FOCUSED CORRECTIVE MEASURES STUDY
FOR GROUNDWATER AT
SOLID WASTE MANAGEMENT UNIT 1
CLASSIFICATION YARD

for the

FORMER SUNFLOWER ARMY AMMUNITION PLANT
DE SOTO, KANSAS

Prepared for:

SUNFLOWER REDEVELOPMENT, LLC
35425 W. 103rd Street
De Soto, Kansas 66018

Prepared by:

TETRA TECH
800 Oak Ridge Turnpike, A-500
Oak Ridge, Tennessee 37830

MARCH 2011
# Comment Response Matrix

## Draft Final, Focused Corrective Measure Study for Groundwater at Solid Waste Management Unit 1, Classification Yard

### Sunflower Army Ammunition Plant

**Commenter:** KDHE

**Comments dated:** January 20, 2011

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<td>KDHE requests SRL include in appendices, copies of field documentation (Field logbooks, Well Purge Forms, Sample Collection Forms, etc.) for Solid Waste Management Unit (SWMU) 1 groundwater sampling performed by SRL; or provides reference to other document(s) where they may be found.</td>
<td>The requested field documentation has been added as Appendix G and is referenced in Section 1.2, on Page 1-4, 5th paragraph.</td>
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<td>KDHE has noted that appendices of DRAFT RCRA Facility Investigation Report And Focused Corrective Measure Study Areas of Concern 18, 19, 20, and 21 Potential Trench Disposal Area, contain at least some of the Well Purge and Sample Collection Forms; however, copies of field logbooks (LTM #1) were not found.</td>
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<td>Page 2-2, Paragraph 1, Section 2.3 and Page 2-3, Paragraph 2, Section 2.3.1</td>
<td>These sections state that the accepted background concentration for Nitrate/nitrite (N/N) is 11,000 µg/L. As previously discussed with SRL, following the initial proposed background value, correspondence indicates that EPA did not agree with the 11,000 µg/L background value; and based on preliminary calculations by KDHE/BER the background value for N/N is substantially less than SRL indicates. Therefore, KDHE/BER disagrees with the suggested background value in the subject report.</td>
<td>The text in the cited sections has been revised to remove reference to an “accepted background concentration of nitrate/nitrite (N/N)” of 11,000 µg/L. In accordance with Field Work Variance 007, the concentration of nitrate/nitrite in groundwater has been compared to the TMCL for nitrate (10,000 µg/L) in the report.</td>
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FINAL

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MARCH 2011
### TABLE OF CONTENTS

1.0 INTRODUCTION ....................................................................................................................... 1-1

1.1 FACILITY DESCRIPTION ................................................................................................. 1-2

1.2 STUDY AREA DESCRIPTION ......................................................................................... 1-2

1.3 PHYSICAL CHARACTERISTICS OF SFAAP ............................................................... 1-4

   1.3.1 Geology ............................................................................................................. 1-5

   1.3.2 Surface Water ................................................................................................. 1-5

   1.3.3 Hydrogeologic System .................................................................................... 1-6

   1.3.4 Land Use and Demography .......................................................................... 1-8

   1.3.5 Groundwater/Surface Water Use ................................................................... 1-9

2.0 IDENTIFICATION AND EVALUATION OF CORRECTIVE ACTION ALTERNATIVES ................................................................................................................. 2-1

2.1 CORRECTIVE MEASURES STUDY METHODOLOGY ................................................... 2-1

2.2 IDENTIFICATION OF TARGET MEDIA CLEANUP LEVELS ......................................... 2-2

2.3 CONTAMINANTS OF CONCERN ................................................................................. 2-2

   2.3.1 Nitrate/nitrite ................................................................................................. 2-3

   2.3.2 DEHP ............................................................................................................. 2-3

   2.3.3 COC Summary .............................................................................................. 2-4

2.4 CORRECTIVE ACTION OBJECTIVES ............................................................................. 2-4

2.5 EXTENT OF CONTAMINATED GROUNDWATER ........................................................... 2-5

2.6 IDENTIFICATION AND SCREENING OF CORRECTIVE ACTION TECHNOLOGIES ..................................................................................................................... 2-5

2.7 RECOMMENDED CORRECTIVE MEASURES APPROACH ............................................. 2-5

3.0 COMMUNITY RELATIONS PLAN ................................................................................... 3-1

4.0 REFERENCES ......................................................................................................................... 4-1
TABLES

Table 1-1 Well Summary
Table 2-1 Chemical Detections Above Ambient Conditions in Groundwater

FIGURES

Figure 1-1 Site Location
Figure 1-2 Site Map
Figure 1-3 Groundwater Elevation Contours (April 2007)
Figure 2-1 DEHP Concentrations vs. Time at 001MW005
Figure 2-2 Bis(2-ethylhexyl)phthalate Results in Groundwater

APPENDICES

Appendix A Analytical Report for November 2007 Groundwater Sample (ON DISC)
Appendix B Analytical Report for May 2008 Groundwater Sample (ON DISC)
Appendix C Analytical Report for November 2008 Groundwater Sample (ON DISC)
Appendix D Analytical Report for June 2009 Groundwater Sample (ON DISC)
Appendix E Analytical Report for December 2009 Groundwater Sample (ON DISC)
Appendix F Analytical Report for June 2010 Groundwater Sample (ON DISC)
Appendix G Field Sampling Forms and Logbook Documentation (ON DISC)
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1.0 INTRODUCTION

This Focused Corrective Measures Study (CMS) addresses groundwater within Solid Waste Management Unit (SWMU) 1 at the Former Sunflower Army Ammunition Plant (SFAAP), located southwest of De Soto, Kansas. Soil at SWMU 1 is addressed in the focused CMS for soil at SWMU 1. The soil CMS recommends a No Further Action remedy and was submitted in July 2007 (Tetra Tech, 2007). The Kansas Department of Health and Environment (KDHE) Bureau of Environmental Remediation (BER) approved the SWMU 1 CMS for soil in September 2007. This CMS is prepared pursuant to the Consent Order between KDHE and Sunflower Redevelopment, LLC (SRL), including Exhibit 6, Scope of Work for Corrective Measures Studies, and in compliance with the Resource Conservation and Recovery Act (RCRA) Corrective Action process. This focused CMS complements previous RCRA Facility Investigations (RFI) performed at SWMU 1 and will be utilized to select the appropriate corrective measure for groundwater at SWMU 1. The measures selected will be described in the Statement of Basis for groundwater at SWMU 1. The Statement of Basis will be made available for public comment before a final corrective measure is selected. Based on the existing data for groundwater at SWMU 1, it is recommended No Action is applicable for groundwater at SWMU 1.

In October 2004, federal legislation was enacted to authorize the U.S. Army, in consultation with the General Services Administration, to convey SFAAP to an entity selected by the Johnson County Board of Commissioners, and in January 2005, the board selected SRL as the entity to acquire SFAAP. On August 3, 2005, the U.S. Army Tank-automotive and Armaments Command at Rock Island, Illinois awarded SRL a requirements-type contract with delivery orders for the environmental remediation and explosives decontamination of the former SFAAP. The requirements-type contract is administered under Consent Order No. 05-E-0111 and requires SRL to remove coal and/or coal fines from SWMU 1 (SFAAP, 2005a). The removal of coal and coal fines was completed by SRL in 2007.

This CMS is organized into three sections as described below:

- **Section 1.0, Introduction** – describes the purpose and organization of this CMS report and provides a general description of the SFAAP facility and SWMU 1.

- **Section 2.0, Identification and Evaluation of Corrective Action Alternatives** – presents the CMS methodology and identifies the contaminants of concern (COCs) and the corrective action objectives (CAO) for SWMU 1, the nature and extent of contaminated groundwater, the identification and screening of corrective action alternatives, and finally, the recommendation of a final corrective measure.

- **Section 3.0, References** – references for this CMS.
1.1 FACILITY DESCRIPTION

SFAAP is located on 9,065 acres, three miles southwest of De Soto, Kansas, in the northwest corner of Johnson County (Figure 1-1). Johnson County is the fastest growing and most populous county in the state (U.S. Census Bureau, 2005). The facility is located approximately 28 miles southwest of Kansas City and 16 miles east of Lawrence along Kansas Highway 10. SFAAP is roughly rectangular in shape, about six miles long by three miles wide, with the long axis oriented in a north-south direction. SFAAP proper is bounded on the north by Lexington Avenue, on the east by Kill Creek, and on the west by Captain Creek.

SFAAP was a government-owned and contractor-operated (GOCO) facility which manufactured smokeless gunpowder, munitions propellants, and other related products beginning in 1942. Since 1971, the majority of the site has been in a standby, inactive status; the last production operation, nitroguanidine (NQ), ceased operations in 1992. In 1998, SFAAP was listed as excess by the U.S. Department of the Army, and in 2005, the property was transferred from the U.S. Government to SRL.

Three base explosive compounds for use as propellants were produced at SFAAP: nitroglycerine (NG), nitrocellulose (NC), and NQ. The propellants manufactured at SFAAP typically consisted of one or more of the three base explosives combined with a stabilizer, a plasticizer, an extrusion lubricant, and generally two burning rate modifiers. In addition to the base explosives, the plant manufactured nitric and sulfuric acids used in the production of base explosives, and calcium cyanamide, which is a reactant used in the production of NQ. Processes involved in the production of propellants included mixing, washing, air drying, blending, rolling, pressing, annealing, fluoroscopying, milling, and trimming. Support functions for the production processing included product testing and storage, water and steam production, waste treatment, and facility maintenance (Law, 1997).

1.2 STUDY AREA DESCRIPTION

The Classification Yard, or SWMU 1, is comprised of approximately 57 acres in the northeastern portion of SFAAP (Figure 1-2). It is divided lengthwise by railroad tracks and is surrounded by a fence with secured gates. The railroad tracks are elevated on a gravel berm, and an unimproved road runs along the interior perimeter of the fence surrounding the site (Law, 1999).

According to lease records and personal conversations with former SFAAP workers, SWMU 1 was used as a receiving and sorting area by the Army during construction and production periods (Law, 1997). Incoming raw materials were sorted in this area before transportation via rail or truck to the appropriate receiving facility within SFAAP. The area operated from 1942 until 1991. After rail operations ended in 1991, the area was exclusively used by Koch Sulfur Products to stage rail cars from 1991 until 2000. Other SFAAP tenants may have used the rail yard between 1950 and 1991.
Although no hazardous wastes were generated within SWMU 1, some hazardous materials were received there prior to being moved to other areas of the plant. Occasionally, during wartime activities, excess coal used to power three coal-fired steam generating plants at SFAAP was stockpiled on the east side of the railroad tracks. Residual coal and coal fines were removed from the ground surface at several of the former stockpile locations in late 2007. The removal of nuisance level coal and coal fines required by the Consent Order is considered complete.

Sediment and surface water run-off were investigated and determined to be unaffected by historic activities at SWMU 1 (Shaw, 2006).

Surface soil, subsurface soil and groundwater at SWMU 1 were investigated during two previous RFIs. During RFI field activities in 1994, four shallow groundwater monitoring wells (001MW001, 001MW002, 001MW003, and 001MW004) were installed at SWMU 1 (Law, 1999). Samples were collected from all wells except for 001MW002, which was dry at the time of sampling. Eight metals were detected below target media cleanup levels (TMCL) in all groundwater samples. Volatile organic compound (VOC) methylene chloride and semivolatile organic compounds (SVOC) bis(2-ethylhexyl)phthalate (DEHP) and di-n-butyl phthalate were detected; all methylene chloride detections, however, were qualified as estimated quantitations, and were likely false positives based on results from method blanks (Law, 1999).

Well 001MW001 was originally installed as an upgradient monitoring well for the SWMU 1 RFI. Due to its upgradient position along the periphery of SFAAP with respect to SWMU 1 and other historically active areas, 001MW001 was selected as a background well during the Sitewide Background Investigation Report (Law, 1996). As part of this background investigation, 001MW001 was sampled for inorganic parameters on four consecutive days (11/29 – 12/02) in 1994, and again in September 1995. Nitrate/nitrite was detected at 11,000 μg/L in a sample collected from 001MW001 on 12/01/1994, which is above the current screening level for nitrate/nitrite in groundwater. However, subsequent nitrate/nitrite results from this well have been below the current screening level and show a decreasing trend since the 12/01/1994 result.

As part of AOC 18 RFI activities in 2009, separate nitrate and nitrite analyses were conducted on two samples collected from 001MW001. Nitrate concentrations were below the TMCL at 150 and 130 μg/L, and nitrite was below detection limits in both samples.

A second RFI report was compiled in 2005 by Shaw, which included the collection of groundwater samples from 001MW001, 001MW003, and a newly installed well, 001MW005, in the southeastern portion of SWMU 1 between 001MW003 and 001MW004 (Figure 1-2). Monitoring wells 001MW002 and 001MW004 were dry at the time of sampling. Di-n-octyl phthalate was detected below its TMCL in monitoring well 001MW001, and DEHP was detected at 23.7 μg/L at 001MW005, which exceeds the specified TMCL of 6 μg/L. One additional groundwater sample was collected in 2004 from a temporary piezometer (001PZ001) upgradient of 001MW001 and 001MW005, and analyzed...
for all parameters but metals due to high turbidity. Neither of the phthalate species previously detected at SWMU 1 was detected at 001PZ001.

Laboratory analytical data from the two RFIs were evaluated in a baseline screening risk assessment to determine the potential human health risk associated with chronic exposure to contaminated groundwater at SWMU 1 for both residential and non-residential land use scenarios (Shaw, 2005; Law, 1999). It was concluded the risk associated with exposure to contaminants of potential concern (COPCs) in groundwater was slightly above regulatory concerns for residential land use due to TMCL exceedances of DEHP. Long-term monitoring was therefore recommended for groundwater at SWMU 1.

Additional groundwater samples were collected from 001MW005 by Tetra Tech and analyzed by Analytical Management Laboratories (AML) in November 2007 and May 2008. The sample collected in November 2007 was analyzed for metals, SVOCs, VOCs, ammonia, nitrate/nitrite, and total kjeldahl nitrogen (TKN). All detected analytes were below TMCLs, and bis(2-ethylhexyl)phthalate was below detection. The groundwater sample collected in May 2008 was analyzed for SVOC – phthalates. DEHP was detected above the TMCL at 37.8 μg/L.

Based on the groundwater exceedances of DEHP and the risk assessment of the SWMU 1 RFIs, semi-annual monitoring of DEHP at 001MW005 was initiated in November 2008. Groundwater samples were collected from 001MW005 for analysis of SVOC – phthalates during four semiannual monitoring events in November 2008, June 2009, December 2009, and June 2010. All SVOC – phthalates, including DEHP were below detection limits in each of the four samples. Sample from these four events were analyzed at the laboratory of Environmental Science Corporation (ESC).

The laboratory reports for the November 2007, May 2008, November 2008, June 2009, December 2009, and June 2010 sampling events are included as Appendices A, B, C, D, E, and F, respectively. Field sampling forms and logbook pages are provided in Appendix G.

Additional information specific to SWMU 1 and general information regarding SFAAP are provided in the Final RCRA Facility Investigation Report Addendum for SWMU 1, the Final RCRA Facility Investigation Report Addendum for SWMU 1 and the Final General RCRA Facility Investigation Report for SFAAP (Law, 1999; Shaw, 2005; Law, 1997).

1.3 PHYSICAL CHARACTERISTICS OF SFAAP

The following sections summarize the regional and site-specific physical setting characteristics for SFAAP and SWMU 1 as presented in the Groundwater, Hydrogeology, and Groundwater Quality Report for SFAAP, Final General RCRA Facility Investigation Report for SFAAP and the two Final RCRA Facility Investigation Report Addendums for SWMU 1 (BMcD, 2000; Law, 1997; Law, 1999; Shaw, 2005).
SFAAP occupies a broad upland ridge approximately two miles south of the Kansas River. Maximum topographic relief at the plant is approximately 190 ft, from a low of 770 ft above mean sea level (msl) along Kill Creek in the northeastern corner of the plant to a high of 960 ft msl in the south-central area of the plant.

At SWMU 1, the topography is generally sloping east/southeast in the direction of Kill Creek, with a topographic relief of approximately 50 ft. The elevation at SWMU 1 ranges from about 860 ft msl in the northwest portion of the SWMU to approximately 810 ft msl in the southeast.

1.3.1 Geology

SFAAP is located in the Kansas River Valley in the Osage Cuestas section of the Central Lowlands Physiographic Province. The Osage Cuestas section generally represents the southern limit of glaciation and is underlain by alternating beds of limestones and shales.

The geology at SFAAP consists of unconsolidated Pleistocene deposits derived primarily from glacial till, with some fluvial sediments near stream valleys and residual weathering near the bedrock/unconsolidated deposits interface. The thickness of the unconsolidated deposits (overburden) at SFAAP ranges from less than 1 ft to approximately 40 ft.

Underlying the unconsolidated deposits are gently dipping, alternating layers of Pennsylvanian age limestone, shale, and occasional sandstone, typical of a shallow marine shelf environment. The site-specific geologic interpretations of the unconsolidated deposits presented here are based on information obtained from boring logs prepared by geologists during RFI activities performed at SWMU 1 and across SFAAP. Additional geological information is available in the Groundwater, Hydrogeology, and Groundwater Quality Report (BMcD, 2000). The majority of the unconsolidated deposits (overburden) consist of clay and silt size particles with some coarser sands occasionally present. The thickness of the unconsolidated deposits in SWMU 1 ranges from 7 ft in the northern sector of SWMU 1 to 23 ft in the southeastern sector of SWMU 1. A review of the site specific boring logs indicates an increase in sand content near the overburden/bedrock interface in the SWMU 1 area.

The Merriam Limestone, the lowermost member of the Plattsburg Limestone Formation was logged from 5.5 – 10 ft below ground surface (bgs) during the installation of bedrock well 001MW006. This unit was underlain by Bonner Springs Shale from 10 – 19 ft bgs, Farley Limestone from 19 – 39.5 ft bgs, and the Island Creek Shale below 39.5 ft bgs; all of which are members of the Lane Shale formation. The bedrock units encountered were not logged during other SWMU 1 monitoring well installations.

1.3.2 Surface Water

There are three perennial streams (Captain Creek, Spoon Creek, and Kill Creek), one ephemeral stream (Hanson Creek), four named surface water impoundments (Robert's Lake, Pond A, Pond B, and Pyott's Pond), and several unnamed surface water impoundments at
SFAAP. The majority of surface runoff from SFAAP runs into the three perennial streams that flow north and discharge into the Kansas River.

Kill Creek drains the northeast corner of SFAAP, including Pond A, Pond B, Pyott's Pond, and Hanson Creek. It receives surface water runoff from the munitions production area (F-Line), the paste and NG area, the south acid area, the potable water treatment plant, the NC Production Area, the photography lab, the sewage treatment plant, boiler blowdown at the Power Houses, the north acid area, and the calcium cyanamide disposal area (Law, 1999). Measured flow in Kill Creek ranges from 0.0017 to 751 cubic ft per second (cfs), with an average of approximately 35 cfs (BMcD, 2000).

Spoon Creek receives run-off from the southeastern section of SFAAP, including part of the munitions storage area, the hazardous waste storage magazines, the munitions production area (F-Line, G-Line and N-Line), the paste area, the ballistics/proving grounds, the new mechanized roll area, and 13 square miles of off-site agricultural land (Law, 1997). Measured flow in Spoon Creek ranges from 0.0015 to 112 cfs, averaging approximately 6 cfs (ATSDR, 2002).

Captain Creek drains the western section of SFAAP, including Robert's Lake located in the southwest section of SFAAP. It receives surface water runoff from part of the munitions storage and solvent propellant production areas (B-Line, C-Line, D-Line, E-Line and G-Line), the burning grounds, the lead recovery area, the southern region of the NQ Production Area, the contaminated waste processor, and the landfill area. Measured flow in Captain Creek ranges from 0.015 to 312 cfs, for an average flow of approximately 16 cfs (ATSDR, 2002).

The original topography at SWMU 1 has been altered by the construction of the elevated bed for the railroad tracks. Five drainage culverts were installed at four locations under the railroad bed. These drainage culverts range in size from 3.5 – 4 ft in diameter. Surface water flow at the extreme northern section of SWMU 1 has been determined to flow north, leaving SWMU 1 through culverts under the north perimeter road. All observed tributaries flow along defined paths through concrete culverts under the railroad bed and across the eastern boundary of the site. Each of these tributaries is referenced in the Master Plan’s Basic Information Maps. There are a total of five unnamed ephemeral tributaries traversing SWMU 1 that convey sediment and runoff into Kill Creek, approximately one mile east of SWMU 1. Four of the ephemeral tributaries enter the site from the west, originating within Area of Concern (AOC) 18 or AOC 19, and flow east towards Kill Creek. The fifth ephemeral tributary enters the site from the southwest and flows north-northwest. These tributaries carry combined sheet flow and stormwater runoff from the upland areas west and south of SWMU 1 (BMcD, 1999).

1.3.3 Hydrogeologic System

According to the hydrogeology report (BMcD, 2000) for the entire SFAAP, the uppermost water-bearing aquifer at SFAAP consists of overburden sediments deposited disconformably on bedrock and composed of glacial till, glacial outwash, and lacsustrine deposits of the
Kansan Stage (Law, 1997) in the uplands area of SFAAP and alluvial sediments deposited along the flood plains of Spoon Creek, Kill Creek, and Captain Creek.

The saturated thickness of the overburden aquifer varies, although saturated thicknesses greater than 10 ft are uncommon, and localized dry areas are common especially near topographically elevated areas and areas where the depth-to-bedrock is less than 10 ft bgs. Groundwater is generally more available in low-lying areas located adjacent to creeks and streams. Groundwater flow in the overburden aquifer generally mimics surface topography, which also mimics bedrock topography, generally flowing from elevated areas toward drainage ditches, streams, and creeks. Spoon Creek, Kill Creek, and Captain Creek are classified as gaining surface water bodies, which generally receive flow from the overburden aquifer under base flow conditions. Well development and purging records indicate that low yields are typical for wells completed in the overburden aquifer. Groundwater within the overburden aquifer may also recharge the underlying bedrock aquifer.

Groundwater may be produced in relatively low quantities from the Pennsylvanian limestones collectively referred to as the bedrock aquifer(s) at SFAAP. Although there is no distinct, ubiquitous aquitard separating the overburden aquifer from the bedrock aquifer, there is commonly a differential hydraulic head between the two aquifers, with the overburden aquifer exhibiting a greater hydraulic head than the underlying bedrock aquifer. This differential hydraulic head is generally less than 5 ft, but can be greater than 10 ft at various locales throughout SFAAP. Groundwater storage and yield are generally attributable to secondary porosity associated with joints and fractures in the cyclothemic limestones. Bedrock aquifer wells constructed at SFAAP have been completed across the South Bend Limestone at the shallowest and the Wyandotte Limestone at the deepest stratigraphic intervals (BMcD, 2000).

A total of six monitoring wells have been installed at SWMU 1. Four wells were installed in 1994: 001MW001, 001MW002, 001MW003, and 001MW004. Wells 001MW002 and 001MW004 are screened only in the overburden, while monitoring wells 001MW001 and 001MW003 are screened in both the overburden and the upper bedrock unit. Monitoring well 001MW006, installed in 1996, is screened entirely within the underlying Farley Limestone bedrock unit. Well 001MW005 was an overburden well installed in 2003 between existing wells 001MW004 and 001MW003 (Figure 1-2).

Based on the groundwater elevations collected during the April 2007 site-wide groundwater survey conducted by Tetra Tech, groundwater flow within the overburden of SWMU 1 is to the east/southeast, generally following the surface topography of the site. The potentiometric contours generated from the 2007 survey along with the inferred direction of groundwater flow at different areas of SWMU 1 are shown on Figure 1-3. Monitoring well 001MW001, to the west of SWMU 1, had the highest groundwater elevation at the site in April 2007 at 852.56 ft amsl, and 001MW005 on the eastern SWMU 1 boundary had the lowest at 799.79 ft above msl. Construction information for all SWMU 1 monitoring wells is included in Table 1-1.
1.3.4 Land Use and Demography

Johnson County lies in the eastern section of Kansas and is bordered by the Kansas River to the north and the Missouri state line to the east. The county population was estimated to be 542,737 in 2009 (U.S. Census Bureau, 2010). Johnson County occupies approximately 476 square miles and is home to 21 cities (BMcD, 2000). There are no residences on SFAAP and the land uses surrounding SFAAP are varied.

Immediately to the north of SFAAP is Clearview City, a private 230-unit multifamily residential development located on a 65-acre parcel of private property. Clearview City was annexed by the City of De Soto in 1998. Clearview City was built to house SFAAP workers during World War II. The population is estimated to be between 300 and 350 people.

The city of De Soto is approximately 3 miles northeast of SFAAP and is located on 1.5 square miles along the south bank of the Kansas River (BMcD, 2000). According the U.S. Census, the city of De Soto had an estimated population of 5,420 in 2008 (U.S. Census Bureau, 2010).

The city of Eudora is located approximately 4 miles northwest of SFAAP near the confluence of the Wakarusa and Kansas Rivers in Douglas County (BMcD, 2000). The 2008 population of Eudora was estimated to be 6,226 (U.S. Census Bureau, 2010).

Access to SFAAP is limited by the presence of fencing around the perimeter of the site. There is an additional internal fence that surrounds the manufacturing areas where most of the SWMUs and AOCs are located. A security gate is located at the main entrance to SFAAP as well. There is no through traffic at SFAAP.

The land uses adjacent to SFAAP are summarized as follows:

**North:** Low-density residences with large land holdings, an apartment complex (Clearview City), Sunflower Park (40 acres), light industry, and warehouse operations.

**East:** Kill Creek Park (850 acres), low-density residences, and Hunt Midwest Quarry.

**West:** De Soto Park (50 acres) and the Lexington Township cemetery.

**South:** Predominately agricultural with scattered low-density residences.

Other land uses in the vicinity of SFAAP are primarily agricultural (soybean, corn, sorghum, alfalfa, and wheat production, or cattle grazing) and low density residences (Johnson County, 1998).

Most of SFAAP lies within the De Soto School District. All of De Soto School District’s schools are located north of Kansas State Highway 10. The closest school is the De Soto High School, located approximately 1.8 miles north of the site (Johnson County, 2005).
A variety of buildings and structures associated with former on-site manufacturing operations are located on SFAAP. Buildings still in use include the city of De Soto potable water treatment plant and the administration building.

### 1.3.5 Groundwater/Surface Water Use

Groundwater at SFAAP is not currently used as a drinking water source; therefore, neither exposure pathways nor public health hazards currently exist from on-site groundwater. Twenty-two off-site private groundwater wells within one mile of SFAAP are being used to supply water to households. Hydrogeologic and analytical data suggest SFAAP is not negatively influencing the quality of drinking water at 13 of these private wells. The potential impact to the other nine private drinking water wells could not be determined because data from the private wells are not available (ATSDR, 2002).

The Kansas River is located about 3 miles north of SFAAP's northern boundary and is a state designated drinking water supply. The cities of De Soto and Eudora receive their public water supply from groundwater wells located to the north and south of the Kansas River, in the Kansas River Valley alluvium. SFAAP obtains its water supply from 12 groundwater wells that are considered to be under the influence of the Kansas River. Six wells are located south of the Kansas River and six wells are located north of the river.

Kill Creek and Captain Creek are designated for primary contact recreation and Hanson Creek and Spoon Creek are designated for secondary contact recreation due to the 2002 Use Attainability Analysis (UAA) (KDHE, 2002). According to the 2009 Kansas Surface Water Register, Kill Creek and Captain Creek are currently designated by the State of Kansas for expected aquatic life, domestic water supply, food procurement, groundwater recharge, industrial water supply, irrigation, and livestock watering. Hanson Creek is currently designated for expected aquatic life, groundwater recharge, industrial water supply, irrigation, and livestock watering. Spoon Creek is currently designated for expected aquatic life, groundwater recharge, irrigation, and livestock watering (KDHE, 2009).

Sediment and surface water run-off from SWMUs 1, 50, 55, and 60, and AOCs 1, 18, 19, 20, and 21 were evaluated by sampling at in-drainage locations KC5, KC6 and KC7 during the SWMU 66 Stream Study (Shaw, 2006). In-drainage sediment samples do not meet the definition of sediment; therefore, the analytical results from these samples were screened against soil pathway cleanup values. No COPCs were detected in sediment or surface water samples from these locations above KDHE residential soil pathway guidelines for sediment or surface water quality standards for surface water.
2.0 IDENTIFICATION AND EVALUATION OF CORRECTIVE ACTION ALTERNATIVES

This section identifies and evaluates appropriate corrective action alternatives that address CAOs for SWMU 1 groundwater. Corrective actions for soil at SWMU 1 are discussed in the Focused CMS for soil at SWMU 1 (Tetra Tech, 2007a).

2.1 CORRECTIVE MEASURES STUDY METHODOLOGY

The purpose of this focused CMS is to identify COCs and CAOs, evaluate corrective action alternatives, and recommend the appropriate path forward regarding groundwater at SWMU 1 based on the data obtained from the RFIs conducted at SWMU 1 (Law, 1999; Shaw, 2005), as well as the sampling of 001MW005 performed between 2007 and 2010 (Tetra Tech, 2007b). The following key components are conceptually considered in identifying appropriate corrective action at SWMU 1.

Contaminants of Concern - COPCs detected in groundwater are evaluated to determine the potential human health risks associated with acute and chronic exposure in residential land use settings. COPCs with unacceptable risk levels are defined as COCs for SWMU 1. The identified COCs are then screened to determine whether they exist at concentrations above TMCLs. This evaluation is used to determine whether corrective action is warranted.

Corrective Action Objectives - CAOs are routinely developed during the CMS process to identify the corrective actions necessary to address potentially unacceptable human health risks due to the presence of contaminants in environmental media (soil, groundwater, etc.). Baseline risk assessments performed during previous investigations at SWMU 1 were evaluated to determine if COCs in groundwater present an unacceptable risk to human health, and if remedial action is warranted. CAOs are commonly media-specific or chemical-specific.

Applicable Corrective Action Technologies - Corrective action technologies that are effective in their ability to reduce the toxicity, mobility, or volume of contaminants are identified and screened based on their relative effectiveness. Technologies that cannot be implemented are eliminated.

Corrective Action Alternatives - Technologies that pass the screening phase are assembled into corrective action alternatives.

Evaluation of Corrective Action Alternatives - Corrective action alternatives are described and evaluated using four criteria: technical, environmental, human health, and institutional factors.

Recommendation of Corrective Action - The results of the evaluation of corrective action alternatives are summarized and a corrective action is recommended for groundwater at SWMU 1.
2.2 IDENTIFICATION OF TARGET MEDIA CLEANUP LEVELS

TMCLs are risk-based, chemical-specific concentrations used to determine if sites or areas require corrective action based on the chemicals of interest specific to that site or area. The TMCLs for SWMU 1 were derived to meet the Performance Standard requirements of the Consent Order and a compilation of sources, including the KDHE Risk-Based Standards for Kansas (RSK) Manual, U.S Environmental Protection Agency (EPA) Region 9 Preliminary Remediation Goals (PRGs), and statistically estimated background concentrations for naturally occurring inorganics (SFAAP, 2005b; KDHE, 2007; EPA, 2009; Law, 1997). In May 2008, the EPA revised the PRGs by combining the Region 9 PRGs with similar risk-based screening levels used by Regions 3 and 6 into a single table. The revised values are referred to as Regional Screening Levels (RSLs) and the current RSL table should supersede the previous PRG table. The KDHE RSKs and EPA RSLs are chemical- and media-specific (soil and groundwater), human health risk-based concentrations derived using EPA risk assessment guidance and directives. The RSKs and RSLs provide cleanup goals for contaminants in soil and groundwater, including Federal Safe Drinking Water Act Maximum Contaminant Levels in drinking water. The RSKs and RSLs also provide for additional concerns, including soil concentrations that are protective of groundwater and the potential presence of chemically saturated soils.

The ordered priority for determining TMCLs from the referenced sources is (1) the Consent Order, (2) the KDHE RSK Manual, and (3) EPA RSLs. The Consent Order specifically identifies soil TMCLs for NC, NG, and GN (SFAAP, 2005a). The KDHE RSK Manual prescribes a tiered approach to determining TMCLs. Tier 2 includes the straightforward use of prescribed risk-based concentrations for residential and non-residential land uses. The Tier 1 approach is offered for metals and other naturally occurring inorganic compounds where the prescribed Tier 2 concentration may be less than what occurs naturally in the environment. In accordance with the Tier 1 approach, background concentrations of metals and other naturally occurring inorganic compounds have been statistically estimated and, if determined to be greater than the KDHE Tier 2 concentrations, the Tier 1 background concentration is used as a TMCL (Law, 1996). The EPA RSLs are similar to the KDHE Tier 2 risk-based summary tables, with the primary exception that EPA uses a target excess cancer risk of 1 in 1,000,000 (1 x 10^-6), whereas KDHE uses a target value of 1 in 100,000 (1 x 10^-5). This variance results in a risk-based concentration that is one order of magnitude less than the concentration of the KDHE equivalent risk-based concentration. Although the future land use at SWMU 1 is currently highway commercial and park land, TMCLs are selected based on a residential land use scenario.

2.3 CONTAMINANTS OF CONCERN

Five metal species (selenium, silver, sodium, vanadium, and zinc) have been detected in groundwater at SWMU 1 above the accepted background concentrations. Additionally, nitrate/nitrite was detected at 001MW001 above the TMCL concentration of 10,000 μg/L for nitrate. Bis(2-ethylhexyl) phthalate, di-n-octyl phthalate, and methylene chloride have also been detected in groundwater at SWMU 1. Historical detections in groundwater at SWMU 1 are summarized in Table 2-1.
The chemicals detected above ambient concentrations as part of the RFI were compared to their respective TMCLs. Nitrate/nitrite and DEHP are the only chemicals that have been detected above residential TMCLs for groundwater at SWMU 1. Therefore, nitrate/nitrite and DEHP are both identified as COPCs in groundwater at SWMU 1, and each is discussed below to determine if either chemical can be defined as a COC.

### 2.3.1 Nitrate/nitrite

Nitrate/nitrite analysis was conducted at well 001MW001 on four consecutive days in 1994 and on four consecutive days in 1995 as part of the Background Investigation (Law, 1996). The 12/01/1994 result of 11,000 μg/L for nitrate/nitrite exceeded the groundwater TMCL for nitrate (10,000 μg/L); however, the average concentration over the four day period was 8,925 μg/L, which is below the TMCL for nitrate. Similarly, the average nitrate/nitrite concentration from the four samples collected in 1995 was 4,725 μg/L, which is less than one-half the TMCL for nitrate. Separate nitrate and nitrite analyses were conducted at 001MW001 in 2009 during the AOCs 18, 19, 20, and 21 investigation to determine current conditions and to confirm that these two nitrogen species do not exceed their respective TMCLs. A field sample and field duplicate collected from the well exhibited nitrate concentrations of 150 and 130 μg/L, approximately two orders of magnitude below the TMCL of 10,000 μg/L. Nitrite concentrations were below the detection limit in both samples.

It should also be noted that well 001MW001 is upgradient of SWMU 1 (Figure 1-3) and was selected as a background well location during the Sitewide Background Investigation Report (Law, 1996). Additionally, downgradient wells within the SWMU 1 boundaries have consistently shown nitrate/nitrite concentrations at least one order of magnitude below the TMCL for nitrate. These conditions demonstrate that nitrate/nitrite concentrations at well 001MW001 are not reflective of historical activities at SWMU 1, and nitrogen in groundwater at this location has not historically affected groundwater quality in the downgradient areas of SWMU 1.

Due to the historical trend and the current nitrate and nitrite levels in groundwater throughout SWMU 1 and at upgradient well 001MW001, nitrate/nitrite is not selected as a COC in groundwater at SWMU 1.

### 2.3.2 DEHP

DEHP has been identified as a COPC in groundwater at SWMU 1 due to intermittent detections above the TMCL at 001MW005. As shown in Figure 2-1, DEHP fluctuated between concentrations above the TMCL and below the reporting detection limit at 001MW005 between 2003 and 2010. Groundwater samples collected on 6/3/2003 (23.7 μg/L) and 5/28/2008 (37.8 μg/L) exceeded the residential TMCL of 6 μg/L.

Following the most recent exceedance, semi-annual monitoring for DEHP was initiated at 001MW005. It should be noted that the dedicated bladder pump was removed from well 001MW005 and sample collection tools were re-evaluated to minimize the potential leaching of phthalates into groundwater samples (i.e., cross-contamination). The use of Tygon tubing was
eliminated from the sample collection procedure, as DEHP is often used as a plasticizer in highly flexible tubing such as Tygon, and may constitute up to 40 percent of finished plastic products (Wahl et al, 1999).

The semi-annual monitoring program continued for four sampling events between November 2008 and June 2010, each of which reported DEHP below the reporting detection limit (Figures 2-1). Therefore, DEHP has been below the reporting limit for all four sampling events at 001MW005 since the bladder pump was removed from the well and potential sources of plasticizers were eliminated from the sampling process. Additionally, this COPC has not been detected historically in other SWMU 1 wells or in well 050MW001 downgradient of 001MW005 (Figure 2-2).

A comparison of the soil concentration to the KDHE RSK Tier 2 residential soil to groundwater pathway criteria was also performed to determine if DEHP detected in soil at SWMU 1 exists at concentrations high enough to provide a source for groundwater contamination. The maximum detection for DEHP in soil at SWMU 1 (0.71 mg/kg) is five orders of magnitude less than the soil to groundwater pathway criteria of 18,000 mg/kg (Tetra Tech, 2007a). DEHP concentrations in soil sampled proximal to 001MW005 were slightly less, ranging from 0.37 – 0.47 mg/kg. Based on these results, soil at SWMU 1 is not considered a potential source of DEHP in groundwater.

In summary, DEHP was below the detection limit at well 001MW005 for four consecutive semiannual sampling events, has not exceeded the TMCL in other wells within SWMU 1 or downgradient areas, and has consistently exhibited soil concentrations much lower than the RSK Tier 2 value for the soil to groundwater protection pathway at SWMU 1. Therefore, DEHP is not selected as a COC at SWMU 1.

2.3.3 COC Summary

Similar to the SWMU 1 CMS for soil, no COCs are identified in groundwater at SWMU 1 (Tetra Tech, 2007a).

2.4 CORRECTIVE ACTION OBJECTIVES

CAOs are developed to protect human health and the environment at sites that pose an unacceptable level of potential risk. CAOs are commonly developed for each media of concern (soil, groundwater, etc.). This focused CMS addresses groundwater only at SWMU 1, and no COCs have been identified. As no COCs in groundwater have been identified, the development of CAOs for groundwater at SWMU 1 is not required.
2.5 EXTENT OF CONTAMINATED GROUNDWATER

No COCs are identified for groundwater at SWMU 1. Additionally, no COCs have been identified in soils which may contribute to groundwater contamination (Tetra Tech, 2007a). Therefore, no quantification of contaminated groundwater is required.

2.6 IDENTIFICATION AND SCREENING OF CORRECTIVE ACTION TECHNOLOGIES

Corrective measure technologies are identified and screened to address CAOs. Because no COCs are identified at SWMU 1, no CAOs are required. Consequently, the identification and evaluation of potential corrective measures technologies for groundwater at SWMU 1 is not necessary.

2.7 RECOMMENDED CORRECTIVE MEASURES APPROACH

Corrective measure technologies are identified and screened to address CAOs. No COCs have been identified in groundwater or in soils which may contribute to groundwater contamination at SWMU 1. Therefore, no CAOs have been developed for groundwater at SWMU 1, and No Action is recommended for groundwater at SWMU 1. The proposed No Action determination is considered protective because there are no unacceptable risks to human health or the environment from SWMU 1 groundwater based on residential and commercial/industrial land use scenarios.
3.0 COMMUNITY RELATIONS PLAN

SFAAP formalized a Community Relations Program in 1997, and the objectives of this program are as follows:

- Provide the public with accurate and timely information with respect to the ongoing and recently completed environmental restoration activities.

- Encourage public input by providing interested citizens the opportunity to attend public meetings and community relations activities.

- Respond to community concerns.

As part of the outreach plan for the community, information regarding the environmental restoration process at SFAAP is provided in an Information Repository. The Information Repository currently resides at the Johnson County Central Resource Library in Overland Park, Kansas. This repository includes documents pertinent to the performance of the restoration activities, including the work plans outlining field activities planned to evaluate the potential for contamination at the facility. Documents are added to the repository as they are completed.

The primary forum for continuing community relations is the bi-monthly public meeting of the Restoration Advisory Board (RAB). The first RAB meeting was held on May 6, 1998. At that meeting, the RAB agreed to meet monthly for six months and then bi-monthly thereafter. The function of the RAB is outlined in *Sunflower Army Ammunition Plant Restoration Advisory Board Operating and Procedure Policies* modified and adopted by the RAB on November 6, 2002 (SFAAP, 2002). Meetings are held on the first Wednesday of every other month at 6 p.m. Currently, RAB meetings are held in the Clearview City Town Hall directly across Lexington Avenue from SFAAP. All RAB meetings are open to the public, and meeting announcements are published in the local media. Representatives of SRL and their subcontractors attend the RAB along with representatives of the EPA and the KDHE. Minutes of RAB meetings are kept and are made available to the public.
4.0 REFERENCES


EPA (U.S. Environmental Protection Agency), 2009. Regional Screening Levels (RSL) for Chemical Contaminants at Superfund Sites. RSL Table Update. <www.epa.gov/region09/waste/sfund/prg/index.htm>. December.


KDHE (Kansas Department of Health and Environment), 2002. Listing of Classified Streams Designated Use Status (Other than Recreational Use) and Use Attainability Analysis Status. KSA 82a-2004(b).


TABLES
Table 1-1
Well Summary
Former Sunflower Army Ammunition Plant

<table>
<thead>
<tr>
<th>Well ID</th>
<th>Alias</th>
<th>Date Completed</th>
<th>Status</th>
<th>Aquifer Unit</th>
<th>Well Diameter (in.)</th>
<th>Ground Elev. (ft amsl)</th>
<th>TOC (ft amsl)</th>
<th>Depth to Bedrock (ft bgs)</th>
<th>Well Depth (ft bgs)</th>
<th>Top of Screen (ft bgs)</th>
<th>Bottom of Screen (ft bgs)</th>
<th>Top Screen Elev. (ft amsl)</th>
<th>Bottom Screen Elev. (ft amsl)</th>
<th>Bedrock Elev.</th>
<th>DTW Apr-07 (ft BTOC)</th>
<th>GW Elev. Apr-07 (ft amsl)</th>
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<tr>
<td>001MW001</td>
<td>94-01</td>
<td>08/24/94</td>
<td>Existing</td>
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<td>2</td>
<td>852.7</td>
<td>855.06</td>
<td>12.0</td>
<td>15.5</td>
<td>5.0</td>
<td>15.0</td>
<td>847.7</td>
<td>837.7</td>
<td>840.7</td>
<td>2.50</td>
<td>852.56</td>
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<td>2</td>
<td>843.9</td>
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<td>7.0</td>
<td>8.5</td>
<td>2.8</td>
<td>7.8</td>
<td>841.1</td>
<td>836.1</td>
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<td>836.64</td>
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<td>23.0</td>
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<td>94-04</td>
<td>08/26/94</td>
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<td>811.89</td>
<td>22.0</td>
<td>23.0</td>
<td>12.6</td>
<td>22.6</td>
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<td>787.6</td>
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<td>796.12</td>
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<td>Ovb</td>
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<td>814.20</td>
<td>25.7</td>
<td>24.7</td>
<td>14.7</td>
<td>24.7</td>
<td>797.2</td>
<td>787.2</td>
<td>786.2</td>
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<td>001MW006</td>
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<td>09/11/96</td>
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<td>861.59</td>
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<td>819.7</td>
<td>853.5</td>
<td>23.58</td>
<td>838.01</td>
</tr>
</tbody>
</table>

Elev. - elevation
ft - feet
amsl - above mean sea level
bgs - below ground surface
TOC - top of casing
BTOC - below top of casing
DTW - depth to water
GW - groundwater
Ovb - overburden
Bdr - bedrock
O/B - overburden/bedrock
## Table 2-1
### Chemical Detections Above Ambient Conditions in Groundwater
#### Former Sunflower Army Ammunition Plant

<table>
<thead>
<tr>
<th>Chemical Name</th>
<th>TMCL (µg/L)</th>
<th>TMCL Source</th>
<th>Background</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>General Chemistry (µg/L)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nitrate</td>
<td>10000</td>
<td>KDHE RSK Tier II</td>
<td>n/a</td>
</tr>
<tr>
<td>Nitrite</td>
<td>1000</td>
<td>KDHE RSK Tier II</td>
<td>n/a</td>
</tr>
<tr>
<td>Nitrate / nitrite</td>
<td>10000</td>
<td>FWV 007</td>
<td>11000</td>
</tr>
<tr>
<td><strong>Metals (µg/L)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Silver</td>
<td>100</td>
<td>KDHE RSK Tier II</td>
<td>4.5 &lt; 2 U &lt; 2 U &lt; 2 U</td>
</tr>
<tr>
<td>Sodium</td>
<td>n/a</td>
<td>n/a</td>
<td>21000 = 15000 = 16000 = 15000 = 15000 =</td>
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<tr>
<td>Vanadium</td>
<td>110</td>
<td>KDHE RSK Tier II</td>
<td>9 &lt; 7 U</td>
</tr>
<tr>
<td>Zinc</td>
<td>5000</td>
<td>KDHE RSK Tier II</td>
<td>14 &lt; 14 U &lt; 14 U &lt; 14 U</td>
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<tr>
<td><strong>Dissolved Metals (µg/L)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Selenium</td>
<td>50</td>
<td>KDHE RSK Tier II</td>
<td>7</td>
</tr>
<tr>
<td><strong>Semivolatile Organic Compounds (µg/L)</strong></td>
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<td></td>
</tr>
<tr>
<td>Bis(2-ethylhexyl)phthalate</td>
<td>6</td>
<td>KDHE RSK Tier II</td>
<td>n/a</td>
</tr>
<tr>
<td>Di-n-octyl phthalate</td>
<td>10</td>
<td>KDHE RSK Tier II</td>
<td>n/a</td>
</tr>
<tr>
<td><strong>Volatile Organic Compounds (µg/L)</strong></td>
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</tr>
<tr>
<td>Methylene chloride</td>
<td>5</td>
<td>KDHE RSK Tier II</td>
<td>n/a</td>
</tr>
</tbody>
</table>

**Notes:**
- µg/L - micrograms per liter
- n/a - not applicable
- **Bold and shaded indicates result greater than TMCL and background.**
- Shaded indicates result greater than TMCL.
- **Bold indicates result greater than background.**
- Blank indicates not analyzed
- TMCL - Target Maximum Concentration Limit
- REG - regular sample
- FD - field duplicate sample
- EPA - Values taken from the April 2009 update to the EPA RSLs and based on the lower of the non-carcinogenic and adjusted carcinogenic (10⁻⁵).
- U - not detected at reporting detection limit.
- J - estimated result.
### Table 2-1

**Chemical Detections Above Ambient Conditions in Groundwater**

**Former Sunflower Army Ammunition Plant**

<table>
<thead>
<tr>
<th>Chemical Name</th>
<th>TMCL</th>
<th>TMCL Source</th>
<th>Background</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nitrate</td>
<td>10000</td>
<td>KDHE RSK Tier II</td>
<td>n/a</td>
</tr>
<tr>
<td>Nitrite</td>
<td>1000</td>
<td>KDHE RSK Tier II</td>
<td>n/a</td>
</tr>
<tr>
<td>Nitrate / nitrite</td>
<td>11000</td>
<td>FWV 007</td>
<td>4300 = 3700</td>
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<tr>
<td>Silver</td>
<td>100</td>
<td>KDHE RSK Tier II</td>
<td>4.5</td>
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<td>Sodium</td>
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<td>11400 = 11300</td>
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<tr>
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<td>KDHE RSK Tier II</td>
<td>9</td>
</tr>
<tr>
<td>Zinc</td>
<td>5000</td>
<td>KDHE RSK Tier II</td>
<td>14</td>
</tr>
<tr>
<td>Selenium</td>
<td>50</td>
<td>KDHE RSK Tier II</td>
<td>7</td>
</tr>
<tr>
<td>Bis(2-ethylhexyl)phthalate</td>
<td>6</td>
<td>KDHE RSK Tier II</td>
<td>n/a</td>
</tr>
<tr>
<td>Di-n-octyl phthalate</td>
<td>10</td>
<td>KDHE RSK Tier II</td>
<td>n/a</td>
</tr>
<tr>
<td>Methylene chloride</td>
<td>5</td>
<td>KDHE RSK Tier II</td>
<td>n/a</td>
</tr>
</tbody>
</table>

**Notes:**
- µg/L - micrograms per liter
- n/a - not applicable

**Bold and shaded indicates result greater than TMCL and background.**

Shaded indicates result greater than TMCL.

**Bold indicates result greater than background.**

Blank indicates not analyzed

- TMCL - Target Maximum Concentration Limit
- REG - regular sample
- FD - field duplicate sample
- EPA - Values taken from the April 2009 update to the EPA RSLs and based on the lower of the non-carcinogenic and adjusted carcinogenic (10^-5).
- U - not detected at reporting detection limit.
- J - estimated result.
Table 2-1
Chemical Detections Above Ambient Conditions in Groundwater
Former Sunflower Army Ammunition Plant

<table>
<thead>
<tr>
<th>Chemical Name</th>
<th>TMCL (µg/L)</th>
<th>TMCL Source</th>
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<tr>
<td>Nitrate</td>
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<td>KDHE RSK Tier II</td>
<td>n/a</td>
</tr>
<tr>
<td>Nitrite</td>
<td>1000</td>
<td>KDHE RSK Tier II</td>
<td>n/a</td>
</tr>
<tr>
<td>Nitrate / nitrite</td>
<td>10000</td>
<td>FWV 007</td>
<td>11000</td>
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</tbody>
</table>

Metals (µg/L)

<table>
<thead>
<tr>
<th>Chemical Name</th>
<th>TMCL (µg/L)</th>
<th>TMCL Source</th>
<th>Background</th>
</tr>
</thead>
<tbody>
<tr>
<td>Silver</td>
<td>100</td>
<td>KDHE RSK Tier II</td>
<td>4.5</td>
</tr>
<tr>
<td>Sodium</td>
<td>n/a</td>
<td>n/a</td>
<td>21000</td>
</tr>
<tr>
<td>Vanadium</td>
<td>110</td>
<td>KDHE RSK Tier II</td>
<td>9</td>
</tr>
<tr>
<td>Zinc</td>
<td>5000</td>
<td>KDHE RSK Tier II</td>
<td>14</td>
</tr>
</tbody>
</table>

Dissolved Metals (µg/L)

<table>
<thead>
<tr>
<th>Chemical Name</th>
<th>TMCL (µg/L)</th>
<th>TMCL Source</th>
<th>Background</th>
</tr>
</thead>
<tbody>
<tr>
<td>Selenium</td>
<td>50</td>
<td>KDHE RSK Tier II</td>
<td>7</td>
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</tbody>
</table>

Semivolatile Organic Compounds (µg/L)

<table>
<thead>
<tr>
<th>Chemical Name</th>
<th>TMCL (µg/L)</th>
<th>TMCL Source</th>
<th>Background</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bis(2-ethylhexyl)phthalate</td>
<td>6</td>
<td>KDHE RSK Tier II</td>
<td>n/a</td>
</tr>
<tr>
<td>Di-n-octyl phthalate</td>
<td>10</td>
<td>KDHE RSK Tier II</td>
<td>n/a</td>
</tr>
</tbody>
</table>

Volatile Organic Compounds (µg/L)

<table>
<thead>
<tr>
<th>Chemical Name</th>
<th>TMCL (µg/L)</th>
<th>TMCL Source</th>
<th>Background</th>
</tr>
</thead>
<tbody>
<tr>
<td>Methylene chloride</td>
<td>5</td>
<td>KDHE RSK Tier II</td>
<td>n/a</td>
</tr>
</tbody>
</table>

Notes:
- µg/L - micrograms per liter
- n/a - not applicable
- Bold and shaded indicates result greater than TMCL and background.
- Shaded indicates result greater than TMCL.
- Bold indicates result greater than background.
- Blank indicates not analyzed
- TMCL - Target Maximum Concentration Limit
- REG - regular sample
- FD - field duplicate sample
- EPA - Values taken from the April 2009 update to the EPA RSLs and based on the lower of the non-carcinogenic and adjusted carcinogenic (10⁻⁵).
- U - not detected at reporting detection limit.
- J - estimated result.
### Table 2-1
Chemical Detections Above Ambient Conditions in Groundwater
Former Sunflower Army Ammunition Plant

<table>
<thead>
<tr>
<th>Sample Name:</th>
<th>Sample Date:</th>
<th>QC Type:</th>
<th>Company Name:</th>
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<tr>
<td></td>
<td>001MW005</td>
<td>REG</td>
<td>Tetra Tech</td>
</tr>
<tr>
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<td>11/09/2007</td>
<td>REG</td>
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</tr>
<tr>
<td></td>
<td>06/10/2010</td>
<td>REG</td>
<td>Tetra Tech</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Chemical Name</th>
<th>TMCL</th>
<th>TMCL Source</th>
<th>Background</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nitrate</td>
<td>10000</td>
<td>KDHE RSK Tier II</td>
<td>n/a</td>
</tr>
<tr>
<td>Nitrite</td>
<td>1000</td>
<td>KDHE RSK Tier II</td>
<td>n/a</td>
</tr>
<tr>
<td>Nitrate / nitrite</td>
<td>10000</td>
<td>FWV 007</td>
<td>11000</td>
</tr>
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<td>Silver</td>
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<td>KDHE RSK Tier II</td>
<td>4.5</td>
</tr>
<tr>
<td>Sodium</td>
<td>n/a</td>
<td>KDHE RSK Tier II</td>
<td>n/a</td>
</tr>
<tr>
<td>Vanadium</td>
<td>110</td>
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</tr>
<tr>
<td>Zinc</td>
<td>5000</td>
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<td>14</td>
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<tr>
<td>Selenium</td>
<td>50</td>
<td>KDHE RSK Tier II</td>
<td>7</td>
</tr>
<tr>
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<td>6</td>
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<td>n/a</td>
</tr>
<tr>
<td>Di-n-octyl phthalate</td>
<td>10</td>
<td>KDHE RSK Tier II</td>
<td>n/a</td>
</tr>
<tr>
<td>Methylene chloride</td>
<td>5</td>
<td>KDHE RSK Tier II</td>
<td>n/a</td>
</tr>
</tbody>
</table>

**General Chemistry (µg/L)**

**Metals (µg/L)**

**Dissolved Metals (µg/L)**

**Semivolatile Organic Compounds (µg/L)**

**Volatile Organic Compounds (µg/L)**

**Notes:**

- µg/L - micrograms per liter
- n/a - not applicable

**Bold and shaded indicates result greater than TMCL and background.**

**Shaded indicates result greater than TMCL.**

**Bold indicates result greater than background.**

Blank indicates not analyzed

TMCL - Target Maximum Concentration Limit

REG - regular sample

FD - field duplicate sample


EPA - Values taken from the April 2009 update to the EPA RSLs and based on the lower of the non-carcinogenic and adjusted carcinogenic (10⁻⁵).

U - not detected at reporting detection limit.

J - estimated result.
FIGURES
Figure 1-3
Groundwater Elevation Contours (April 2007)
Figure 2-1. DEHP Concentrations vs. Time at 001MW005

![Graph showing DEHP concentrations vs. time with notes: U - not detected at reporting detection limit. J - estimated result.](image-url)

Concentration (μg/L)

Date Sampled

Notes:
- U - not detected at reporting detection limit.
- J - estimated result.
Figure 2-2
Bis(2-ethylhexyl)phthalate Results in Groundwater
APPENDIX A

ANALYTICAL REPORT FOR NOVEMBER 2007
GROUNDWATER SAMPLE
(ON DISC)
APPENDIX B

ANALYTICAL REPORT FOR MAY 2008
GROUNDWATER SAMPLE
(ON DISC)
APPENDIX C

ANALYTICAL REPORT FOR NOVEMBER 2008
GROUNDWATER SAMPLE
(ON DISC)
APPENDIX D

ANALYTICAL REPORT FOR JUNE 2009
GROUNDWATER SAMPLE
(ON DISC)
APPENDIX E

ANALYTICAL REPORT FOR DECEMBER 2009
GROUNDWATER SAMPLE
(ON DISC)
APPENDIX F

ANALYTICAL REPORT FOR JUNE 2010
GROUNDWATER SAMPLE
(ON DISC)
APPENDIX G

FIELD SAMPLING FORMS AND
AND LOGBOOK DOCUMENTATION
(ON DISC)