the current required groundwater monitoring.

B. Site Inspection

Inspections at the site were conducted on July 26, 2004 by the representatives of SFAAP, USACE, Spec-Pro (SFAAP operating contractor) and KDHE. A walk over inspection was conducted for SWMU's 10, 11, 13, 27, 33/35 41/42, and 50. The purpose of the inspections was to assess the protectiveness of the remedy, including the condition of the restored and revegetated areas, landfill covers, and stream bank stabilization.

At SWMU 10/11, the vegetation on the remediated area is in good condition and appears healthy. Minor erosion rills were noted at several locations but their presence did not constitute a concern since similar features are found in pastures of this size on this degree of slope.

At SWMU 13, the vegetation on the remediated area is in good condition and appears healthy. The remediation had been completed in such a manner that it was difficult to distinguish the lagoon location from the surrounding ground. However, several gullies several feet deep were forming on the eastern edge of the SWMU, but outside the identified footprint of the old lagoon. The gullies would be filled in as part of normal maintenance of the area if they continued to erode.

At SWMU 27, the vegetation on the remediated area is in good condition and appears healthy. The remediation had been completed in such a manner that it was difficult to visualize the actual location of the original lagoons. No concerns were noted.

At SWMU 33/35, the vegetation on the remediated area is in good condition and appears healthy. The half tank which had been thoroughly cleaned remained on site. The Army will require flashing of the tank prior to recycling or disposal. No concerns were noted.

At SWMU 41/42, the landfill cover was in very good condition. There were no signs of the cover integrity being impacted by sloughing, settlement, and animal burrows which had been noted prior to repairing the cover in 1998. The vegetation on the cover is in good condition and appears healthy. No concerns were noted.

At SWMU 50, the vegetation on the remediated area is in good condition and appears healthy. Stream bank areas which had been stabilized at SWMU 50 North and South were in good condition with no signs of sloughing or exposed waste. Minor amounts of loose or exposed transite shingles were noted in stream banks and channels. This observation is consistent with observations during ongoing annual inspections.

C. Data Review

As noted in Part A of this section, the review of data in Remedial action reports and correspondence concluded that the Target Media Cleanup Levels established for soils and required site restoration activities for each site had been achieved.

Available Groundwater sampling results from 1996 to 2004 for Contaminants of Concern were reviewed.

At SWMU 10/11, Nitrate levels have been reduced below the MCL (10 mg/L) in the majority of wells. Sulfate has been reduced below the secondary MCL (250 mg/L) in the majority of wells. Bis(2-ethylhexyl)phthalate above its MCL (6 ug/L) was detected in several wells. However, its presence is not consistent between sampling events. Monitoring reports recommend the continued monitoring for nitrate, sulfate and bis(2-ethylhexyl)phthalate at selected wells until concentration levels are below MCLs for four consecutive rounds.

At SWMU 13 and 27, levels of nitrate consistently above MCL and for sulfate above the secondary MCL (250 mg/L) occur at both SWMU 13 and 27. However, during the period from 1996 to 2004, nitrate/nitrite and sulfate have decreased significantly to moderately.

At SWMU 33/35, results from monitoring of the SWMU 33/35 Nitroglycerine Area Settling pounds indicate that concentrations of Lead and of bis(2-ethylhexyl)phthalate were above the MCL values. Continued monitoring of the Nitroglycerine Area Settling Pond area should be performed with compounds of concern being sulfate, lead, manganese, benzo(a)anthracene and bis(2-ethylhexyl)phthalate.

At SWMU 41/42, groundwater at the site exceed the MCL for nitrate and Sulfate. The presence of VOCs or SVOCs is not a concern based on existing data. The landfill will continue long term monitoring as a component of landfill closure.

At SWMU 50, groundwater monitoring is not a component of long term maintenance of the SWMU.

D. Interviews

Interviews were conducted in conjunction with site inspections. Mr. Randy Carlson, the KDHE Federal Facilities Unit Chief, and Mr. Tim Davis, Site Environmental Manager for Spec-Pro were interviewed. No significant problems regarding the nine SWMUs were identified during the interviews.

VIII. TECHNICAL ASSESSMENT

A. SWMU 10/11

- ***Question 1: Is the remedy functioning as intended?***

The remedy for the SWMU 10/11 is functioning as intended. The contaminated soils and sediments were excavated and stabilized prior to disposal. The contaminated media in the areas remediated have been made non-hazardous and no longer present a threat to human health or the environment. Additional contamination is expected to require removal from beneath explosive sewers and building foundations at SWMU 10/11. Evaluation of groundwater contamination is ongoing and will be part of a future groundwater action.

- ***Question 2: Are the exposure assumptions, toxicity data, cleanup levels and remedial action objectives used at the time of remedy selection still valid?***

The assumptions used for the remedy selection are valid. However, as noted in the review, the Statement of Basis identified industrial, future land-use cleanup TMCLs for SWMU 10. These cleanup standards were used in the remedial action completed by IT Corporation in 2000. Since the completion of this removal action the intended future land use of the site has been changed from industrial to residential. The new TMCLs are 400 mg/kg for lead, 3.6 mg/kg for bis(2-ethylhexyl)phthalate, and 35 mg/kg for nitroglycerine. These are appropriately protective, based on residential exposure assumptions and current toxicity information. A second stage of remedial action at SWMU 10 is believed to have excavated, treated and disposed of all materials above the new TMCLs.

- ***Question 3: Has any other information come to light that could call into question the protectiveness of the remedy?***

No

B. SWMU 13

- ***Question 1: Is the remedy functioning as intended?***

The interim remedial action for SWMU 13 is functioning as intended in the KDHE wastewater treatment pond closure requirements. The contaminants were remediated by land application of the liquid contents of the lagoon, followed by dismantling of the lagoons by combining a soil/vegetation mixture with the sludge, grading, and seeding with perennial grasses. Nitrate + Nitrite levels in site soils are below the combined target concentration of 50 mg/Kg. With the contaminant sources removed, groundwater contamination appears to be trending downward. Groundwater will be monitored until there have been four consecutive samples at or below the proposed drinking water standard for sulfate and maximum contaminant level for nitrate/nitrite.

• ***Question 2: Are the exposure assumptions, toxicity data, cleanup levels and remedial action objectives used at the time of remedy selection still valid?***

Final cleanup levels for soil or groundwater at this site have not been determined. The risk assessment assumed future residential exposure to groundwater. The target concentration for combined Nitrate + Nitrite in soils/sludge was therefore set to protect groundwater from being impacted by leachate. The MCL for nitrate + nitrite was set to protect future residents that may use the groundwater as a potable water source. Cleanup levels remain protective. For sulfate, the original KDHE groundwater cleanup standard used a proposed primary drinking water standard for drinking water for sulfate (400 mg/L). By default, all recent sampling compares sampling results to 250 mg/L secondary MCL for sulfate , which is not health-based, but rather established based on taste.

• ***Question 3: Has any other information come to light that could call into question the protectiveness of the remedy?***

No.

C. SWMU 27

• ***Question 1: Is the remedy functioning as intended?***

The interim remedial action for SWMU 27 is functioning as intended in the KDHE wastewater treatment pond closure requirements.. The contaminants were remediated by land application of the liquid contents of the lagoon, followed by dismantling of the lagoons by combining a soil/vegetation mixture with the sludge, grading, and seeding with perennial grasses. Nitrate + Nitrite levels in site soil/sludge are below the combined target concentration of 50 mg/Kg. With the contaminant sources removed, groundwater contamination appears to be trending downward. Groundwater will be monitored until there have been four consecutive samples at or below the proposed primary drinking water standard for sulfate and maximum contaminant level for nitrate/nitrite.

• ***Question 2: Are the exposure assumptions, toxicity data, cleanup levels and remedial action objectives used at the time of remedy selection still valid?*** Final cleanup levels for soil or groundwater at this site have not been determined. The risk assessment assumed future residential exposure to groundwater. The target concentration for combined Nitrate + Nitrite in soils/sludge was set to protect groundwater from being impacted by leachate. The MCL for nitrate + nitrite was set to protect future residents that may use the groundwater as a potable water source. Cleanup levels remain protective. For sulfate, the original KDHE groundwater cleanup standard used a proposed primary drinking water standard for drinking water for sulfate (400 mg/L). By default, all recent sampling compares sampling results to 250 mg/L secondary MCL for sulfate , which is not health-based, but rather established based on taste.

• ***Question 3: Has any other information come to light that could call into question the protectiveness of the remedy?***
No.

D. SWMU 33/35

• ***Question 1: Is the remedy functioning as intended?***
The interim removal action for SWMU 33/35 is functioning as intended. The contaminated soils and sediments were excavated & stabilized prior to disposal. With the contaminant sources removed, groundwater contamination appears to be trending downward.

• ***Question 2: Are the exposure assumptions, toxicity data, cleanup levels and remedial action objectives used at the time of remedy selection still valid?***
Final cleanup levels for soil or groundwater at this site have not been determined. The assumptions used for the removal action remain valid. Excavation of contaminated soils has rendered exposure pathways as incomplete.

• ***Question 3: Has any other information come to light that could call into question the protectiveness of the remedy?***
No

E. SWMU 41/42

• ***Question 1: Is the remedy functioning as intended.***
The interim remedial action for the SWMU 41/42 is functioning as intended. The landfill cover was in very good condition and capable of preventing contact with waste disposed in the landfill.

• ***Question 2: Are the exposure assumptions, toxicity data, and remedial action objectives used at the time of remedy selection still valid?***
Final cleanup levels for soil or groundwater at this site have not been determined. The assumptions used for the interim action remain valid. The landfill cover has rendered exposure pathways incomplete.

• ***Question 3: Has any other information come to light that could call into question the protectiveness of the remedy?***
No.

F. SWMU 50

• ***Question 1: Is the remedy functioning as intended.***

The interim removal action for SWMU 50 is functioning as intended. Debris and lead-contaminated soil have been removed and stream bank stabilization, where needed, has occurred. The minor amounts of transite siding which appear in the creek channel are being addressed through collection during annual inspection.

• ***Question 2: Are the exposure assumptions, toxicity data, and remedial action objectives used at the time of remedy selection still valid?***

Final cleanup levels for soil or groundwater at this site have not been determined. The assumptions used for the interim action remain valid. The cleanup level set for lead in soil was based on recreational exposure, which remains the current and intended future land use.

• ***Question 3: Has any other information come to light that could call into questioned the protectiveness of the remedy?***

No.

IX. DEFICIENCIES / ISSUES

All actions to date have been to eliminate risks from contact with contaminated soil. Remedial decisions for groundwater will be made after completion of the respective investigations. With the establishment of GWOUs 1 and 2, groundwater at SWMU 10/11, 13, 27 and 33/35 may be monitored under an operable unit approach.

Additional contamination is expected to require removal from beneath explosive sewers and building foundations at SWMU 10/11.

No deficiencies during the five year review were noted at the sites at Sunflower Army Ammunition Plant where remedial actions or removal actions have been completed.

Institutional controls have not been established at SWMUs 13, 27, 41/42 and 50 to address restrictions required based on remaining contamination.

X. RECOMMENDATION AND FOLLOW-UP ACTIONS.

Due to the development of the groundwater operable unit concept, a mechanism should be investigated to designate no further action of a SWMU while deferring groundwater issues relating to that SWMU to the groundwater operable unit.

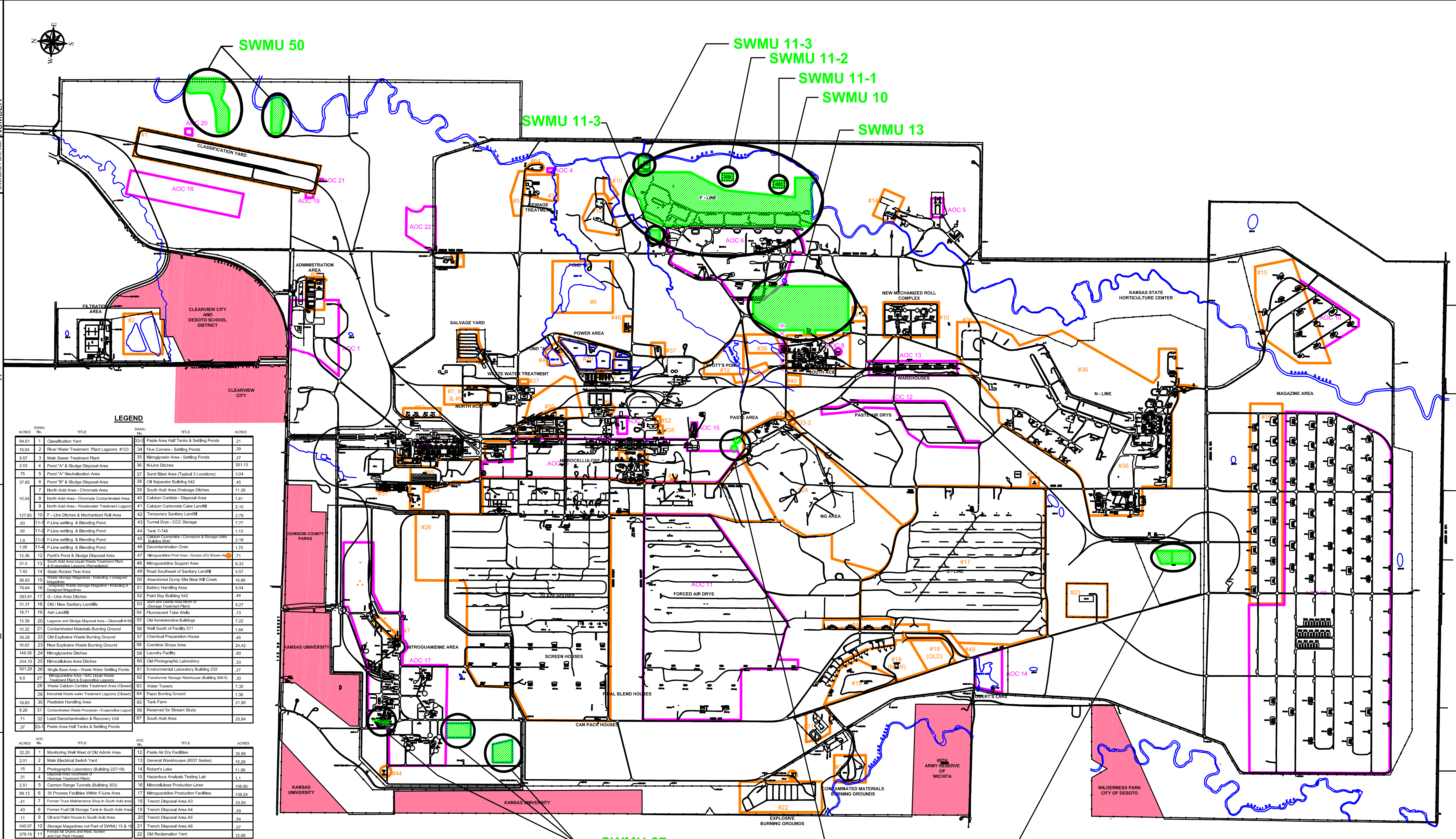
XI. PROTECTIVENESS STATEMENT

The current and future protectiveness resulting from remedies at SFAAP and specifically with regards to SWMU's 10, 11, 13, 27, 33/35, 41/42, and 50 are protective of human health and the environment and exposure pathways that could result in unacceptable risk are being controlled.

XII. NEXT REVIEW

In general, a Five-Year Review Report should be conducted every five years when hazardous substances, pollutants, or contaminants remain at a site above levels that allow for unlimited use and unrestricted exposure. However, a five year review is not required if a site is deferred to RCRA prior to placement on the NPL, but the Army believes five year reviews are necessary at SFAAP. Therefore, the next five-year review for SFAAP should begin in October, 2010.

ATTACHMENT A: SITE FIGURE



LEGEND

ACRES	SWMU No.	TITLE	SWMU No.	TITLE	ACRES
64.61	1	Classification Yard	33-2	Paste Area Half Tanks & Settling Ponds	.21
19.04	2	River Water Treatment Plant Lagoons #123	34	Five Corners - Settling Ponds	.39
9.57	3	Main Sewer Treatment Plant	35	Nitroglycerin Area - Settling Ponds	.37
2.53	4	Pond "A" & Sludge Disposal Area	36	N-Line Ditches	301.13
.75	5	Pond "A" Neutralization Area	37	Sand Blast Area (Typical 3 Locations)	3.04
37.65	6	Pond "B" & Sludge Disposal Area	38	Oil Separator Building 542	.45
10.04	7	North Acid Area - Chromate Area	39	South Acid Area Drainage Ditches	11.38
	8	North Acid Area - Chromate Contaminated Area	40	Calcium Carbide - Disposal Area	1.81
	9	North Acid Area - Wastewater Treatment Lagoon	41	Calcium Carbonate Cake Landfill	2.10
127.85	10	F - Line Ditches & Mechanized Roll Area	42	Temporary Sanitary Landfill	2.79
.93	11-1	F-Line settling & Blending Pond	43	Tunnel Drys - CCC Storage	7.77
.92	11-2	F-Line settling & Blending Pond	44	Tank T-748	1.13
1.9	11-3	F-Line settling & Blending Pond	45	Calcium Cyanamide - Conveyors & Storage Units Building 9040	2.18
1.09	11-4	F-Line settling & Blending Pond	46	Decontamination Oven	1.70
12.36	12	Pyott's Pond & Sludge Disposal Area	47	Nitroguanidine Prod Area - Sumps (23) Shown As	.71
31.5	13	South Acid Area Liquid Waste Treatment Plant & Evaporative Lagoons (Remediated)	48	Nitroguanidine Support Area	6.33
7.42	14	Static Rocket Test Area	49	Road Southeast of Sanitary Landfill	5.57
56.83	15	Waste Storage Magazines - Including J Designed Magazines	50	Abandoned Dump Site Near Kill Creek	16.86
78.64	16	Temporary Waste Storage Magazine - Including B Designed Magazines	51	Battery Handling Area	8.04
283.91	17	G - Line Area Ditches	52	Paint Bay Building 542	.44
31.37	18	Old / New Sanitary Landfills	53	Burn and Debris Area North of (Sewage Treatment Plant)	5.27
18.71	19	Ash Landfill	54	Fluorescent Tube Wells	.13
15.39	20	Lagoons and Sludge Disposal Area - Clearwell #165	55	Old Administrative Buildings	7.22
10.32	21	Contaminated Materials Burning Ground	56	Well South of Facility 211	1.64
30.28	22	Old Explosive Waste Burning Ground	57	Chemical Preparation House	.45
16.62	23	New Explosive Waste Burning Ground	58	Combine Shops Area	24.42
149.36	24	Nitroglycerine Ditches	59	Laundry Facility	.80
244.10	25	Nitrocellulose Area Ditches	60	Old Photographic Laboratory	.33
501.29	26	Single Base Area - Waste Water Settling Ponds	61	Environmental Laboratory Building 232	.27
9.5	27	Nitroguanidine Area - SAC Liquid Waste Treatment Plant & Evaporative Lagoons	62	Transformer Storage Warehouse (Building 566-5)	.30
	28	Waste Calcium Carbide Treatment Area (Closed)	63	Water Towers	7.35
	29	Industrial Waste water Treatment Lagoons (Closed)	64	Paper Burning Ground	1.38
19.83	30	Pesticide Handling Area	65	Tank Farm	21.90
8.29	31	Contaminated Waste Processer - Evaporative Lagoon	66	Reserved for Stream Study	
.71	32	Lead Decontamination & Recovery Unit	67	South Acid Area	25.84
.37	33-1	Paste Area Half Tanks & Settling Ponds			

ACRES	AOC No.	TITLE	AOC No.	TITLE	ACRES
32.20	1	Monitoring Well West of Old Admin Area	12	Paste Air Dry Facilities	35.99
2.01	2	Main Electrical Switch Yard	13	General Warehouses (8037 Series)	15.28
.15	3	Photographic Laboratory (Building 227-18)	14	Robert's Lake	11.96
.31	4	Disposal Area Southwest of (Sewage Treatment Plant)	15	Hazardous Analysis Testing Lab	1.1
2.51	5	Cannon Range Tunnels (Building 303)	16	Nitrocellulose Production Lines	106.90
89.13	6	35 Process Facilities Within F-Line Area	17	Nitroguanidine Production Facilities	139.24
.41	7	Former Truck Maintenance Shop in South Acid area	18	Trench Disposal Area A3	33.50
.43	8	Former Fuel Oil Storage Tank in South Acid Area	19	Trench Disposal Area A4	.59
.11	9	Oil and Paint House in South Acid Area	20	Trench Disposal Area A5	.54
540.97	10	Storage Magazines not Part of SWMU 15 & 16	21	Trench Disposal Area A6	.07
278.15	11	Forced Air Dryers and Rest, Screen and Can Pack Houses	22	Old Reclamation Yard	12.58

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Plotted By: T. Richardson

Shaw Environmental, Inc.

U.S. ARMY CORPS OF ENGINEERS
KANSAS CITY, MISSOURI

FIGURE 1-1
SWMU LOCATION MAP
SUNFLOWER AMMUNITION PLANT
DESOTO, KANSAS

DESIGNED BY		CHECKED BY	
DRAWN BY	T. RICHARDSON	APPROVED BY	
SCALE: NOTED	DRAWING NO. 843882-G-01	SHEET NO.	REVISION NO. 0

ATTACHMENT B: REFERENCE DOCUMENTS

REFERENCE DOCUMENTS

USACE, 2004, Installation Action Plan for Sunflower Army Ammunition Plant

EPA, 2001,Comprehensive Five-Year Review Guidance

LAW Eng & Environmental, 1997, Final RCRA Facility Investigation and QC Summary Report SWMUs 10/11

Burns & McDonnell Eng Co., Inc. 1999, Final Corrective Measures Study, SWMU 10/11 and 22/32

IT Corp, 2001, Remedial Action Summary Report Solid Waste Management SWMUs 10/11

Shaw, Inc., 2004, Additional Characterization Investigation Report and Corrective Measures Work Plan, Solid Waste Management SWMUs 10, F-Line Uplands Building Foundation, Old Mechanized Roll Area, and New Mechanized Roll Area

EPA, 2000, Final Corrective Measure Decision, RCRA ID# KS3213820878

LAW Eng & Environmental, 1999, Final RCRA Facility Investigation Report for SWMU 13

LAW Eng & Environmental, 1999, Final RCRA Facility Investigation Report and QC Summary Report Addendum SWMU 27

Burns & McDonnell Eng Co., Inc., 2002, Final RCRA Facility Investigation Report Addendum & QC Summary Reports SWMUS 33,34, & 35 - Half Tanks and Settling Ponds

Shaw, Inc., 2003, Interim Remedial Action Report SWMUs 18,32,33,34,35

Alliant Techsystems, 1997, Closure Plan, SWMU 41

Burns & McDonnell Eng Co., Inc., 2000, Final RCRA Facility Investigation Report Addendum & QC Summary Report SWMUs 41 and 42-Calcium Carbonate Cake & Temp Sanitary Landfills

LAW Eng & Environmental, 1997, Final RCRA Facility Investigation Report SWMU 50 and Final QC Summary Report Addendum for SWMU 50

Environmental Chemical Corp, 2001, Final Project Closure Report, SWMU 50

Environmental Chemical Corp, 2002, Annual Landfill Inspection Report, SWMU 50

USACE, 2003, Final Annual Waste Disposal Areas Inspection, SWMU 50

REFERENCE DOCUMENTS (Cont.)

USACE, 2004, Final Annual Waste Disposal Areas Inspection, SWMU 50

Environmental Chemical Corp, 2002, Final Data Summary Report SWMUs 13, 27, 48 Initial Sampling Event and Subsurface Investigation

USACE, 2003, 2003 Long Term Monitoring Report, SWMU 11 & 33-35

LAW Eng & Environmental, 1996, Final Background Investigation Report

LAW Eng & Environmental, 1997, Final General RCRA Facility Investigation Report

ATTACHMENT C: PUBLIC COMMENTS AND RESPONSES

To be completed following a public comment period, which will follow completion of the review by EPA and KDHE.