UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 7
11201 Renner Boulevard
Lenexa, Kansas 66219

SEP 3 0 2015

MEMORANDUM:

SUBJECT: Third Five-Year Review
Weldon Spring Ordnance Works
Weldon Spring, Missouri

FROM: Hoai Tran, Remedial Project Manager
Missouri/Kansas Remedial Branch

THRU: Jeff Field, Chief
Missouri/Kansas Remedial Branch

TO: Mary P. Peterson, Director
Superfund Division

Enclosed is the Third Five-Year Review Report, dated September 2015, submitted by the Department of the Army (DA) for the Weldon Spring Ordnance Works Site (site) in Weldon Spring, St. Charles County, Missouri. The site includes two operable units (OUs): Soil and Pipeline (OU1) and Groundwater (OU2).

The DA provides the following protectiveness statements in the FYR report:

OU1 Soil and Pipeline

The remedy at OU1 is protective of human health and the environment. Exposure to contaminated soils has been eliminated through the excavation of these soils. Unlimited use/unrestricted exposure (UU/UE) conditions have been met for this OU and five-year reviews (FYRs) are no longer required.

OU2 Groundwater

The remedy at OU2 is currently protective of human health and the environment because institutional controls (ICs) are in place for Weldon Spring Training Area (WSTA) to prevent exposure to contaminated groundwater. However, in order for the remedy to be protective in the long-term, ICs for state-owned property need to be in place.

Site-Wide

The remedies at the site are currently protective of human health and the environment. Remedial actions occurred to eliminate ingestion and dermal exposure of contaminated soils for OU1. ICs are in place for the WSTA, preventing exposure to contaminated groundwater. However, ICs on state-owned property need to be in place for the remedy for OU2.

For OU1, the agency concurs that the remedy is currently protective. However, the agency does not concur that the OU has achieved UU/UE and that FYR's should be discontinued. Contamination remains in soil above UU/UE, therefore FYR's remain a statutory requirement. Furthermore, the evaluation UU/UE and the need for future FYR's is separate from remedy protectiveness. The agency removed the text referencing UU/UE and future FYR's from the protectiveness statement.

For OU2, the DA divides the OU into sub-areas because ICs have not been implemented for all areas. The agency evaluates protectiveness on an OU basis and revised the protectiveness statement accordingly. The agency concurs that the remedy for OU2 is currently protective and that ICs should be implemented to ensure long-term protectiveness.

The side-wide protectiveness statement incorporated the revisions from the two OUs. Overall, the agency concurs with the protectiveness determination from the DA. The remedy at the site is currently protective, but ICs should be completed to ensure long-term protectiveness.

The agency generally concurs with the DA's protectiveness determination but does not concur with the protectiveness statements in the FYR report due to the issues detailed in this memo. The agency will issue independent protectiveness statements for each OU and the entire site. These protectiveness statements will be reported to Congress.

The agency's protectiveness statements are as follows:

OU1 Soil and Pipeline

The remedy at OU1 is currently protective of human health and the environment. Remedial actions occurred to eliminate ingestion of and dermal exposure to contaminated soils. Contaminated soils remain in the subsurface at some site locations, but the contamination is located at depth and does not present a completed pathway to receptors.

OU2 Groundwater

The remedy at OU2 is currently protective of human health and the environment. However, in order for the remedy to be protective in the long-term, ICs for groundwater need to be in place.

Site-Wide

The remedies at the site are currently protective of human health and the environment. Remedial actions occurred to eliminate ingestion of and dermal exposure to contaminated soils. Contaminated soils remain in the subsurface at some site locations, but the contamination is located at depth and does not present a completed pathway to receptors. In order for the remedy to be protective in the long-term, ICs for groundwater need to be in place.

The next FYR is due on September 30, 2020.

APPROVAL

Mary P. Peterson

Mary P. Peterson
Superfund Division Director

9/30/2015

Date

Enclosure

FIVE-YEAR REVIEW REPORT
FORMER WELDON SPRING ORDNANCE WORKS
WELDON SPRING, MISSOURI

Prepared for:

Department of the Army
88th Regional Support Command
United States Army Reserve

and

U.S. Army Environmental Command
Fort Sam Houston, Texas

September 2015

FIVE-YEAR REVIEW REPORT
FORMER WELDON SPRING ORDNANCE WORKS
WELDON SPRING, MISSOURI

Approved by:

Signature

9/28/15
Date

David Moore
Chief, Environmental Division
88th Regional Support Command

FIVE-YEAR REVIEW REPORT
FORMER WELDON SPRING ORDNANCE WORKS
WELDON SPRING, MISSOURI

Prepared by:

U.S. Army Corps of Engineers
Seattle District
Seattle, Washington

Prepared by:

Marlowe Laubach 9-28-15
Signature *Date*

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Chemical Engineer
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Prepared by:

Lisa Scott 9-28-15
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Lisa Scott, P.G.
Geologist
U.S. Army Corps of Engineers

Executive Summary

This is the third Five-Year Review (FYR) of the former Weldon Spring Ordnance Works Site (WSOW or Site) located in St. Charles County, Missouri. The purpose of Five-Year Reviews (FYRs) is to evaluate the implementation and performance of a remedy in order to determine if the remedy is or will be protective of human health and the environment. The triggering action for this FYR was the signing of the previous FYR on September 30, 2010.

The WSOW is located in St. Charles County, Missouri, about 30 miles west of St. Louis and about 14 miles southwest of the City of St. Charles. It is bisected by State Highway 94, bounded to the north by U.S. Highway 40-61, and bounded to the south by the Missouri River. The Site encompasses the Weldon Spring Training Area (WSTA), August A. Busch Memorial Conservation Area, the Weldon Spring Conservation Area, a Missouri Department of Transportation Depot, Francis Howell High School, Weldon Spring Heights, former Chemical Plant Area (CPA), and the Missouri Research Park. The former CPA is a separate National Priority List (NPL) site and is being addressed by the Department of Energy.

The U.S. Army (Army) acquired the WSOW in late 1940 and early 1941 for the production of trinitrotoluene (TNT) and dinitrotoluene (DNT) during World War II. The facility included 18 TNT production lines and two DNT production lines. Wooden pipelines used to transfer wastewater formerly traversed the original plant complex. The plant operated from 1941 to 1945. The original property of the WSOW consisted of 17,232 acres. Following deactivation of the production facility, the majority of the property was transferred to State and local entities.

Nitroaromatic-contaminated soils and pipeline were the principal threats to human health and the environment at the Site. The hazard from the pipeline was primarily safety-related rather than health-related due to potential accidental detonation from digging into buried pipeline. Groundwater contamination encountered at the WSOW is a result of nitroaromatic compounds leaching into groundwater from numerous historical surface and shallow subsurface releases associated with former ordnance activities.

The WSOW was listed on the NPL on February 21, 1990, and is being addressed under the guidelines established in a three-party Inter-Agency Agreement effective August 8, 1991, between U.S. Environmental Protection Agency (EPA) Region 7, Missouri Department of Natural Resources, and the Army. A Federal Facilities Agreement, signed June 25, 1991, defines the regulatory framework between the Army, the EPA, and MDNR. The Army is the lead agency responsible for planning and implementing the response action as defined by the RODs, ESD, and Remedial Design/Remedial Action (RD/RA) Work Plan. The EPA and MDNR are the support agencies who assist the lead agency.

The Site includes two operable units (OUs): Soil and Pipeline (OU1) and Groundwater (OU2). Contaminants of concern (COCs) for soil are 2,4,6-trinitrotoluene (2,4,6-TNT), 2,4-dinitrotoluene (2,4-DNT), 2,6-dinitrotoluene (2,6-DNT), polychlorinated biphenyls (PCBs), polycyclic aromatic hydrocarbons (PAHs), and lead. COCs for groundwater are 2,4,6-TNT, 2,4-DNT, 2,6-DNT, o-nitrotoluene (o-NT), m-nitrotoluene (m-NT), p-nitrotoluene (p-NT), and photolytic degradation products, 1,3-dinitrobenzene, and nitrobenzene.

Soil and Pipeline OU

The Record of Decision (ROD) for the Soil and Pipeline OU (OU1), signed on September 26, 1996, selected the following remedy to protect human health and the environment:

- Treat excavated nitroaromatic-contaminated soils and wooden pipeline by incineration.
- Stabilize lead-contaminated soils, as needed to meet toxicity characteristic leaching procedure requirements and place in the on-site landfill,
- Place PAH-contaminated soil and PCB-contaminated soils with concentrations less than 50 parts per million (ppm) in a landfill on-site, and
- Separate construction debris from the contaminated soils and place in the on-site landfill.

A remedial action was conducted in phases beginning in1998 to excavate and incinerate DNT/TNT-impacted pipelines, soils, and other wastes; to treat lead-impacted soils; and to restore the property. Soils (contaminated, treated, and/or stabilized) and miscellaneous debris were placed at the Weldon Spring Chemical Plant Disposal Cell. In 2003, additional explorations were conducted at Areas T13 and T14 to determine whether DNT/TNT-contaminated soils were present. The results of these explorations indicated that DNT/TNT-contaminated soils were present at T13, but not at T14. A remedial action at T13 began in 2003. Excavation of soils continued to a depth of 22 feet below ground surface (bgs). Confirmation samples collected at the 19 bgs and 22 feet bgs showed that DNT-contaminated soils remained above the remedial goal of 2.5 milligrams per kilogram. Sidewall confirmation samples were also collected with results showing concentrations greater than the remedial goal for DNT at depths between 16 and 22 feet bgs.

In 2004, an Explanation of Significant Differences (ESD) was published. The ESD presents three differences from the ROD, as stated below.

- Rotary Kiln Treatment – The quantity of nitroaromatics contaminated soil substantially exceeded original estimates resulting in a greater quantity of soil to be rotary kiln treated. The increase of soil quantities caused an increase in both remediation time and cost.
- Land Disposal in the Weldon Spring Chemical Plant Disposal Cell – Additional materials were placed in the Weldon Spring Chemical Plant disposal cell. Nitroaromatic or lead contaminated soil containing asbestos exceeding regulatory limit allowed for incineration was disposed of in the cell. Prior to disposal, this soil was stabilized to be compliant with DNT and lead Toxicity Characteristic Leaching Procedure (TCLP) requirements. Also, portions of the nitroaromatics contaminated wooden pipeline were placed in the cell.
- Off-Site Disposal of Materials – The ROD provided for offsite disposal of small quantities of materials. Nitroaromatic contaminated soil discovered after the rotary kiln incineration operations ceased were disposed of offsite. The quantity of this material was greater than originally anticipated at the time of remedy selection.

Groundwater OU

The ROD for the Groundwater OU (OU2) was signed on September 30, 2004. The remedy for OU2 Groundwater at the WSOW is monitored natural attenuation (MNA), which includes the following components.

- Collection of monitoring data from the existing groundwater monitoring network to verify effectiveness of naturally occurring processes.
- Use of select wells from the existing groundwater monitoring network to collect groundwater data. Use of select springs at the site for additional monitoring data. The initial monitoring network will

be presented during the remedial design. This network will be modified over time, if necessary, to aid in the evaluation of progress toward the RAO. This modification may include installation of new monitoring wells.

- Institutional controls (ICs) in areas which exceed remedial goals designed to limit ingestion or dermal exposure to groundwater and prevent use of groundwater contamination above ARARs or health-based remediation goals as a potable water source. The ICs would also restrict activities that may negatively impact the remediation of contamination or result in creation of a potential for downward migration of contamination.

A Remedial Design/Remedial Action work plan was prepared which described the monitoring program to evaluate the effectiveness of naturally occurring processes and also addressed the design and implementation of ICs. A monitoring well network throughout the WSOW and several springs within the Busch and Weldon Spring Conservation areas are sampled annually. Institutional controls for the WSOW include restrictions on groundwater use through Army policy, State regulations, and notices. Army policy, State regulations, and deed notices have been implemented, thus far. However, a document describing IC management has yet to be finalized.

The remedial action removed contaminated soils above ROD remedial goals except at Area T13. The remaining soils at Area T13 are at depths where current or future receptors are not exposed to these soils. The remedial action also removed a large mass of contamination, thus reducing contaminants that may migrate to groundwater. In addition, signs are present at Area T13 notifying readers that soil contamination is present above remedial goals and to consult with Army Reserve Environmental staff prior to digging or disturbing ground cover. In addition, the location of this area is included on the geographic information system (GIS) overlay maintained by the 88th RCS and the installation Future Development Plan (FDP.)

The EPA Superfund Site Lead Policy was superseded by the Revised Interim Soil Lead Guidance for CERCAL sites and RCRA Corrective Action Facilities, which decreased the residential soil screening level to 400 ppm. Exposure pathways identified in the BRA are still valid. Inhalation risks related to vapor intrusion was not evaluated in the BRA. The evaluation conducted for this FYR concluded that the PCBs and a carcinogenic PAH, benz(a)anthracene meet the definition of volatile. However, these contaminants were excavated during the remedial action performed between 1998 and 2004 and no longer remain on site. Toxicity values changed for several COCs. In comparing the ROD remedial goals with current EPA RSLs (which represent risk concentrations at 10^{-6} risk using the most current toxicity values), the remediation goals are within the EPA acceptable risk range. Therefore, toxicity changes do not affect the protectiveness of the remedy. The remedy at OU1 (Soil and Pipeline OU) has met UU/UE conditions. Therefore, future FYRs are not required for this operable unit.

In general, MNA is occurring in the Groundwater OU. Recent trend analysis shows three exceptions. Locations with two or more detections with increasing trends; Spring SP5602 for m-NT and p-NT, Spring SP6502 for 2,4,6-TNT, and Well USGS4 for m-NT. However, the 2014 sampling results show no exceedances above the clean up levels for these locations and COCs. Analytical results and statistical analysis indicate that: contaminants are attenuating at a rate sufficient to meet cleanup goals in a reasonable time; contaminant migration remains confined to the currently impacted groundwater system; and contaminant levels at potential exposure points (springs) are declining over time.

There were no changes to promulgated standards, which some ROD remediation goals were based. Toxicity values changed for several COCs. In comparing the ROD remedial goals with current EPA RSLs (which represent risk concentrations at 10^{-6} risk using the most current toxicity values), the remediation goals are within the EPA acceptable risk range. In addition, 2014 concentrations of COCs

were much lower than EPA RSLs. Therefore, toxicity changes do not affect the protectiveness of the remedy. In addition, ICs have been implemented for the WSTA per the ROD to prevent exposures to contaminated groundwater. However, ICs for state-owned property have not been fully implemented. No other information has come to light, which calls into question the protectiveness of the remedy.

For OU1, the remedy is protective of human health and the environment. Exposure to contaminated soils has been eliminated through the excavation of these soils. Remedial action objectives and UU/UE conditions have been met for this OU and FYRs are no longer required.

For OU2, the remedy is currently protective of human health and the environment because ICs are in place for WSTA to prevent exposure to contaminated groundwater. However, in order for the remedy to be protective in the long-term, ICs on state-owned property need to be in place.

The remedies at the Site are currently protective of human health and the environment. Remedial actions occurred to eliminate ingestion and dermal exposure of contaminated soils for the Soil and Pipeline OU (OU1). ICs are in place for the WSTA preventing exposure to contaminated groundwater. However, ICs on state-owned property need to be in place for the remedy for the Groundwater OU (OU2) to be protective in the long-term. The Soil and Pipeline OU (OU1) has met RAOs and UU/UE conditions; therefore FYRs are no longer required.

Five-Year Review Summary Form

SITE IDENTIFICATION		
Site Name: Former Weldon Spring Ordnance Works		
EPA ID: MO5210021288		
Region: 7	**State:** MO	**City/County:** Weldon Spring/St. Charles

SITE STATUS	
NPL Status: Final	
Multiple OUs? Yes	**Has the site achieved construction completion?** Yes

REVIEW STATUS
Lead agency: Other Federal Agency **If "Other Federal Agency" was selected above, enter Agency name:** Army
Author name (Federal or State Project Manager): Jonathan Harrington
Author affiliation: Army Environmental Command
Review period: April 2014 – August 2015
Date of site inspection: January 22, 2015
Type of review: Statutory
Review number: 3
Triggering action date: September 30, 2010
Due date *(five years after triggering action date)*: September 30, 2015

Five-Year Review Summary Form (continued)

Issues/Recommendations				
OU(s) without Issues/Recommendations Identified in the Five-Year Review:				
OU1 Soils and Pipeline				
Issues and Recommendations Identified in the Five-Year Review:				
OU(s): OU2 Groundater	**Issue Category: Institutional Controls**			
	Issue: Institutional controls have not been completed on state-owned property as required in the Phase II RD/RA Work Plan.			
	Recommendation: Complete institutional controls on state-owned property.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Implementing Party**	**Oversight Party**	**Milestone Date**
No	Yes	State	EPA	September 2016

Protectiveness Statements		
Operable Unit: **Soil and Pipeline OU**	***Protectiveness Determination:*** **Protective**	***Addendum Due Date (if applicable):*** **Click here to enter date.**
Protectiveness Statement: The remedy at OU1 Soil and Pipeline is protective of human health and the environment. Exposure to contaminated soils has been eliminated through the excavation of these soils. UU/UE conditions have been met for this OU and FYRs are no longer required.		
Operable Unit: **Groundwater OU**	***Protectiveness Determination:*** **Short-term Protective**	***Addendum Due Date (if applicable):*** **Click here to enter date.**
Protectiveness Statement: The remedy at OU2 Groundwater is currently protective of human health and the environment because ICs are in place for WSTA to prevent exposure to contaminated groundwater. However, in order for the remedy to be protective in the long-term, ICs for state-owned property need to be in place.		

Sitewide Protectiveness Statement	
For sites that have achieved construction completion, enter a sitewide protectiveness determination and statement.	
Protectiveness Determination: Protective	*Addendum Due Date (if applicable):* Click here to enter date.
Protectiveness Statement: The remedies at the Site are currently protective of human health and the environment. Remedial actions occurred to eliminate ingestion and dermal exposure of contaminated soils for the Soil and Pipeline OU (OU1). ICs are in place for the WSTA preventing exposure to contaminated groundwater. However, ICs on state-owned property need to be in place for the remedy for the Groundwater OU (OU2) to be protective in the long-term. The Soil and Pipeline OU (OU1) has met RAOs and UU/UE conditions; therefore FYRs are no longer required.	

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List of Abbreviations

DNT	2,4-dinitrotoluene
2,4,6-TNT	2,4,6-trinitrotoluene
2,6-DNT	2,6-dinitrotoluene
ARARs	applicable, relevant and appropriate requirements
Army	U.S. Army
AR	Army Regulations
bgs	below ground surface
BRA	baseline risk assessment
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CPA	Chemical Plant Area
COC	contaminant of concern
CSR	Code of State Regulations (Missouri)
DA	Department of the Army
DNB	1,3-dinitrobenzene
DNT	2,4-dinitrotoluene
DOE	Department of Energy
ESD	Explanation of Significant Differences
EPA	U.S. Environmental Protection Agency
FDP	Future Development Plan
FYR	Five-Year Review
GIS	geographic information system
IC	institutional control
IUR	inhalation unit risk
LTMP	Long-Term Management Plan
µg/L	micrograms per liter
µg/m3	micrograms per cubic meter

mg/kg	milligrams per kilogram
mg/kg-d	milligrams per kilogram per day
mg/m^3	milligrams per cubic meter
MDC	Missouri Department of Conservation
MDNR	Missouri Department of Natural Resources
MNA	monitored natural attenuation
m-NT	m-nitrotoluene
NA	not available
NB	nitrobenzene
NCP	National Contingency Plan
NPL	National Priority List
NB	nitrobenzene
NT	nitrotoluene
OB	Objective
o-NT	o-nitrotoluene
OSWER	Office of Solid Waste and Emergency Response
OU	operable unit
OU1	Soil and Pipeline OU
OU2	Groundwater OU
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
ppm	parts per million
p-NT	p-nitrotoluene
RA	remedial action
RAO	remedial action objective
RCRA	Resource Conservation and Recovery Act
RD/RA	Remedial Design/Remedial Action
RfCi	reference concentration (inhalation)

RfDo	reference dose (oral)
RfDi	reference dose (inhalation)
RI	remedial investigation
ROD	Record of Decision
RSC	Regional Support Command
RSL	regional screening level
SFi	slope factor (inhalation)
SFo	slope factor (oral)
Site	Weldon Spring Ordnance Works
TCLP	Toxicity Characteristic Leaching Procedure
TNT	trinitrotoluene
USACE	U.S. Army Corps of Engineers
USAEC	U.S. Army Environmental Command
USGS	U.S. Geological Survey
WSOW	Weldon Spring Ordnance Works
WSS	Weldon Spring Site
WSTA	Weldon Spring Training Area

Third Five-Year Review Report

for

Weldon Spring Ordnance Works

1. Introduction

1.1. Purpose

The purpose of Five-Year Reviews (FYRs) is to evaluate the implementation and performance of a remedy in order to determine if the remedy is or will be protective of human health and the environment. The methods, findings, and conclusions of reviews are documented in FYR reports. In addition, FYR reports identify issues found during the review, if any, and recommendations to address them.

1.2. Authority

The U.S. Army (Army) is preparing this five-year review pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) §121 and the National Contingency Plan (NCP). CERCLA §121 states:

> If the President selects a remedial action that results in any hazardous substances, pollutants, or contaminants remaining at the site, the President shall review such remedial action no less often than each five years after the initiation of such remedial action to assure that human health and the environment are being protected by the remedial action being implemented. In addition, if upon such review it is the judgment of the President that action is appropriate at such site in accordance with section [104] or [106], the President shall take or require such action. The President shall report to the Congress a list of facilities for which such review is required, the results of all such reviews, and any actions taken as a result of such reviews.

The U.S. Environmental Protection Agency (EPA) interpreted this requirement further in the NCP; 40 Code of Federal Regulations (CFR) §300.430(f)(4)(ii) states:

> If a remedial action is selected that results in hazardous substances, pollutants, or contaminants remaining at the site above levels that allow for unlimited use and unrestricted exposure, the lead agency shall review such action no less often than every five years after the initiation of the selected remedial action.

U.S. Army Corps of Engineers (USACE) has conducted a FYR, on behalf of the U.S. Army Environmental Command (USAEC), of the remedial actions implemented at the former Weldon Spring Ordnance Works Site (WSOW or Site) in St. Charles County, Missouri. This review was conducted from April 2014, through September 2015. This report documents the results of the review. This is the third FYR for the WSOW. The triggering action for this review is the date of the previous FYR. The FYR is required due to the fact that hazardous substances, pollutants, or contaminants

remain at the site above levels that allow for unlimited use and unrestricted exposure. The Site consists of two Operable Units (OUs).

- OU1 pertains to contaminated soils and pipeline.
- OU2 pertains to groundwater contamination.

Both OUs have a remedy in place. This FYR addresses both OUs at the WSOW.

2. Site Chronology

Table 1 lists the dates of important events for the Site.

Table 1. Chronology of Site Events

Event	Date
Pre-Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) cleanup including contaminated soil removal and decontamination of manufacturing equipment	1944
Pre-CERCLA cleanup including contaminated soil removal and decontamination of manufacturing equipment	August 1945–August 1946
Transfer of a portion of WSOW from Army to the State of Missouri	1948
Pre-CERCLA cleanup involving re-grading and contaminated soil removal from trinitrotoluene (TNT) pipelines	1950
Pre-CERCLA cleanup involving the removal of contaminated soil and buried TNT wastewater pipeline, and the burning and razing of buildings	1955
Pre-CERCLA cleanup involving the destroying and dismantling of buildings	1956
Pre-CERCLA cleanup involving the removal of equipment and demolishing of buildings	1962-1963
Pre-CERCLA cleanup involving the dismantling of the wastewater incineration plants, removal of additional equipment, and the demolishing of buildings	1965-1967
Federal Facilities Agreement between Army and Environmental Protection Agency (EPA)	1986
Comprehensive remedial investigation (RI) completed	1989
Federal Facilities Agreement modified between Army, EPA, and Missouri Department of Natural Resources (MDNR)	April 1990
The former Weldon Spring Ordnance Works Site (WSOW) added to the National Priorities List	February 21, 1990
Companion RI completed	1990-1991
Federal Facilities Agreement between Army, EPA, and MDNR modified	June 25, 1991
Interagency agreement between the Army, U.S. Environmental Protection Agency (EPA), and Missouri Department of Natural Resources (MDNR) in effect.	August 8, 1991
Baseline risk assessment (BRA) for the WSOW	1992-1993

Event	Date
Operable Unit 1 (OU1) Feasibility Study	1993
Army released the Proposed Plan for the former WSOW OU1: Soils and Pipeline	1993
Operable Unit 2 (OU2) RI began	1995
OU1 Record of Decision signed	1996
OU2 BRA completed	1997
Restoration Advisory Board established	1997
OU1 remedial action initiated	1998
Department of Energy (DOE)/Army joint Feasibility Study completed for OU2	1998
OU1 remedial action completed	2001
OU1 draft Final Remedial Action Report submitted to regulators	2001
Draft Final Close-Out Report submitted at OU1	2002
Additional contamination discovered at OU1	2002
Follow-up remedial action initiated at T-13 at OU1	2003
Remedial action at T-13 completed at OU1	2004
Draft-Final Remedial Action Report submitted to regulators for OU1	2004
Explanation of Significant Differences signed for OU1	2004
Final Remedial Action Report finalized for OU1	2004
OU1 closure given by EPA	2004
Army Supplementary Feasibility Study completed for OU2	2004
Proposed Plan for OU2 available to the public	June 2004
Public meeting on proposed plan for OU2 held	June 24, 2004
OU2 ROD signature	September 30, 2004
First Five-Year Review (FYR) for OU1	March 2005
Phase 1 RD/RA Work Plan finalized	June 2005
Phase II RD/RA Work Plan finalized	January 2006
Missouri Well Code published in Missouri Register	August 2007
Second FYR (OU1 and OU2)	September 2010
Phase 1 RD/RA Work Plan amended	March 2011
Phase II RD/RA Work Plan amended	January 2014
88th Regional Support Command (RSC) Future Development Plan finalized	November 2014
Environmental notice for WSTA recorded with the St. Charles County Recorder's Office	June 8, 2015

3. Background

3.1. Physical Characteristics

The Weldon Spring Ordnance Works Site (WSOW or Site) is located in St. Charles County, Missouri about 30 miles west of St. Louis and about 14 miles southwest of the City of St. Charles. It is bisected by State Highway 94, bounded to the north by U.S. Highway 40-61 and bounded by the south by the Missouri River. Figure 1 presents the site location.

A surface water divide exists between the Missouri and Mississippi Rivers, which bisects the Site in an approximately east to west direction. Surface water running from the northern half of the Site flows

along gently rolling plains to Dardenne Creek, a tributary of the Mississippi River. Surface water in the southern portion of the site flows in steep, well-channeled ravines toward the Missouri River. Surface water drainage both to the northeast and southeast moves as losing stream segments, gaining stream segments, and a series of springs before reaching the river.

Three aquifers have been identified in the area of the Site. They are the sand and gravel alluvium of the Missouri River; the shallow bedrock aquifer (Burlington-Keokuk Formations-limestone); and the deeper bedrock aquifer (St. Peter Formation). The principal recharge to this aquifer is through precipitation infiltration from the overburden, from losing stream drainages, or from surface water impoundments. The deeper aquifer is separated from the shallow zone by an aquitard. The aquitard consists of the Hannibal Formation, Sulphur Springs Group, Kimmswick Formation, Decorah Group, Plattin Formation, and Joachim Formation. As with surface water, a groundwater divide also exists running roughly east to west across the main portion of the Site. Both surface and shallow groundwater flows towards the Mississippi River north of the divide, in the north to northeasterly direction, and towards the Missouri River south of the divide.

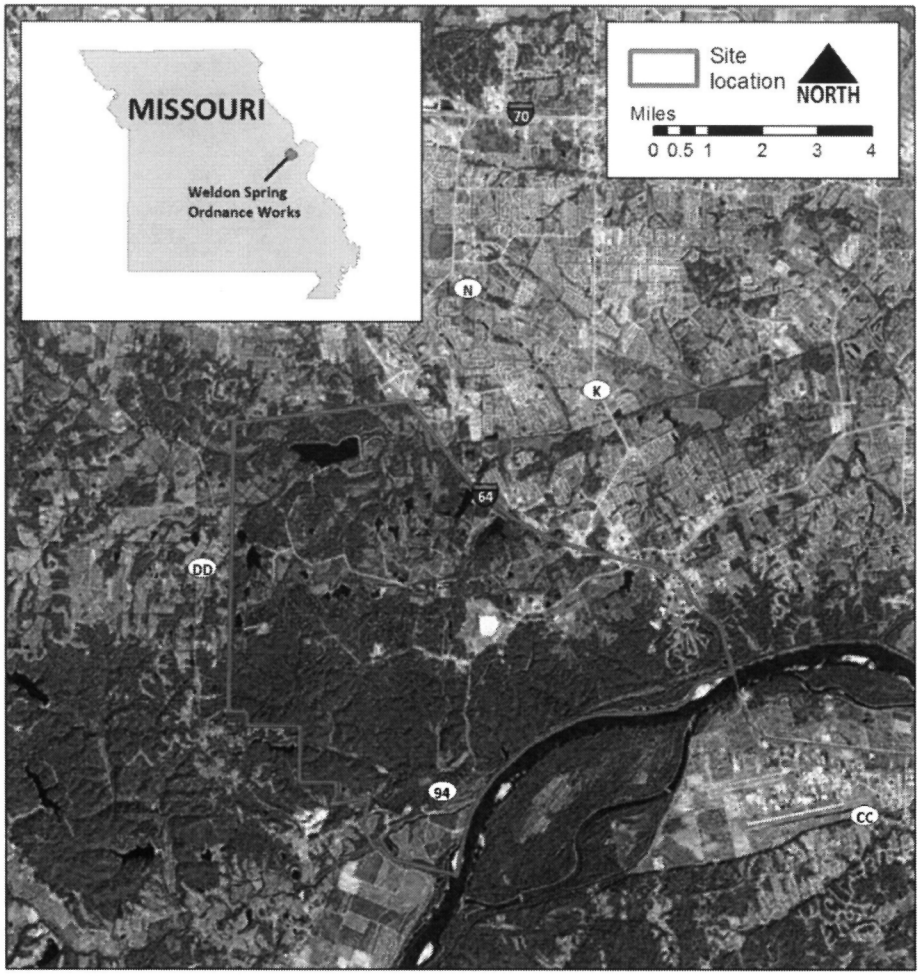

Figure 1. Site Location

3.2. Land and Resource Use

The Site encompasses the Weldon Spring Training Area (WSTA); August A. Busch Memorial Conservation Area; the Weldon Spring Conservation Area; a Missouri Department of Transportation Depot; Francis Howell High School, Weldon Spring Heights; the former Chemical Plant Area (CPA); and the Missouri Research Park. The former CPA is a separate NPL site and is being addressed by the Department of Energy (Figure 2).

The area to the northeast has been rapidly developed into single-family and multi-family residential areas. Increases in population occurred in recent years in nearby incorporated areas such as O'Fallon, St. Peters, and Cottleville. Although there are no residential properties where plant operations occurred on the Former WSOW NPL Site, based on current land use, cleanup goals were set to protect potential future residents. Office buildings have been built in Missouri Research Park. The August A. Busch and Weldon Spring Conservation Areas attract over one million visitors per year for fishing, hunting, and nature studies. Natural resources include several heavily wooded areas, the most diversified flora of any part of the State, migratory bird refuge areas, 37 lakes, and numerous fishing ponds.

The WSTA is currently used by the 88th Regional Support Command (RSC) as an active Army Reserve training area. The firing range at the WSTA is also used by local and federal law enforcement officials.

The original property of the WSOW consisted of 17,232 acres. Following 1946, the property was subsequently divided with most (all but 2,000 acres) being transferred to the State of Missouri and the University of Missouri. A portion of the original WSOW (228 acres) was transferred in 1957 to the U.S. Atomic Energy Commission with an additional 15 acres from the WSTA conveyed in 1964 for the construction and operation of Weldon Spring Uranium Feed Materials Plant. The plant was active from 1957 through 1966 and is part of the Weldon Spring Site (WSS). The WSS also includes a quarry area in the south of the WSOW. The WSS was placed on the NPL in 1987, and the U.S. Department of Energy (DOE) is the lead agency for actions at the WSS. The CPA is located within the WSS.

Two communities closest to the site are Weldon Spring and Weldon Spring Heights, about 2 miles northeast of the WSTA. No private residents exist between Weldon Spring Heights and the WSTA. Francis Howell High School is about 0.6 miles northeast of the WSTA along Missouri State Route 94. All of these areas are within the original boundary of the WSOW.

A maintenance facility is located adjacent to the east and north of the WSTA, once used by Missouri Department of Transportation Weldon Spring, is now used by St. Charles County. About 741 acres of land east and southeast of the high school is owned by the University of Missouri with the northern third being developed into a high-technology research park.

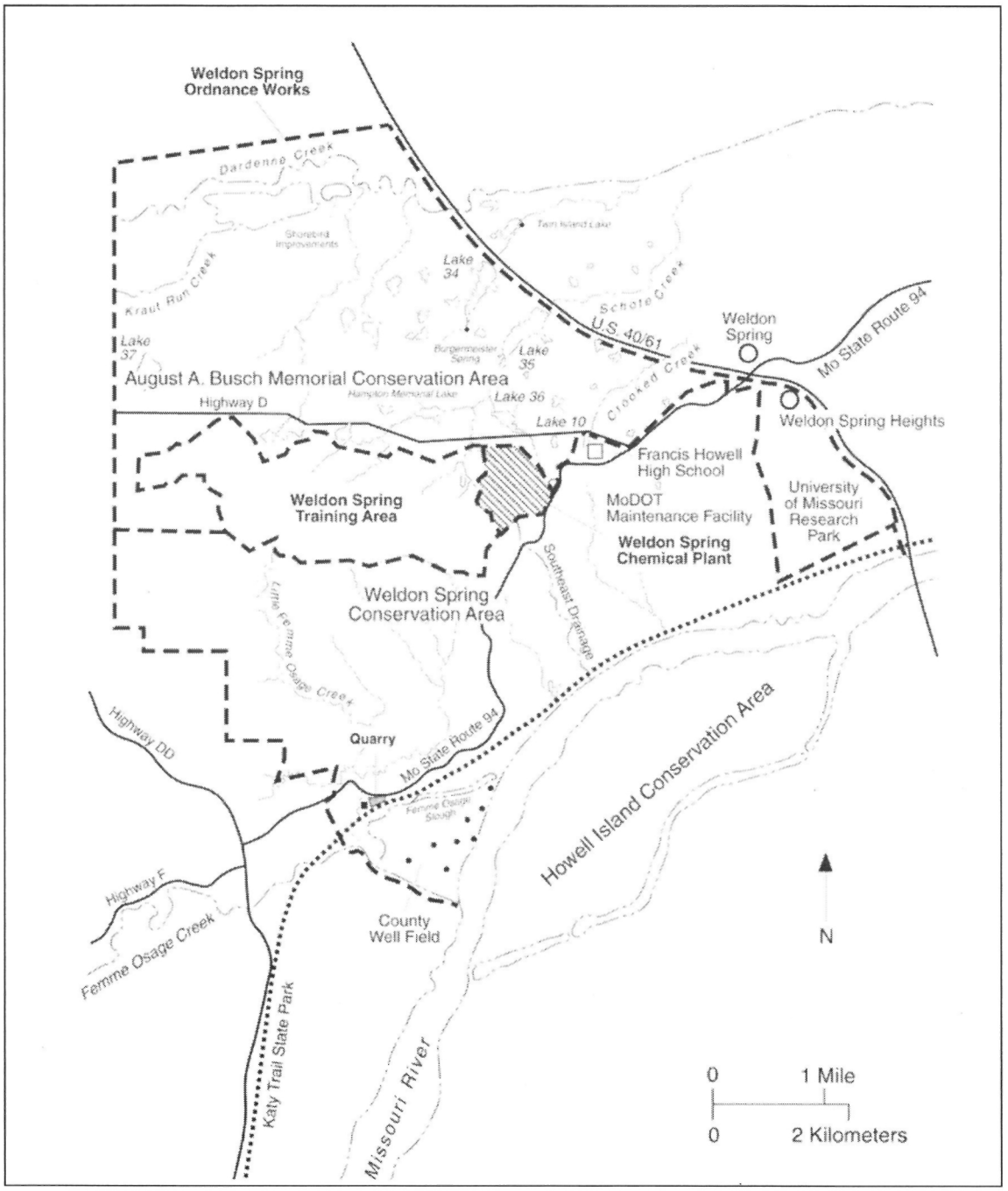

Figure 2. Site Boundary Map

NOTE: The Missouri Department of Transportation Maintenance Facility has since been transferred to St. Charles County.

The shallow aquifer beneath the boundaries of the WSTA is not currently being used for drinking water or irrigation purposes. No domestic wells are known to be active within the WSTA, the adjacent CPA, or the August A. Busch Conservation Area.

A well located on the WSTA, referred to as the Army Well, is located in an area not impacted by nitroaromatics and yielded non-detect analysis results at the time of the ROD. The well is inactive. An irrigation well is located at the Missouri Research Park within 2 miles of the impacted areas of the WSOW. This well is located cross-gradient of the WSOW groundwater contamination.

The current source of water for the majority of residents in the area is municipal water provided by several companies. County zoning for future housing developments in the area of the WSTA indicates that when available, municipal water will continue to be a source of drinking water. There are several drinking water supply wells within the boundaries of the WSOW. These wells are operated by the St. Charles County and are located south of the quarry area in the alluvial aquifer. The community of Weldon Spring Heights obtains drinking water from a well installed in the St. Peter Sandstone. This well is cross-gradient to the contamination within the shallow aquifer at the WSOW.

3.3. History of Contamination

The Army acquired the WSOW in late 1940 and early 1941 for the production of trinitrotoluene (TNT) and dinitrotoluene (DNT) during World War II. The facility included 18 TNT production lines and two DNT production lines. Wooden pipelines used to transfer wastewater traversed the original plant complex. The plant operated from 1941 to 1945. Following deactivation of the production facility, the majority of the property transferred to State and local entities.

Nitroaromatic-contaminated soils and pipeline were the principal threats to human health and the environment at the Site. The hazard from the pipeline was primarily safety-related rather than health-related as an accidental detonation from digging into buried pipeline.

Groundwater contamination encountered at the WSOW is a result of nitroaromatic compounds leaching into groundwater from numerous historical surface and shallow subsurface releases associated with former ordnance activities.

The WSOW was listed on the NPL on February 21, 1990, and is being addressed under the guidelines established in a three-party Inter-Agency Agreement effective August 8, 1991, between EPA Region 7, Missouri Department of Natural Resources (MDNR), and the Army. A Federal Facilities Agreement, dated June 25, 1991, defines the regulatory framework between the Army, the EPA, and MDNR. The Army is the lead agency responsible for planning and implementing the response action as defined in the RODs, ESD, and Remedial Design/Remedial Action (RD/RA) Work Plan. The EPA and MDNR are the support agencies assist the lead agency.

3.4. Initial Response

Several responses occurred in the 1940s and 1950s with steps taken to remove contaminated soils and demolish contaminated buildings prior to the placement of the site on the NPL in 1990. Detailed descriptions of these initial response actions are presented in the Final Remedial Investigation and in the 2010 FYR. A Remedial Investigation (RI) was initiated in 1988.

3.5. Basis for Taking Remedial Action

The primary contaminants of concern (COCs) for soil include 2,4,6-trinitrotoluene (2,4,6-TNT), 2,4-dinitrotoluene (2,4-DNT), 2,6-dinitrotoluene (2,6-DNT), polychlorinated biphenyls (PCBs), polycyclic aromatic hydrocarbons (PAHs), and lead.

The primary groundwater COCs include the following nitroaromatic compounds: 2,4,6-TNT, 2,4-DNT, 2,6-DNT, o-nitrotoluene (o-NT), m-nitrotoluene (m-NT), p-nitrotoluene (p-NT), and photolytic degradation products, 1,3-dinitrobenzene (DNB), and nitrobenzene (NB).

Non-cancer and cancer risks to COCs in soils by future residents and on-site workers were greater than the hazard index of 1 (non-cancer) and the acceptable cancer risk range of 10^{-6} and 10^{-4}. Non-cancer and cancer risks from COCs by a future resident drinking groundwater were greater than the hazard index of 1 (non-cancer) and the acceptable cancer risk range.

The presence of these contaminants in soil and groundwater at concentrations above acceptable risks provided the basis for taking action under CERCLA. These nitroaromatic compounds, PAHs, and lead are considered possible and/or probable human carcinogens. PCBs are considered possible human carcinogens. The primary threat to human health was posed by ingestion of or dermal contact with contaminated soils and ingestion of contaminated groundwater from a spring or drinking water well.

4. Remedial Actions

4.1. OU 1 Soil and Pipeline

4.1.1. Regulatory Actions

On September 26, 1996, a Record of Decision (ROD) was signed to address the Soil and Pipeline OU (OU1) at the former WSOW.

4.1.2. Remedial Action Objectives

The 1996 ROD does not specify remedial action objectives. However, the ROD states the following objectives for the response action.

"This response action will then allow full and unimpeded use of WSTA for military activities and other parts of WSOW for occupational, recreational, and ecological activities. The selected action will remove the risk of adverse health effects from long-term exposure to soils and safety concerns from the pipeline. Another objective of the action is to properly dispose of construction debris, materials, and equipment from the ordnance works era that may contain trace amounts of TNT or other contaminants, or non-hazardous materials that may simply need to be permanently removed from the site....The purpose of this response action is to prevent current or future exposure to the contaminated soils and to reduce contaminant migration into groundwater."

4.1.3. Remedy Description

The remedy described in the ROD includes nitroaromatic-contaminated soils and wood pipeline will be treated by incineration, lead-contaminated soils will be stabilized, if needed, to meet lead Toxicity Characteristic Leaching Procedure (TCLP) requirements and placed in the on-site landfill, and

construction debris separated from the contaminated soils will also be disposed of in the on-site landfill The remedy includes the following major components:

- Excavation of contaminated soil with levels above the Remediation Goals. This includes TNT above 57 parts per million (ppm), DNT above 2.5 ppm, lead above 500 ppm, total PCBs above 10 ppm, and PAHs above 10 ppm.
- Evacation of an estimated 83,000 feet of wooden pipeline buried at average depths of 4 feet. This includes necessary clearing and grubbing to access the pipeline, which is located almost entirely within the boundaries of WSTA.
- Transportation of contaminated soils and pipeline from excavation sites to the pretreatment and treatment (incineration) or containment (landfill) locations, and storage prior to treatment in accordance with Resource Conservation Recovery Act (RCRA) substantive standards.
- Debris separation by screening to remove material either too large or not appropriate for incineration. Separated materials will either be shredded and returned to the waste stream for incineration or sprayed with high pressure water to remove surface contamination prior to landfill disposal.
- Removal of steel bands from wooden pipeline prior to the shredding process.
- Shredding of the wooden pipeline to reduce it to a size that is more acceptable for incineration and tha can be handled by the incinerator feed system. Shredding will be done under controlled conditions to prevent detonation.
- Incineration of contaminated soils and debris (above Remediation Goals) and shredded pipeline material on-site in a rotary kiln incinerator unit constructed and operated in accordance with RCRA substantive requirements. Air emissions from the incinerator will be controlled to levels required by MDNR regulations.
- Testing of ash to determine if it is below Remediation Goals, below TCLP levels, and below land disposal restriction levels. If all criteria are satisfied (and the ash is not listed waste generated from incineration of DNT-contaminated soil from the DNT lines), then the ash can be used as backfill.
- Stabilization of lead-contaminated soils and some incinerator ash that do not pass lead TCLP with binder material to prevent leaching of contaminants.
- Landfill of stabilized lead-contaminated soil and stabilized incinerator ash in an on-site landfill designed to meet applicable Federal and State criteria.
- On-site landfill of PAH-contaminated sods and PCB-contaminated soils with PCB concentrations less than 50 ppm.
- Landfill of screened materials and non-hazardous construction debris in the on-site landfill designed to at least meet appropriate solid waste landfill requirements.
- Backfill of excavations with ash from the incineration process that passes TCLP (except soils from DNT lines) and revegetation of the backfilled areas. The ash can be used as backfill because it is not a RCRA listed waste.
- Treatment of contaminated wastewater and storm water runoff
- Contingency for off-site disposal of treated wastewater and storm water runoff at a publicly own treatment works in the event that short-term generation exceeds capability to reuse the water in the incinerator.
- Abandonment of well no longer in use (in accordance with Missouri 10 CSR 23-4), removal of underground storage tanks (in accordance with Missouri 10 CSR 20-10), demolition of laboratory building S-22, and other miscellaneous remedial actions.
- Contingency for off-site disposal of small quantities of hazardous wastes, such as listed waste U105 or U106 (DNT-contaminated soils from DNT lines) or soils with PCB concentrations above

50 ppm, if encountered, that would otherwise require more stringent design of on-site treatment/disposal facilities.

- Abandonment of wells no longer in use (in accordance with Missouri 10 CSR 23-4), removal of underground storage tanks (in accordance with Missouri 10 CSR 20-10), demolition of laboratory building S-22, and other miscellaneous remedial actions.
- Contingency for off-site disposal of small quantities of hazardous waste, such as listed waste U105 or U106 (DNT-contaminated soils from DNT lines) or soils with PCB concentrations above 50 ppm, if encountered, that would otherwise require more stringent design of on-site treatment/disposal facilities.
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The ROD included remedial goals for the soil which are presented in Table 2. Note that even though the land use on the WSOW is primarily occupational and recreational, the remedial goals were selected to protect potential future residents.

Table 2. Soil and Pipeline OU ROD Remedial Goals

Contaminant	Remedial Goal (mg/kg)	Source
2,4,6-TNT	57	10^{-6} risk, residential exposure[1]
2,4-DNT	2.5[2]	10^{-6} risk, residential exposure[1]
2,6-DNT	2.5[2]	10^{-6} risk, residential exposure[1]
Total PCBs	10	EPA PCB Spill Cleanup Policy
Total carcinogenic PAHs	10	10^{-6} risk, residential exposure[1]
Lead	500	EPA Superfund Site Lead Policy

mg/kg – milligrams per kilogram

1 – Risk-based remediation goals are based on excess carcinogenic risks of 10^{-6} based on assumed residential use; actual use of the site will be recreational and occupational, which generally results in less frequent exposures to contaminated media (EPA 1996).

2 – Applies to the DNT mixture, rather than individual isomer.

In 2004, an Explanation of Significant Differences (ESD) was published. The ESD presents three differences from the ROD, which are stated below.

- Rotary Kiln Treatment – The quantity of nitroaromatic-contaminated soil substantially exceeded original estimates resulting in greater quantity of soil to be rotary kiln treated. The increase of soil quantities caused an increase in both remediation time and cost.
- Land Disposal in the Weldon Spring Chemical Plant Disposal Cell – Additional materials were placed in the Weldon Spring Chemical Plant disposal cell. Nitroaromatic or lead contaminated soil containing asbestos exceeding regulatory limit allowed for incineration was disposed of in the cell. Prior to disposal, this soil was stabilized to be compliant with DNT and lead TCLP requirements. Also, portions of the nitroaromatics contaminated wooden pipeline were placed in the cell.
- Off-Site Disposal of Materials – The ROD provided for offsite disposal of small quantities of materials. Nitroaromatic contaminated soil discovered after the rotary kiln incineration operations ceased were disposed of offsite. The quantity of this material was greater than originally anticipated at the time of remedy selection.

During implementation of the remedy, nitroaromatic-contaminated soils were discovered in greater quantities than estimated. (USACE, 2004).The increased material volumes increased costs and completion times.

4.1.4. Remedy Implementation

The remedy was implemented through an Interagency Agreement between the Army, MDNR, and EPA. A Federal Facilities Agreement, dated June 25, 1991, defines the regulatory framework between the Army, the EPA, and MDNR. The Army is the lead agency responsible for planning and implementing the response action as defined in the RODs, ESDs, and RD/RA Work Plan. The EPA and MDNR are the support agencies who assist the lead agency. The remedial action began in 1997 and occurred in several phases to remove contaminated pipelines, soils, and other wastes; and restore the property.

Between 1997 and 1999, DNT/TNT contaminated soils were excavated, pipeline material and associated DNT/TNT and lead contaminated soils and debris were thermally treated, abandoned toluene pipelines were removed, lead-contaminated soils were excavated from WSTA areas and Burning Ground 1 (This was located southeast of the WSTA, but within the boundaries of the original WSOW property.) Excavated areas were backfilled with treated ash, borrow soils, and top soil.

Between 2000 and 2001, previously treated waste, contaminated soil and miscellaneous debris from the WSOW was transported to the DOE WSSRAP storage cell that were stockpiled, additional material was excavated from Burning Ground 1, and DNT and/or lead-contaminated soil was chemically stabilized and disposed of at the DOE WSSRAP storage cell. (USACE, 2010)

In the summer of 2002, additional nitroaromatic-contaminated soil was identified near TNT Line 4 and grid T13. In 2003, additional explorations were conducted at training Areas T13 and T14 to determine whether DNT/TNT-contaminated soils were present. The results of these explorations indicated that DNT/TNT-contaminated soils were present at T13, but not at T14. A remedial action at T13 began in 2003. Excavation of soils continued to a depth of 22 feet below ground surface (bgs). Confirmation samples collected at 19 and 22 feet bgs showed that DNT-contaminated soils remained above the remedial goal of 2.5 mg/kg. Sidewall confirmation samples, within the greater excavation and at the excavation perimeter, were also collected with results showing concentrations greater than the remedial goal for DNT at depths between 16 and 22 feet bgs. One sidewall sample at the clay-tile pipe excavation exceeded the remedial goal for DNT at a depth of 10-16 feet bgs. Figure 3 shows the extent of material remaining above remedial goal concentrations and presents remaining contaminant concentrations at depth. The excavation floor was leveled and compacted, after which orange construction fencing was placed prior to the first lift of backfill material. Material used for backfill was tested for TCLP metals, volatile organic compounds, semi-volatile organic compounds, PCBs, and explosives and met project specifications for these chemicals. Prior to the final lift of backfill material, another layer of orange construction fencing was installed over the T13 excavation. (Pangea, 2004).

Based on agreements made by MDNR, EPA and USACE during the T13 excavation, the sidewall from the 10 to 16 feet depth was not advanced further. USACE risk assessments after excavation indicated exposure to DNT contamination at depths greater than 8 feet bgs to be insufficient to require further excavation. MDNR and EPA concurred that no further excavation was necessary as documented in the 2004 Remedial Action Report (Pangea, 2004).

The 2005 Preliminary Close-Out Report (EPA 2005) stated the following.

"The Army has restored the WSTA to unrestricted use with the exception of a small area (less than once acre that will be controlled by institutional controls (ICs) in the WSTA Base Master Plan.)"

4.1.5. Operations & Maintenance

In 2014, a survey was conducted to delineate the excavation area and a 20-foot buffer area around the excavation at Area T13. This survey is included in the geographic information system (GIS)-based environmental overlay used to manage and approve facility construction projects throughout the WSTA. Signs notifying that contamination remains on site were erected shortly after the excavation work in this area. This area is regularly mowed to ensure signs are visible. During the mowing activity, the area is inspected for erosion and dumping or storage of materials.

4.2. OU 2 Groundwater

4.2.1. Regulatory Actions

The ROD for the Groundwater OU (OU2) was signed on September 30, 2004.

4.2.2. Remedial Action Objectives

The remedial action objectives (RAOs) described in the ROD are to minimize the potential for exposure either by ingestion, dermal contact, or inhalation of contaminated groundwater until concentrations are reduced to the remediation standards listed in Table 3.

4.2.3. Remedy Description

The remedy for OU2 Groundwater at the WSOW is monitored natural attenuation (MNA), which includes the following components.

- Collection of monitoring data from the existing groundwater monitoring network to verify effectiveness of naturally occurring processes.
- Use of select wells from the existing groundwater monitoring network to collect groundwater data. Use of select springs at the site for additional monitoring data. The initial monitoring network will be presented during the remedial design. This network will be modified over time, if necessary, to aid in the evaluation of progress toward the RAO. This modification may include installation of new monitoring wells.
- Institutional controls (ICs) in areas which exceed remedial goals designed to limit ingestion or dermal exposure to groundwater and prevent use of groundwater contamination above ARARs or health-based remediation goals as a potable water source. The ICs would also restrict activities that may negatively impact the remediation of contamination or result in creation of a potential for downward migration of contamination.

Remedial goals for the Groundwater OU are presented in Table 3 below.

Table 3. Groundwater OU ROD Remedial Goals

Contaminant of Concern	Standard (µg/L)	Basis for Standard
2,4-DNT	0.11	Missouri Water Quality Standards, 10 CSR 20-7.031
1,3-DNB	1.0	Missouri Water Quality Standards, 10 CSR 20-7.031
NB	17	Missouri Water Quality Standards, 10 CSR 20-7.031
2,6-DNT	1.3	Risk-based concentration equivalent to 10^{-5} resident scenario
2,4,6-TNT	2.8	Risk-based concentration equivalent to 10^{-6} resident scenario
o-NT	37	Risk-based concentration based on Hazard Index of 1 residential scenario
m-NT	37	Risk-based concentration based on Hazard Index of 1 residential scenario
p-NT	37	Risk-based concentration based on Hazard Index of 1 residential scenario

CSR – Code of State Regulations.

The ROD provides that a Remedial Design/Remedial Action (RD/RA) Work Plan describe the groundwater monitoring program including performance goals and monitoring strategy and the appropriate response actions should the performance goals not be achieved. Institutional controls (ICs) will also be described in the RD/RA Work Plan.

The ROD identifies the following performance goals:

- Contaminants will attenuate at a rate sufficient to meet cleanup goals in reasonable time (estimated at the time of the ROD at approximately 160 years.)
- Contaminant migration will remain confined to the currently impacted groundwater system; and
- Contaminant levels at potential exposure points (e.g. springs) will not pose unacceptable risks to receptors and will decline over time.

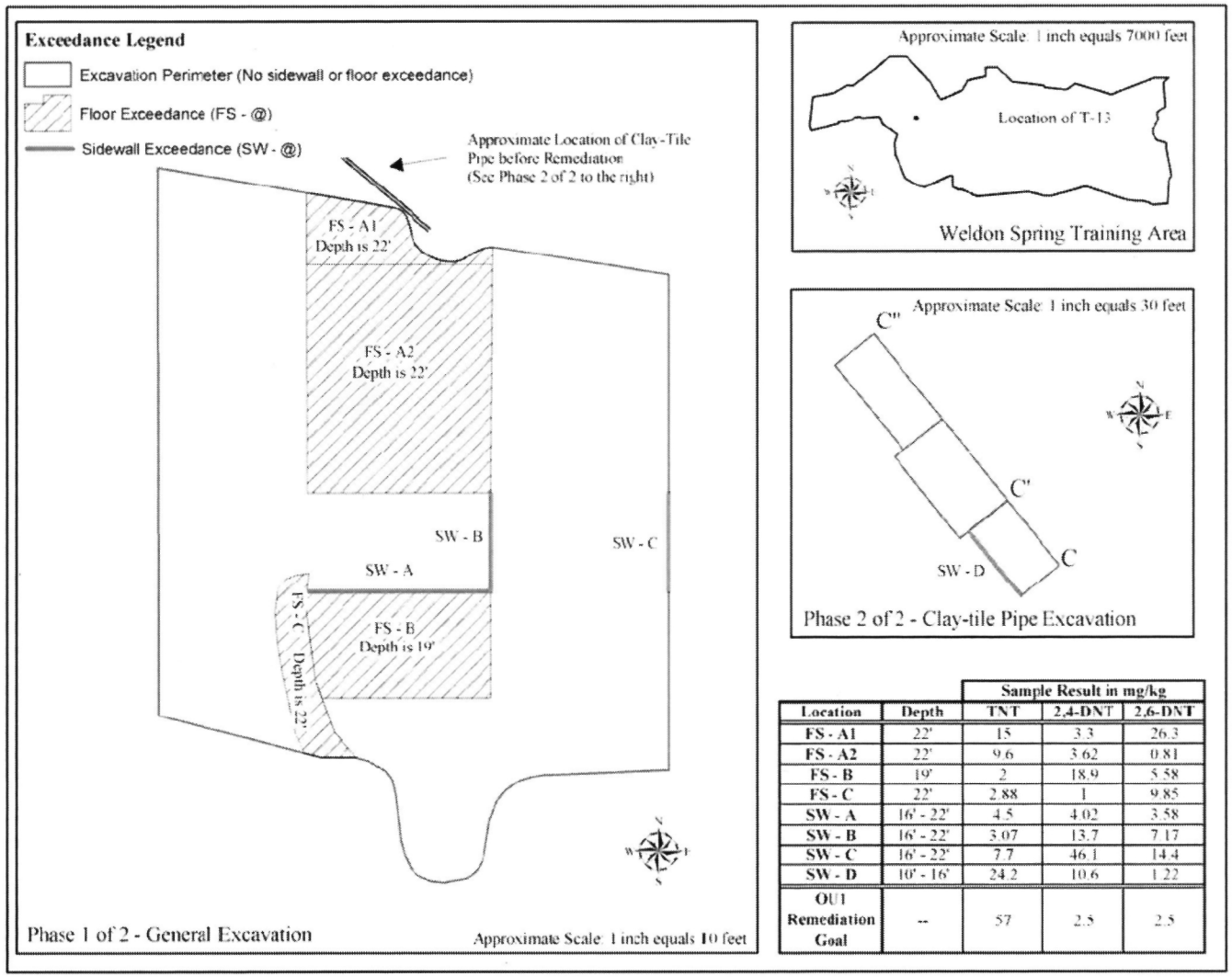
To ensure these performance goals are met, a groundwater program will be developed using existing monitoring wells (and any new wells that may be required in the future) to evaluate contaminant behavior over time. Any new well installation or plugging of abandoned wells will follow the Missouri requirements for well construction as identified in 10 CSR 23-4.050.

ICs would be needed in impacted areas to ensure protection of human health and the environment until remediation goals are met which is considered to be unrestricted use at this site. To maintain the integrity of the remedial actions, the ROD states that the ICs are intended to:

- Restrict activities that may negatively impact the remediation of contamination.
- Restrict activities that may result in creation of a potential for downward migration of contamination.
- Reduce the potential for ingestion or dermal exposure to groundwater contaminated at concentrations above remediation goals.
- Prevent use of groundwater contaminated above applicable, relevant and appropriate requirements (ARARs) or health-based remediation goals as a potable water source.

The ROD States that the Department of the Army (DA) will implement, maintain, and enforce ICs as they apply to currently owned federal property. The implementation, maintenance, and enforcement of

ICs on state-owned property will be addressed during the remedial design. On state-owned property and upon future transfers of federally-owned property, compliance with the IC performance objectives may involve actions by the property owners in accordance with deed restrictions or other agreements, however, ultimate responsibility for assuring that the objectives are met remains with the Army as the party responsible under CERCLA for the remedy.



		Sample Result in mg/kg		
Location	Depth	TNT	2,4-DNT	2,6-DNT
FS - A1	22'	15	3.3	26.3
FS - A2	22'	9.6	3.62	0.81
FS - B	19'	2	18.9	5.58
FS - C	22'	2.88	1	9.85
SW - A	16' - 22'	4.5	4.02	3.58
SW - B	16' - 22'	3.07	13.7	7.17
SW - C	16' - 22'	7.7	46.1	14.4
SW - D	10' - 16'	24.2	10.6	1.22
OU1 Remediation Goal	--	57	2.5	2.5

Figure 3. Area T13 Remaining Contamination

4.2.4. Remedy Implementation

A RD/RA Work Plan was produced in two phases; Phase I for MNA and Phase II for ICs.

Monitored Natural Attenuation

The Phase 1 RD/RA Work Plan described a monitoring program using the pre-ROD monitoring network. The 2010 FYR recommended optimizing the monitoring program. In 2011, an addendum to the Phase I RD/RA Work Plan was published which revised the monitoring frequency depending on sampling results. As a result, two monitoring wells were removed from the monitoring network in 2012, though groundwater level information is still collected from these wells. Monitoring is conducted annually and includes a performance monitoring network of 7 springs and 17 groundwater monitoring wells.

Institutional Controls

The Phase II RD/RA Work Plan (institutional controls) was published in 2006. The Phase II RD/RA Work Plan summarized institutional controls (ICs) on Federal and State property, to include compliance with regulations, coordination of a restrictive covenant, easement, or similar instrument, and informational devices. Figure 4 shows the boundary lines for the IC areas for groundwater use restrictions and the owning entity for OU2 as presented in the Phase II RD/RA Work Plan.

The specific IC requirements in the work plan are described below.

On the WSTA, the following ICs are to be implemented.

- Compliance with Federal, Department of Defense (DOD) regulations, Department of Army (DA) Regulations (ARs) associated with environmental planning and implementation of ICs (including AR 200-1, DA Pamphlet 200-1, and AR 210-20, making use of the Installation Master Plan, as appropriate.)
- Installation, regulation, or instruction with provisions consistent with the basic requirements of the Missouri Well Construction Code (10 SCR-23-3), including those ICs for a designated special area in order to restrict well construction or any groundwater access activities.
- Informational devices – pamphlet/notice with regard to the groundwater contamination at the WSTA and associated restriction to be circulated on installation and in a public repository, and/or at the DOE Weldon Spring Site Interpretative Center.
- Compliance with CERCLA 120(h) and DOD guidance for future transfers of property to State or private ownership.

DA environmental and property management regulations provide a framework for the development and management of ICs during change in use or change in ownership. The Phase II RD/RA Work Plan references AR 210-20 (Real Property Master Planning for Army Installations), which provides requirements for incorporation of land use controls into the environmental overlay of the Installation Master Plan [currently known as the Future Development Plan (FDP)]. The environmental overlay, which is GIS-based, includes information on areas with groundwater contamination and identify the nature of activities restricted and/or limited by the presence of contaminated groundwater.

On State-owned property (and property transferred out of Federal ownership in the future) the following ICs are to be implemented.

- State enforcement of Missouri Well Construction Code (10 CSR 23-3) procedures and potential designation of the impacted State-owned property as a "sensitive area" under the Code provisions of 10 CSR 23-3-100.
- Implementation of a restrictive covenant, easement, or similar instrument in accordance with state property law and environmental law and relevant guidance by the State agency.
- Informational devices – pamphlet/notice regarding groundwater contamination and associated use restrictions to be available in public repositories and at the DOE Weldon Spring Site Interpretative Center.

For areas within the former WSOW but outside of the WSTA, the Phase II RD/RA Work Plan states that "...the DA will coordinate with appropriate state agencies to implement a restrictive covenant or easement that would allow the State to impose, maintain, modify, terminate, and enforce groundwater use restrictions[, easement, or similar instrument] against any subsequent property owner(s), or user(s) or their contractors, tenants, lessee or other parties...Under state law, a restrictive covenant may be used as an IC at the WSOW" (OU2 RD/RA Work Plan – Phase II, 2006).

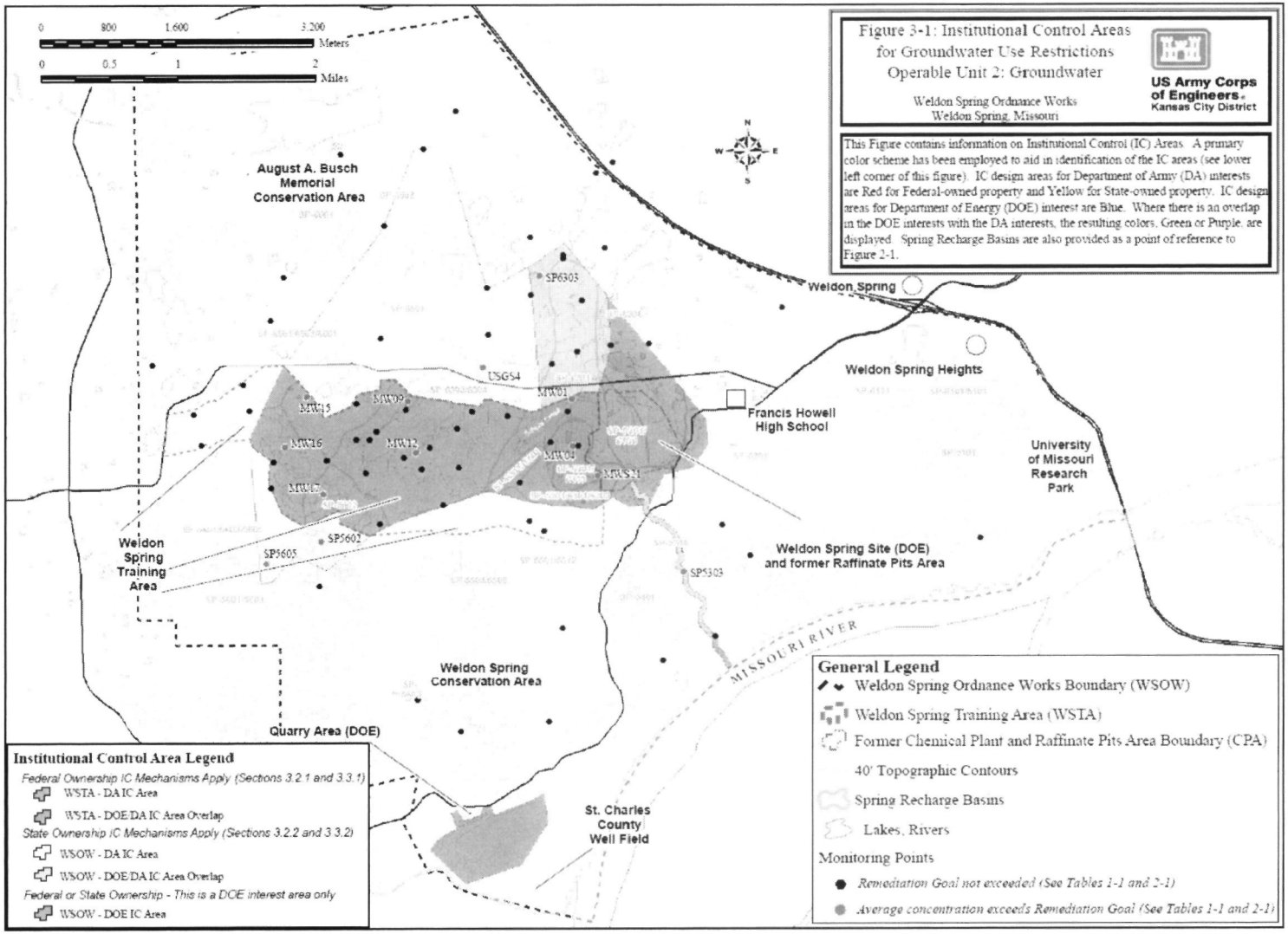


Figure 4. Institutional Control Areas
(Source: 88th RSC, 2006)

The Phase II RD/RA Work Plan describes implementation actions for each of the ICs components described above which include:

- Installation Master Plan/Operations: The development of an environmental overlay by the DA to be put into the installation master plan and the administrative record consistent with AR 210-20. In addition the following actions are to be performed by the DA
    - A copy of the IC RD to the Installation DPW director; Missouri Department of Conservation (MDC), and DOE
    - Prepare a map indicating location and dimensions of OU2 and extent of groundwater contamination with IC location
    - If state law permits, record a survey plat incorporating IC objectives for the limited purpose of providing public notice of environmental conditions and limitation of use of property. The plat shall also be placed in the information repository for CERCLA actions.
    - Confirm that technical reviews will be conducted on all planned construction activities to prevent uses consistent with the IC objectives, adequate safety measures are used, and prior approval is obtained through the commanding officer and/or installation planning board before site approval for construction or land use changes for the area subject to ICs under this RD.
- Monitoring/Site Inspections: Periodic site inspections will be conducted to confirm whether the required ICs remain effective and meet IC objectives for remedy protectiveness as stated in the OU2 ROD. Initially, this inspection will be conducted annually with changes in frequency to be coordinated with regulatory agencies. For the state-owned property of the former WSOW, these site inspections may be performed by the state in coordination with the DA.
- CERCLA 121(c) Five-Year Reviews: The DA shall prepare a report certifying the continued effectiveness of the remedy, including the effectiveness of the ICs. The periodic inspection reports will be used in the preparation of the Five-Year Review and will include an assessment of the need to modify the ICs or their objectives.
- Modification of ICs and Land Use Changes: Regulator concurrence shall be obtained with the terms outlined in the installations Federal Facilities Agreement, if applicable. The DA shall not without EPA concurrence, make a modification to or terminate an IC, or make a land use change inconsistent with the OU2 ROD objectives. Likewise, the DA shall see prior EPA concurrence before commencing actions that may impact remedy integrity.
- IC Enforcement: If DA, EPA or the state discovers any land use that causes failure to meet an IC objective or that impairs the effectiveness of the OU2 remedy, that party will notify the others as soon as practicable but no later than 10 business days after discovery. The DA will work with EPA, the state, and if applicable, transferees/lessees of the property to take corrective measures. Any violations that breach federal, state, or local criminal or civil law will be reported to the appropriate civil authorities.

- Termination of ICs: ICs will remain until ARARs or health-based remediation goals are met. At such time that the DA and EPA agree that this has been achieved for site (or portions thereof), ICs will be terminated as needed. The decision to terminate ICs will be documented consistent with the NCP process for post-ROD changes, including potentially an explanation of significant differences or a RA Completion Report.

- Leases and Property Transfers: At the earliest possible time, but not later than 60 days prior to leasing or transferring any portion of DA-owned property the exhibits impacted groundwater to another agency, person, or entity, the DA shall provide notice to EPA and MDNR of such intended lease or transfer.

- Responsibilities of Subsequent Owners/Lessees for IC Implementation: In the event of property transfer or lease, the DA may require the transferee or lessee and subsequent property owners(s) and use(s) to assume certain responsibilities for IC implementation involvement of the appropriate regulators and/or local government representatives.

- Notification by the Transferee or Lessee: The transferee or lessee, as well as subsequent property owner(s) and user(s),will be responsible for promptly notifying DA and the appropriate regulators

The 88th RSC produced a Future Development Plan (FDP) in November 2014, which is a master planning document that highlights existing conditions on the WSTA that may impact future development at the training area to include contamination in the groundwater. In addition, the FDP includes a statement that restricts groundwater use on the entire training area; meaning that well construction, groundwater withdrawal, and potable use of the groundwater are not allowed at WSTA. This is more stringent than the "sensitive area" requirements of the Missouri Well Construction Code, 10 CSR 23-3-100. This Code, which the Army assisted in codifying, describes specific requirements for the installation of wells within the WSOW, which provides additional groundwater use restrictions because well installation in the "sensitive area" requires State of Missouri approval prior to installation. Excerpts of the FDP are included in Appendix E.

The 88th RCS Directorate of Public Works (DPW) is responsible for the management of the WSTA and maintains the GIS environmental overlay for the installation. The environmental overlay for WSTA includes soil sampling grids, areas of soil excavation, former and current utilities and pipelines, wetlands, the MDNR Well Construction Code Special Area 4, monitoring wells, springs, the T13 restricted digging area, and surface drainage. The DPW Environmental Division coordinates with the Directorate of Planning and Training, who is responsible for troop training, regarding potential environmental impacts and restrictions. Any actions that impact the restrictions in place will be either disapproved or withdrawn.

An environmental notice was recorded with St. Charles County in 2015. The notice informs the public that groundwater contamination is present across portions of the WSTA. Two informational pamphlets have been produced. One pamphlet was produced for staff and visitors to the WSTA and includes natural resource and environmental information for the training area. This pamphlet is available at the WSTA. The other pamphlet was produced for visitors of the conservation areas presenting contamination concerns at these areas. This pamphlet is available to the public at the MDC headquarters located on the Busch Conservation Area. The environmental notice and pamphlets are included in Appendix E.

The draft Long-Term Monitoring Plan (LTMP) was produced in 2015 describing the implementation actions for groundwater monitoring and land use controls. A site inspection form was developed by the 88th RSC to assess the condition and implementation of land use controls at the WSTA and is included in the draft LTMP. The site inspection forms may be used in future FYRs to assess IC implementation.

A restrictive covenant, easement, or similar instrument for the state-owned property of the WSOW was coordinated in accordance with the RD/RA Plan and forwarded to the State and EPA regulatory attorneys. A restrictive covenant, easement, or similar instrument for state-owned property has not been recorded.

4.2.5. Operations & Maintenance

Monitoring for MNA has occurred during the last five years. The results from data collected are presented in Section 6.4.

Table 4 presents annual costs from the last five years related to groundwater monitoring at the Groundwater OU.

Table 4. Annual System Operations/Operations & Maintenance Costs

Dates	Total Cost (rounded to nearest $1,000)
2010	$76,000
2011	$73,000
2012	$69,000
2013	$36,000
2014	$31,000

Beginning in 2013, a new contract was awarded for groundwater monitoring that included several other Army long-term monitoring sites. This new contract accounts for the difference in costs between the period from 2010 through 2012 and the period from 2013 and 2014 by providing economies of scale.

5. Progress Since the Last Five-Year Review

5.1. Protectiveness Statements from Last Review

5.1.1. OU 1 Soil and Pipeline

The protectiveness statement from the last Five-Year Review (FYR) for OU1 is as follows: "The remedy is complete and is protective of human health and the environment. The T-13 area on the WSTA has contamination remaining at depth. This area is under restricted access, as it lies within the fence line of the WSTA. The contamination is present at a depth of 10 feet or greater and is of limited lateral extent. There is limited chance of exposure to the contamination due to the fact that the remaining contamination is present at depths greater than construction activities would require disturbing."

5.1.2. OU 2 Groundwater

The protectiveness statement from the last five-year review for OU2 is as follows: "The remedy is expected to be protective of human health and the environment upon attainment of [remedial goals] RGs, through MNA, which is functioning as designed. In the interim, exposure pathways that could result in unacceptable risks are being controlled; and ICs are in the process of being formalized to prevent the groundwater in the restricted area from being used in the future."

5.2. Status of Recommendations and Follow-up Actions from Last Review

Table 5 summarizes the status of recommendations and follow-up actions from the last FYR.

Table 5. Actions Taken Since the Last Five-Year Review

Issues from Previous Review	Recommendations/ Follow-up Actions	Party Responsible	Milestone Date	Action Taken and Outcome	Date of Action
An area of contamination remains at T13	Generate IC document to include procedures for providing current WSTA property owner/user with updates on remedial activities and provide assistance as needed for usability of the WSTA with respect to OU1 COCs	USAEC/ 88th RSC	Ongoing	Evaluation of the T13 post remedy implementation shows the site is in a condition of UU/UE and therefore ICs are not necessary.	N/A
IC document	Generate IC document to include a summary of the ICs, applicable regulations and guidance, contact information, and environmental overlay, and other ICs that may be developed	USAEC/88th RSC	September 2011	WSTA FDP and draft LTMP produced which identify ICs and implementation procedures.	N/A
Restrictive covenant	Complete review by USAEC counsel of applicability of a covenant based on the Missouri Environmental Covenants Act. Complete negotiations with Missouri Department of Conservation to implement deed restrictive covenant (in conjunction with DOE)	DOD	September 2011	A restrictive covenant, easement, or similar instrument for the State-owned property was coordinated in accordance with the RD/RA Plan and forwarded to State and EPA attorneys.	N/A
Monitoring program optimization [at OU2]	Implement changes to modify monitoring locations and monitoring frequencies based on recent data, monitoring location objectives, and statistical analysis.	DOD	January 2011	The RD/RA Addendum No. 1 was issued updating monitoring frequencies and sampling schedules.	March 2011

The RA Report (Pangea, 2004), summarized in Section 4.1.4, shows that contaminants, present above remediation goals, are located from depths of 10 to 22 feet bgs and of limited lateral extent. Any future

land use, including residential use, would not result in exposure to these contaminants, because the depths of remaining contamination are greater than construction activities would require.

5.3. Work Performed Since the Last Review

The following items were performed since the last FYR.

- The RD/RA Work Plan was updated in 2011 with the RD/RA Work Plan Addendum Number 1 (DA, 2011). This addendum revised groundwater sampling frequencies and schedule and documented updates to groundwater monitoring procedures.
- The Phase II RD/RA Work Plan was amended in 2014, updating the milestone schedule.
- An environmental notice was recorded in 2015, as described Section 4.2.4.
- The draft LTMP was produced in March 2015 and describes long-term management activities associated with residual explosives contamination in groundwater within the WSOW. The draft LTMP describes a groundwater monitoring program and land use controls associated with contaminated groundwater on the WSTA and state-owned properties. This document is not yet finalized.
- Groundwater monitoring was conducted annually during the last five years. Results of groundwater monitoring are discussed in Section 6.4.
- Signage was installed at the WSTA alerting visitors of nitroaromatic-contaminated groundwater and that it is not safe for human consumption.
- A restrictive covenant, easement, or similar instrument for state-owned property was coordinated with MDC and EPA attorneys.
- The Army worked with MDC on an access agreement related to use restrictions on state-owned property and a finalized agreement is expected.

6. Five-Year Review Process

6.1. Administrative Components

The Army initiated the Five-Year Review (FYR) in April 2014 and scheduled its completion for September 2015. The review team included Marlowe Laubach, chemical engineer, and Lisa Scott, geologist, with USACE, Seattle District. In April 2014, a scoping call was held with the installation, USAEC, and review team to discuss the Weldon Spring Ordnance Works Site (WSOW or Site) and items of interest as they related to the protectiveness of the remedy currently in place. A review schedule was established that consisted of the following:

- Community notification,
- Document review,
- Data collection and review,
- Site inspection,
- Local interviews, and

- FYR report development and review.

6.2. Community Involvement

On April 8, 2015, a public notice was published in the St. Charles Journal, St. Peters Journal, O'Fallon Journal, and the Wentzville Journal. On April 10, 2013, a public notice was published in the St. Charles edition of the St. Louis Post-Dispatch. The public notice announces the commencement of the FYR process for the Site, provides contact information, and invites community participation. The press notice is available in Appendix B.

The FYR report will be made available to the public once it has been finalized. Copies of this document will be placed in the designated information repository:

St. Charles City/County Library
Middendorf-Kredell Branch
2750 Highway K
O'Fallon, Missouri 63368-7859

Upon completion of the FYR, a public notice will be placed in the publications noted above to announce the availability of the final FYR report in the Site information repository.

6.3. Document review

This FYR included a review of relevant, Site-related documents including the RODs, remedial action reports, and recent monitoring data. A complete list of the documents reviewed can be found in Appendix A.

6.4. Data review

6.4.1. OU 1 Soil and Pipeline

Remaining contamination information from the remedial action is presented in Section 4.1. No additional soil data was generated during this FYR period.

6.4.2. OU 2 Groundwater

T13

Area T13 appears to be located in a groundwater divide and in weathered limestone bedrock. In addition, the original groundwater program was not based on the contaminated soil remaining at the T13 site. This area has potential ground movement into several spring recharge basins; SP5601/5603/5605 (MWS16), SP6501 (MWS15), SP5602 (MWS17); see Figure 5 and Figure 6. Additional discussion on the groundwater divide is presented below. Table 6 presents wells near Area T13.

The RD/RA Work Plan (DA, 2011) indicates that MWS16 (basin SP5605) is located downgradient of Area T13; however, available maps did not display the location of Area T13 in relation to existing monitoring wells. In 2011, the monitoring program was optimized to remove sample location or decrease sampling frequency at several locations based on annual sampling results. In 2012, MWS16 was sampled for the last time and was subsequently removed from sampling because concentrations

were below remedial goals for several monitoring rounds. The groundwater direction or gradient for the T13 site is unclear. Therefore it is unclear whether MWS16 is actually downgradient of the site.

As part of this assessment, reports documenting dye tests conducted by the Missouri Department of Natural Resources (MDNR) and U.S. Geological Survey (USGS) between 1988 and 1998 were reviewed. The document review did not identify any dye tests conducted specifically around Area T13.

Table 6. Wells near Area T13

Well	Spring Recharge Basin	Monitoring Program	Remarks
MWS15	SP6501	Yes	Analytical sample annually. Historical exceedances.
MWS16	SP5601/5603/5605	Yes	Historical exceedance, removed from sampling program in 2012 due no exceedances in 8 sampling rounds. Only water level readings annually.
MWS17	SP5602	Yes	Historical exceedance, removed from sampling program in 2012 due no exceedances for 6 sampling rounds. Only water level readings annually.
MWS27	SP5605	No	Water level readings annually.
MWS28	SP5601/5603/5605	No	Water level readings annually.
MWS20	SP5601/5603/5605	No	Water level readings annually.

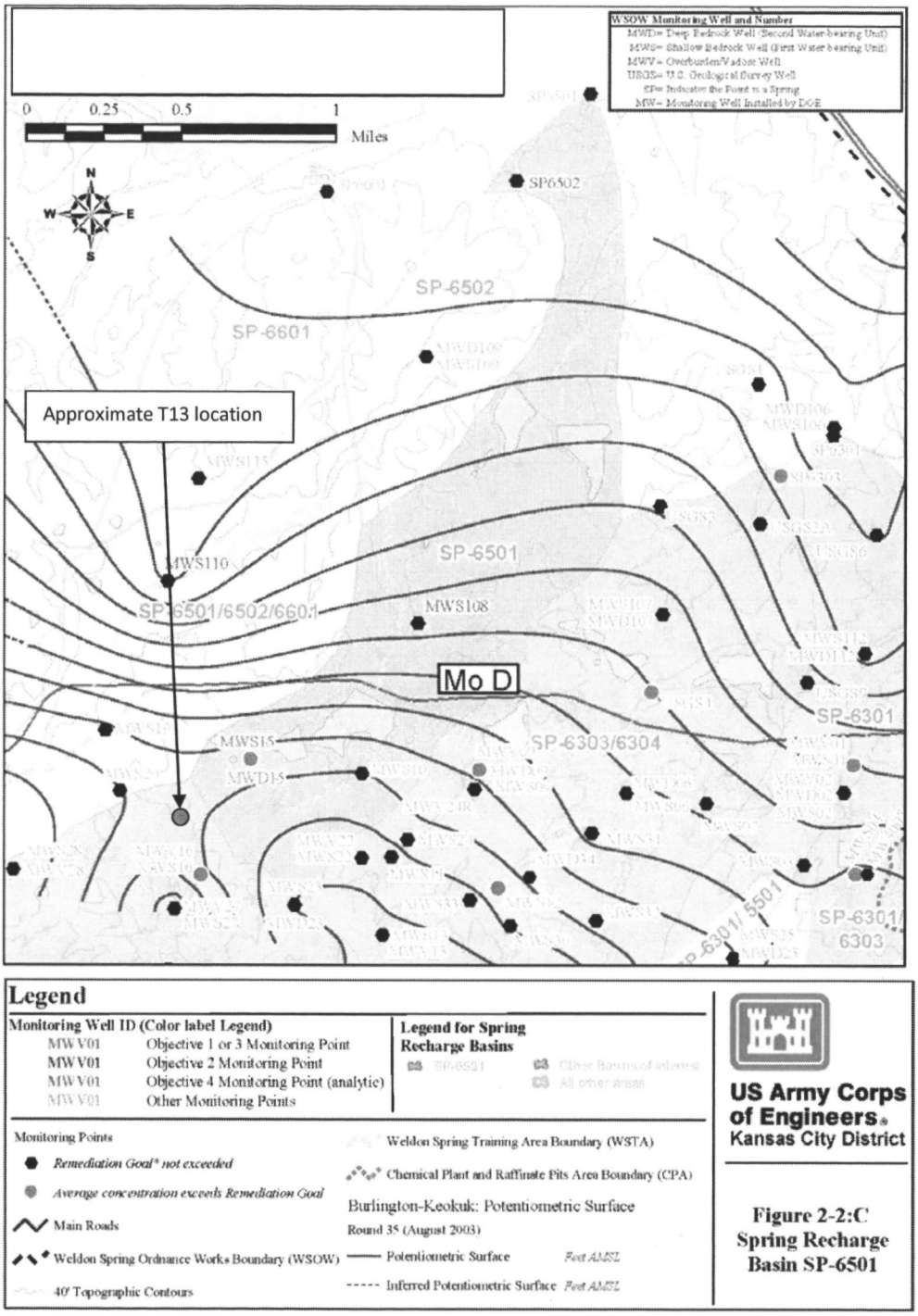


Figure 5. Spring Recharge Basin SP-6501
Note: Figure 2-2:C in the RD/RA Work Plan [HydroGeologic, 2015]

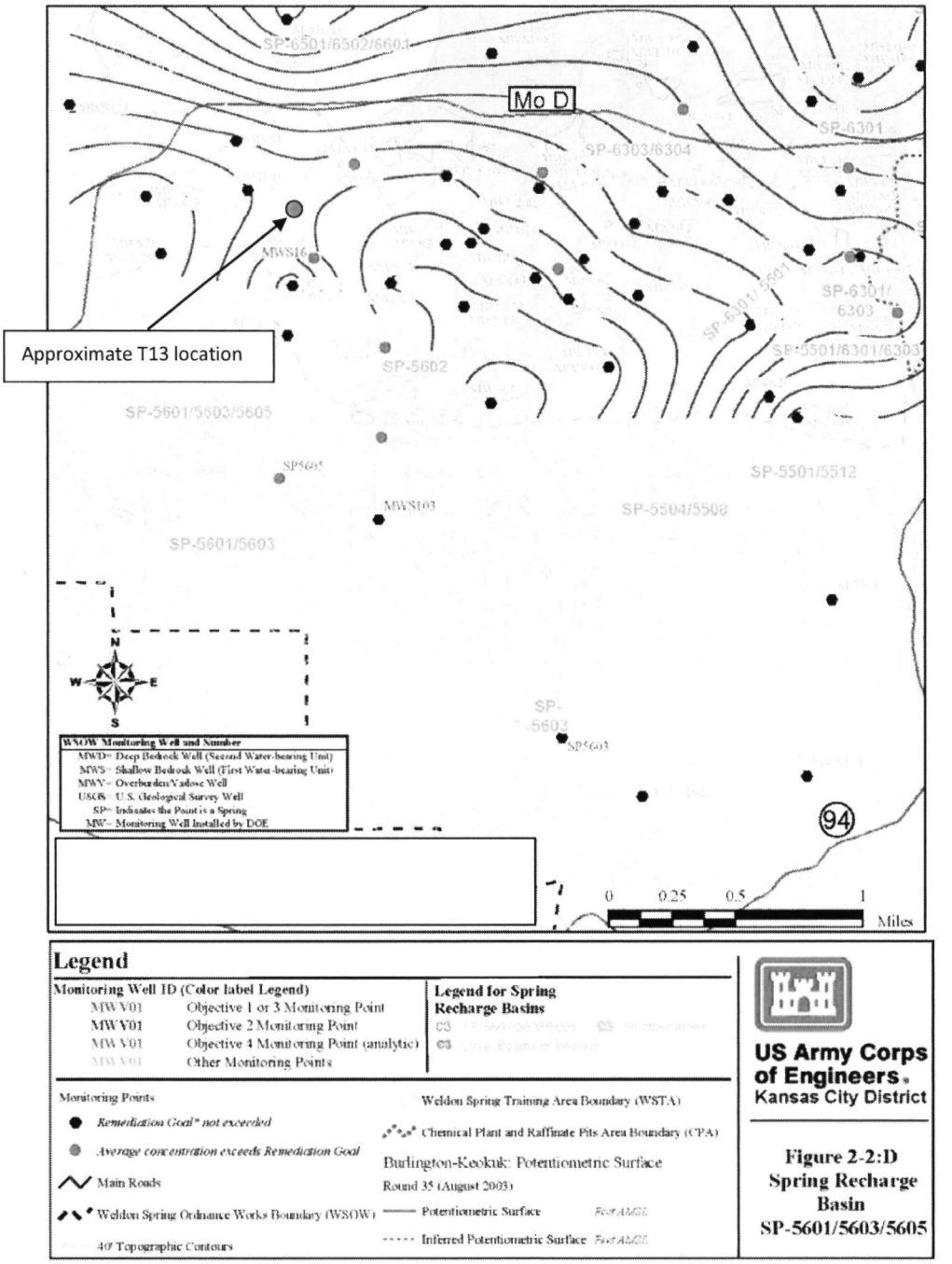


Figure 6. Spring Recharge Basin SP-5601/5603/5605
Note: Figure 2-2:D in the RD/RA Work Plan [HydroGeologic, 2015]

Groundwater Elevations/Gradients

In April 2014, 78 monitoring wells were gauged for water levels. The current groundwater monitoring program includes the groundwater gauging of 83 monitoring wells (see Figure 7). Five wells that were not gauged were due to the following circumstances:

- MWS26 - the well was dry.
- MWS31 - the water level was below the top of the pump.
- MWS102 and MWS103 - the water level probe could not get past an obstruction (possibly the tubing was interfering with the water probe).
- USGS2A - this well was reported to be destroyed.

Groundwater level measurements are summarized on Table 19 (Appendix F).

The majority of the monitoring wells are in the Burlington-Keokuk formation (upper bedrock). The potentiometric map for the most recent sampling event (April 2014), is very similar to previous gauging events (see Figure 8, below, and Table 19 in Appendix F). The potentiometric map shows a groundwater divide generally running east to west across training area. North of the divide, the groundwater flows toward the Mississippi River in a north to northeasterly direction. South of the divide, the groundwater flows to the south toward the Missouri River. Due to the nature of the bedrock (limestone [karst]-weathered bedrock, solution joints, fractures, and bedding planes), water flowing through these drainages may cross between the surface and subsurface several times (losing/gaining streams, springs, sinkholes and other karst features) before reaching surface water creeks and rivers off site. Groundwater may also locally cross over identified drainage and spring basins through subsurface horizontal fractures that transmit beneath the dissected topography, which dominates surface hydraulic controls. Off-site migration also occurs laterally through solution-enlarged conduits and bedding planes in the weathered Burlington-Keokuk Limestone. Groundwater dye tracer studies (DOE, 1997) conducted in the northern drainages (Mississippi River watershed) illustrates that groundwater does cross surface water divides and emerges in other drainages. Groundwater dye tracer studies (DOE, 1997) indicated that the groundwater in southern drainages (Missouri River Watershed) does not cross into adjacent drainages.

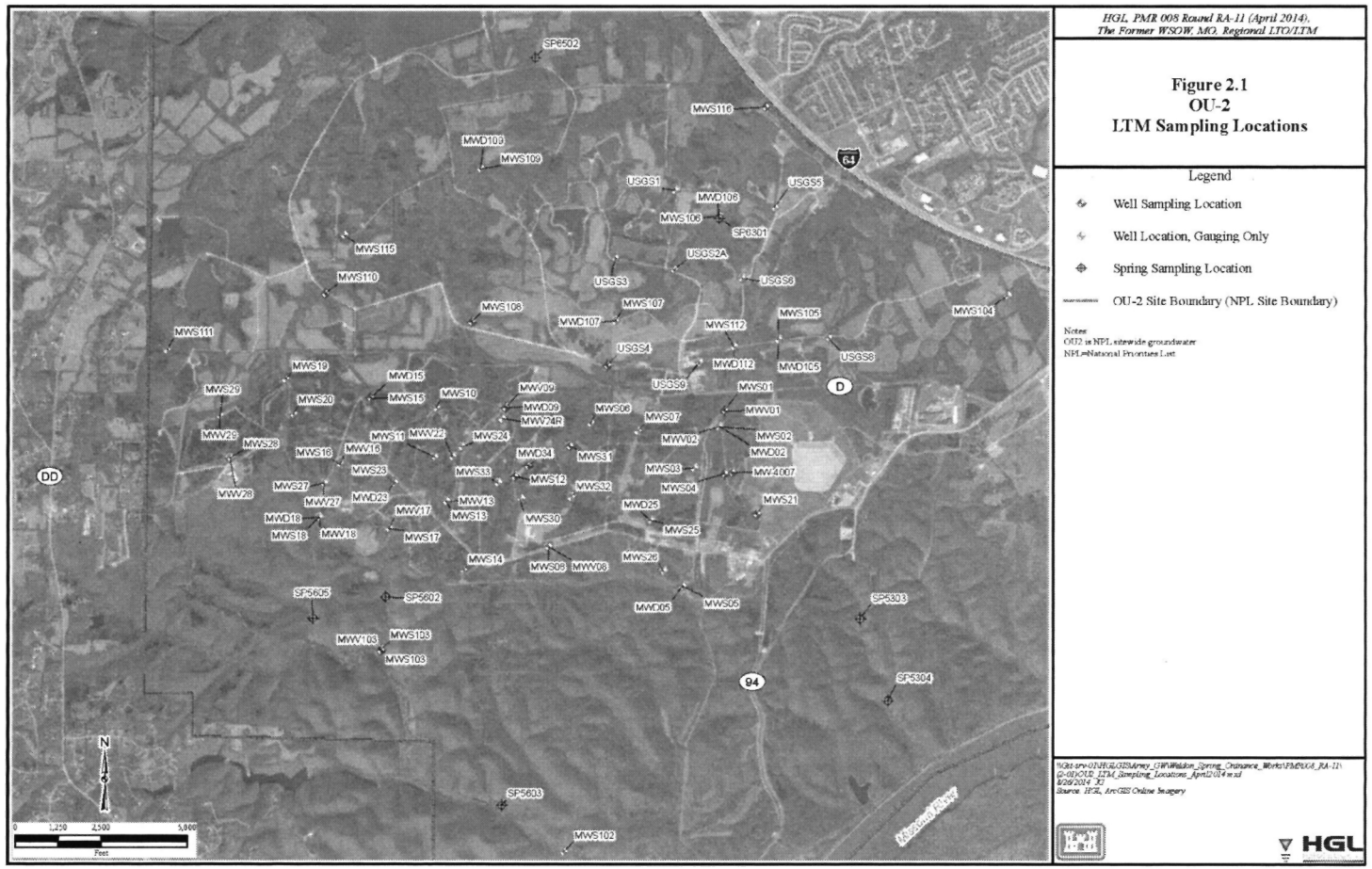


Figure 7. Groundwater Monitoring Locations

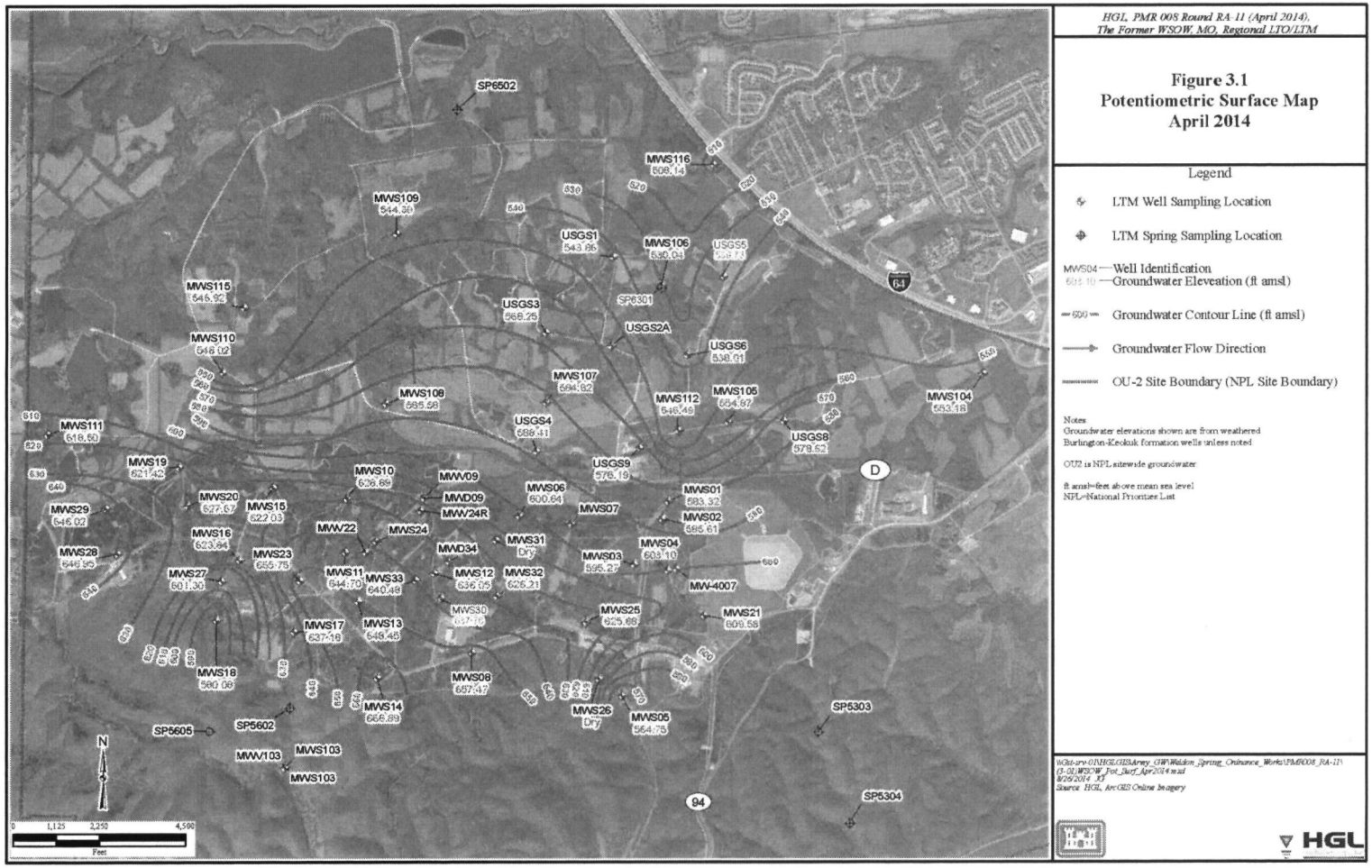


Figure 8. Potentiometric Surface Map

Groundwater Quality

The remedial action monitoring program was developed as a performance monitoring network for the selected remedy of monitored natural attenuation. The performance monitoring network originally consisted of 28 monitoring locations (8 springs and 20 groundwater monitoring wells). These locations were based on historical exceedances of the remedial goals or based on locations downgradient of monitoring locations with historical exceedances. The first round of monitoring (designated Round RA-01) was conducted in August 2005.

The monitoring locations or points were based on objectives to assure achievement of remedial action objectives (RAOs) specified in the ROD. These monitoring locations were classified as Objective (OB) 1, 2, 3, or 4 depending on the function of the selected monitoring location in the overall groundwater monitoring program.

- Objective 1 is to verify that contaminant concentrations are declining with time at a rate and in a manner so that cleanup standards will be met in a reasonable time.
- Objective 2 is to ensure that the lateral migration does not significantly extend beyond the current area of impact.
- Objective 3 is to monitor contaminant levels at the impacted springs, which are the only potential points of exposure under current land use conditions.
- Objective 4 is to monitor hydrologic conditions at the site over time in order to identify any changes in groundwater flow that might affect the protectiveness of the selected remedy.

The optimization of the monitoring program was evaluated in the last FYR (ECC and Burns, 2010b) and the Performance Monitoring Report 004 (ECC and Burns, 2011). Based on these evaluations, the monitoring program reduced sampling locations to 26 monitoring locations (7 springs and 19 groundwater monitoring wells), with possible reduction locations depending on future sampling event results. In the RD/RA Work Plan Addendum Number 1 (DA, 2011) updates to the sampling schedule were documented. After the 2012 sampling event, monitoring wells MW16S and MW17S were removed from the monitoring program because concentrations were less than remedial goals for several sampling events.

The most recent sampling event conducted in April of 2014, sampled 24 locations (7 springs and 17 groundwater monitoring wells).

Monitoring wells sampled in 2014 included the following.

MWS01	MWD15	MWS108
MWV01	MWS15	MWS110
MWS04	MWS21	MWS116
MWD09	MWS31	USGS4
MWV09	MWD34	MW4007
MWS12	MWS103	

Springs sampled in 2014 included the following.

SP5303	SP5603	SP6502
SP5304	SP5605	
SP5602	SP6301	

Eight monitoring locations had remedial goal exceedances in one or more of the contaminants of concern (2,6-DNT, 2,4-DNT, and/or 2,4,6-TNT) (See Table 7). Five wells (MWD34, MWS12, MWS21, MWV01, MWV09) had at least one contaminant above the remedial goals. Three springs (SP5602, SP5605, SP5303) located in the southern portion of the site had at least one contaminant above the remedial goals. Wells MWS12, MWV09, and MWD 34 are located in close proximity of each other in the center of the site. MWD34 and MWS21 had a primary and duplicate sample taken with inconsistent results, one sample measured as slightly above the remedial goals and the other a non-detect. MWS15 sampling results for 2,6-DNT showed a non-detect with reporting limit above the remedial goal of 1.3 µg/L, which may be a reporting error. Table 20 (Appendix F) summarizes all the analytical results from the 2014 sampling event for all monitoring locations.

Table 7. Monitoring Locations where Remedial Goals were Exceeded

Location	Objective	2,6-DNT (1.3 µg/L)	2,4-DNT (0.11 µg/L)	2,4,6-TNT (2.8 µg/L)
MWD34	4	ND (0.40)	**0.14 J**	ND (0.10)
MWS12	1	**12.2**	ND (0.095)	1.4
MWS21	1	ND (0.40)	**0.46**	ND (0.098)
MWV01	1	0.26	**0.13 J**	0.16 J
MWV09	1	**2.9**	**11.4**	**4.8**
SP5602	3	**3.3**	**0.76**	2.2
SP5605	3	ND (0.099)	ND (0.099)	**5.5**
SP5303	3	ND (0.10)	ND (0.10)	**7.9**

Note: The remedial goal for each analyte is in parentheses.
Bold indicates greater than remedial goal.
ND – non-detect; reporting limits shown in parentheses.

Also, results of the 2014 well inspection indicate that Well USGS2A had been destroyed. It is recommended that this well be closed properly. Prior to closing Well USGS2A, follow-up is required to ensure that this well is not needed in the monitoring program and to coordinate with United States Geological Services (USGS) to properly close the well.

Monitored Natural Attenuation

The selected remedy provides for monitored natural attenuation (MNA) with institutional controls (ICs) that include limiting groundwater use. Eleven rounds of sampling have been conducted since the implementation of the OU2 Remedial Action (RA) (RA- 01 August 2005 to RA-11 April 2014).

Table 22 (Appendix F), which summarizes all data from RA-01 to RA-11, flags COC sampling results where there have been increases in concentration, specifically between sampling rounds RA-09 and RA-10 and again between RA-10 and RA-11. There were no COCs with three rounds of consecutive increases in concentrations. The 2014 sampling event had eight monitoring points with at least one exceedance above the remedial goals for COCs. However, the Mann-Kendall trend analysis (see Statistical Trend Analysis, below) showed no increasing trends for those monitoring points and related COCs. The nineteen sampling locations that showed increasing trends were below the remedial goals for all rounds sampled used to conduct the trend analysis. In addition, all 23 monitoring point/constituent pairs that showed increasing trends in the trend analysis below had no remedial goal exceedances from the 2014 sampling event. Wells MWD09, MWS116, MWS15, and USGS04, and springs SP6301 and SP6502 had no detections during the 2014 sampling event.

Analytical results and statistical analysis indicate that: contaminants are attenuating at a rate sufficient to meet cleanup goals in a reasonable time; contaminant migration remains confined to the currently

impacted groundwater system; and contaminant levels are declining over time. Concentrations are not expected to exceed historical maximums; however localized and temporary upward trends resulting from ongoing dispersion, analytical variability, or other factors, may be observed. Overall, the natural attenuation during the last five years has reduced contaminant concentrations.

Statistical Trend Analysis

Trend analyses were conducted on the 21 monitoring locations for the 8 COCs using the Mann-Kendall analysis (using Sanitas™ for Groundwater, Version 9.4, statistical software) as part of the Performance Monitoring Report 008. Three locations were not included in the trend analyses due to no detections during this sampling event. According to the RA/RD Work Plan (USACE 2005) "The Mann- Kendall test can be performed as frequently as needed for each Objective 1 (and 3) location for contaminants exceeding remediation goals. The test can therefore be an indicator for trend changes (i.e. from no statistically significant trend in either direction to a statistically significant upward or downward trend (or any combination)). The Mann-Kendall test will be conducted if an increase in concentration of a contaminant of concern is observed in two consecutive sampling rounds for the specific monitoring point and contaminant exhibiting the increase. The test will be useful in gaining frequent evaluations of trends without the need to go through complex statistical analysis." The Mann-Kendall analysis ascertains the existence of an increasing or decreasing trend and is coupled with the Sen's Slope Estimator, which computes the magnitude of the trend. Mann-Kendall analysis was conducted using all available data results for sampling locations starting in 1999 or 2000. The use of data prior to the 2004 ROD and final removal of contaminated soil (except remaining in T-13) in 2004 may be biased towards an increasing trend.

The Mann-Kendall analysis was performed on 101 of the 192 monitoring points/constituent pairs (Twenty-four [24] monitoring points times 8 COCs equals 192. However, 91 pairs were removed because there were no detections over a 14-year monitoring period.) Of the 101 monitoring points/constituent pairs, 71 showed no significant trend, 23 showed an increasing trend, and 7 showed a decreasing trend. The Mann-Kendall analysis graphs can be found in Appendix E of the Performance Monitoring Report 008 (HydroGeoLogic, 2015).

Nineteen (19) of the 23 monitoring points/constituent pairs with increasing trend analysis used non-detect data with one or two detects over a 14-year monitoring period. The non-detect data was used by substituting a numerical value of 0.05 µg/L or 1/2 the detection limit, whichever was greater. Using non-detect data is less reliable in showing the true nature of the trend.

Only four of the 192 monitoring points/constituent pairs with more than two detections, showed an increasing trend for specific COCs; these were Well MWS04 for 1,3-DNB, Well MWS12 for 2,4,6-TNT and NB, and Spring SP5602 for o-NT. However, the 2014 sampling results show no exceedances above the clean up levels for these locations and COCs.

Confidence interval analysis performed on the 192 monitoring points/constituent pairs from the 2014 sampling event indicated that there were only 10 pairs with both the upper and lower limits of the 99-percent confidence interval that fell above the respective remedial goals. These 10 pairs are among only 5 monitoring locations (3 wells and two springs). Table 15 (Appendix F) is a summary of the statistical analysis of the confidence interval. All 10 monitoring location/constituent pairs are OB-1 or OB-3 monitoring points. This is an improvement compared to the initial screening of the data for the ROD at 52 pairs with upper limits of 99-percent confidence above the respective remedial goals. However, the confidence interval lower limits are predicting much higher concentrations than the

current analytical data is reporting at some locations, which is inconsistent with current data (below the remedial goals).

Linear regression analysis was conducted on 9 of the 10 monitoring location/constituent pairs exceeding the confidence intervals in order to calculate an estimated time to reach the remedial goals (Performance Monitoring Report 008). Table 15 (Appendix F) also includes a summary of the statistical analysis of estimated time to reach remedial goals. The estimated times to reach the respective remedial goals are within the RAO timeframe of 163 years. The highest estimated time to reach respective remedial goals is 137 years MWS12 (2,6-DNT). This is an improvement from 2009 where three of the current nine pairs showed increasing slopes and from 2004 where six of the pairs showed increasing slopes.

Monitoring Program

As mentioned above, the monitoring program was optimized in 2011. The monitoring program was evaluated in this FYR and it was observed that four monitoring locations had similar sampling frequencies. However, only one location followed the monitoring frequency schedule provided in the RD/RA Work Plan Addendum Number 1 (DA, 2011).

After 2012, the frequency of monitoring at MWS04 was changed to a sampling schedule of every two years based on optimization criteria in the RD/RA Work Plan Addendum Number 1 (DA, 2011). Three other sampling locations meet optimization criteria of sampling every two years, however, these wells have remained on an annual sampling frequency including no detections of COCs above the remedial goals from 1999 through the April 2014 sampling event. These are wells MWS110 and MWS108, and Spring SP5603. Table 8 presents the monitoring frequency and optimizing criteria for these four monitoring locations.

The 2014 analytical report recommends that the sampling frequency at wells MWS108 and MWS110, and spring SP5603 be changed to every 2 years as recommended in RD/RA Work Plan Addendum Number 1 monitoring program optimization.

The monitoring network assumed that Well MWS16 is downgradient of Area T13 and has since been removed from the monitoring network. As noted above, Area T13 is located within a groundwater divide where groundwater potentially could flow to the north as well as the south. Well MWS15, located northeast of Area T13 is currently monitored annually. However, it is not known whether either well is downgradient of Area T13.

Table 8. Monitoring Frequency of Four Wells

Monitoring Location	Original Monitoring Frequency	Optimized Monitoring Frequency	Notes
*MWS04	Annual	Annual for 2 years, if continued <RGs, then every 2 years	Continue annual schedule for 2 years, then reevaluate. If detections remain <RGs, then sampling every 2 years would be sufficient to monitor trends.
MWS110	Annual	Annual	Continue annual schedule for 2 years, then reevaluate. If detections remain <RGs, then sampling every 2 years would be sufficient to monitor trends. Retain downgradient OB-2F SP6502 for Spring Basin Group C on annual schedule.
MWS108	Annual	Annual	Continue annual schedule for 2 years, then reevaluate. If detections remain <RGs, then sampling every 2 years would be sufficient to monitor trends. Retain downgradient OB-2F SP6502 for Spring Basin Groups B and C on annual schedule.
SP5603	Annual	Annual	Continue annual schedule for 2 years, then reevaluate. If detections remain <RGs, then scheduling every 2 years would be sufficient to monitor trends. Retain upgradient MWS103 as OB-2N for Spring Basin Groups D and E.

*MWS04 currently being sampled every two years.
RG – remedial goals.

6.5. Site Inspection

A site inspection was conducted on January 22 and 23, 2015 to assess site conditions. Personnel from the 88th RSC, EPA, MDNR, USAEC, and USACE attended the site inspection.

The site visit began with a meeting on January 22, 2015, to discuss FYR progress and answer specific questions the FYR team had regarding the site and the remedy components. After the meeting, the group proceeded to Area T13 where the team observed informational signs and flagging from a recent survey that will be included in the installation GIS-based environmental overlay.

On January 23, 2015, the FYR team viewed two monitoring wells used to establish groundwater contours (MWS106 and MWD106) and two monitoring wells sampled for contaminant concentrations (MWS08 and MWS110). One monitoring well (MWS110) was observed to be unlocked; the team locked the well upon leaving that location. The wells viewed appear to be in good condition; however all wells should be locked. The team was unable to find spring locations; the springs may not have been flowing at the time of the site visit.

The trip report in Appendix C provides details of the site inspection and the full list of participants. The Site Inspection Checklist is also presented in Appendix C.

6.6. Interviews

During the FYR process, interviews were conducted with parties impacted by or aware of the Site, including community members, current landowners, and regulatory agencies involved in Site activities. The purpose of the interviews was to document views about current Site conditions, problems, or related concerns. Table 9 provides a list of persons interviewed. Interviews are summarized below and complete interview records are included in Appendix D.

Interviews were conducted with a few community members including the interim director of the St. Charles Department of Health, a board member of the nearby Weldon Spring Heights subdivision, and a current volunteer at the Department of Energy Interpretative Center. In general, the community members did not have any concerns related to the portion of the Site for which the Army is responsible. For the Department of Health and the Weldon Spring Heights subdivision, the DOE facility and radioactive cleanup were more of a concern. However, both local entities would like to be more informed about the cleanup actions related to the Army site.

The regulatory agency personnel interviewed from EPA and MDNR generally believe that the remedy for OU2 is not fully implemented, specifically related to the implementation of ICs and that nitroaromatic contaminant concentrations in groundwater do not show significant increasing or decreasing trends. Also, MDNR recommended ICs not required in the ROD be implemented at OU1 for Area T13.

Long term groundwater monitoring at the Site is conducted by USACE, Kansas City District. USACE generally felt that the groundwater remedy is performing as intended. Monitoring is conducted annually with the majority of the wells showing no significant trend based on the latest monitoring report (January 2015). For the Soil and Pipeline OU remedy, soil excavation performed appears to have reduced leaching of explosive contamination in groundwater even though DNT remains in discrete portions at depth. In addition, the completion of land use controls is recognized as an important milestone to be reached in this fiscal year.

Table 9. Interviewee List

Name	Title/Affiliation	Date Interviewed	Interview Method	Contact Information
John Vogel	Wildlife Management Biologist/MDC	January 20, 2015	Telephone	(636) 300-1953 x4131 John.vogel@mdc.mo.gov
Hoia Tran	Remedial Project Manager/ EPA Region 7	January 27, 2015	Email	(913) 551-7330 Tran.hoai@epa.gov
Jim Harris	Environmental Specialist/MDNR	January 30, 2015	Email	(573) 522-1892 Jim.harris@dnr.mo.gov
Hope Woodson	Interim Director/ St. Charles Department of Community and Environment	January 22, 2015	Visit	(636) 949-7477
Josephine Newton-Lund	Project Manager/USACE	January 26, 2015	Email	(816) 389-3912 Josephine.m.newton-lund@usace.army.mil
Brad Brink	Geologist/USACE	February 20, 2015	Email	(816) 389-3883 Bradley.j.brink@usace.army.mil
Community Member	Weldon Spring Heights Association	January 23, 2015	Visit	Contact information withheld
Community Member	Volunteer	January 23, 2015	Visit	Contact information withheld

MDC – Missouri Department of Conservation
EPA – Environmental Protection Agency
MDNR – Missouri Department of Natural Resources
USACE – U.S. Army Corps of Engineers

7. Technical Assessment

7.1. Question A: Is the Remedy Functioning as Intended by the Decision Documents?

The remedy for the Soil and Pipeline OU1 is operating as intended by the decision documents.
The remedy for the Groundwater OU2 is functioning as intended by the decision documents.

7.1.1. OU 1 Soil and Pipeline

Remedial action performance (i.e., is the remedy operating as designed?)
The remedial action removed contaminated soils above ROD remedial goals except at Area T13. The remaining soils at Area T13 are at depths where current or future receptors are not exposed to these soils. The remedial action also removed a large mass of contamination, thus reducing contaminants that may migrate to groundwater. Therefore, Area T13 has attained a condition allowing for UU/UE.

Implementation of institutional controls and other measures.
Prior to backfilling at Area T13, orange construction fencing was installed at the bottom of the excavation. The excavation was backfilled with clean materials. Another layer of orange construction fencing was installed on top of the backfilled excavation prior to placement of the topsoil. This orange fencing was intended to be a physical marker should Area T13 be excavated in the future. In addition, signs are present at Area T13 notifying readers that soil contamination is present above remedial goals and to consult with Army Reserve Environmental staff prior to digging or disturbing ground cover. In addition, the location of this area is included on the GIS overlay maintained by the 88th RCS and the installation FDP.

7.1.2. OU 2 Groundwater

Remedial action performance (i.e., is the remedy operating as designed?)
In general, monitored natural attenuation (MNA) is occurring at the Site. Per the trend analysis, three locations with two detections or more had increasing trends; Spring SP5602 for m-NT and p-NT, spring SP6502 for 2,4,6-TNT, and Well USGS4 for m-NT. However, the 2014 sampling results show no exceedances above the clean up levels for these locations and COCs.

Analytical results and statistical analysis indicate that: contaminants are attenuating at a rate sufficient to meet cleanup goals in a reasonable time; contaminant migration remains confined to the currently impacted groundwater system; and contaminant levels at potential exposure points (springs) are declining over time. Concentrations are not expected to exceed historical maximums; however localized and temporary upward trends resulting from ongoing dispersion, analytical variability, or other factors, may be observed. Overall, the natural attenuation during the last five years has reduced contaminant concentrations.

Early indicators of potential issues
Area T13 is located on a groundwater divide and on weathered/unweathered limestone bedrock where groundwater flow may be unpredictable. Groundwater flow direction has not been assessed around Area T13. Well MWS16 historically has been presented as downgradient from Area T13; however, with the uncertain groundwater flow direction, it is unclear whether monitoring well MWS16 is

actually downgradient from the area. Well MWS16 was removed in 2012 from the monitoring network because of multiple year declines in concentration. As noted below, ICs are currently in place preventing exposure to contaminated groundwater on the WSTA.

System operations/operations and maintenance.
Groundwater monitoring and reporting is performed annually. The costs for sampling have decreased in recent years compared to 2010 through 2012. This is due primarily to changes in contracting where the use of a single contract to provide long-term monitoring at several sites versus one contractor per site has led to economies of scale.

Opportunities for optimization.
Optimization of the long-term monitoring was performed in 2011. No other opportunities for optimization were identified.

Implementation of ICs and other measures.
As described in Section 4.2.4, the Phase II Remedial Design/Remedial Action (RD/RA) Work Plan included requirements for specific ICs to be implemented for the Groundwater OU. On the WSTA, a FDP has been implemented which mentions the groundwater contamination and the groundwater use restriction policy established by the 88th RSC. The Missouri Well Construction Code (10-CSR-233100) designates "sensitive areas" within the WSOW preventing human consumption of contaminated groundwater. The WSTA is included within these "sensitive areas." In addition, this regulation describes specific requirements for well installation within these areas that provides additional groundwater use restrictions. The draft LTMP describes procedures for implementation of ICs for the Groundwater OU on the WSTA. An environmental notice has been recorded with the St. Charles County detailing institutional controls that are applicable to the federally-owned property, WSTA. This notice informs future purchasers of the property of the institutional controls that are in place restricting access to groundwater.

The Missouri Well Construction Code (10-CSR-23-3-100) also includes State-owned property of the WSOW within the "sensitive areas" designation. This regulation has not changed since the last FYR and is still valid. In addition, an informational pamphlet, detailing contamination concerns on the conservation areas, has been produced and is available to the public. A restrictive covenant, easement, or similar instrument described in the Phase II RD/RA for State-owned property within the WSOW but outside of the WSTA has been coordinated with the State and EPA in accordance with the RD/RA plan. This restrictive covenant, easement, or similar instrument for state-owned property is not yet in place.

In addition, the Phase II RD/RA Work Plan includes periodic monitoring/inspection requirements to ensure ICs remain in place. Monitoring/inspection of ICs through frequent contact with 88th RSC staff and periodic contact with stakeholders have been performed to ensure they remain effective. However, formal documentation of the inspections in a report or checklist has not been done. Formal documentation of ICs to ensure they remain in place will be implemented as part of annual well inspections.

7.2. Question B: Are the Exposure Assumptions, Toxicity Data, Cleanup Levels, and Remedial Action Objectives (RAOs) Used at the Time of the Remedy Selection Still Valid?

Yes. Exposure assumptions, toxicity data, cleanup levels, and RAOs for both OUs are still valid.

7.2.1. OU 1 Soil and Pipeline

Changes in standards, newly promulgated standards, to be considered standards.
The ROD remedial goals are either risk-based or policy-based. There have been no changes to the policies related to PCB and lead remedial goals. The cleanup level at the time of the ROD of 500 ppm was based on the EPA Superfund Site Lead Policy. This policy was superseded by the Revised Interim Soil Lead Guidance for CERCLA sites and RCRA Corrective Action Facilities which decreased the residential soil screening level to 400 ppm. As stated in the 2010 FYR, the average concentration of lead in soils remaining was less than 400 ppm, providing adequate protection for unrestricted use with respect to lead. Changes in toxicity values which may impact risk-based remediation goals are discussed in further detail below.

Changes in exposure pathways.
A baseline risk assessment (BRA) for the WSOW was conducted during 1992 and 1993 to define the existing and future human health and environmental risks associated with the chemicals found in surface soil, surface water, groundwater, springs, and sediments at the WSOW. The populations at risk of exposure to site COCs were identified for the WSTA and the remainder of the WSOW. Exposure to contents within the TNT pipeline was not included in the 1992/1993 BRA.

The following exposure scenarios were used to calculate cancer and non-cancer risks:

- Recreational and occupational receptor exposure through ingestion and dermal contact of surface soils.
- Recreational exposure receptor through ingestion of sediments.

The majority of contaminated soils have been excavated and removed. Remaining contaminated soils above remediation goals are located at Area T13 at depths between 10 to 22 feet. Therefore, the exposures to surface soils via ingestion and dermal contact to recreation and occupational receptors presented in the BRA are incomplete pathways.

The BRA included an ecological assessment which concluded that some animals at WSOW may be at risk due to concentrations of nitroaromatics and metals in soils. Specific species potentially affected included wild turkey, long-tailed weasel, and white-tailed deer. Biologists working in wildlife management in the two conservation areas on WSOW were not able to confirm that these populations are under stress. The contaminated soils have not affected critical habitat on the Conservation Areas because of the relatively few acres impacted by contamination. This assessment is currently still valid, especially as all remaining contamination is greater than 10 feet below ground surface (bgs).

Inhalation risks related to vapor intrusion have been a concern for many sites. Vapor intrusion was not evaluated in the BRA. Each COC presented in the ROD was evaluated per EPA *Office of Solid Waste and Emergency Response (OSWER) Technical Guide for Assessing and Mitigating the Vapor Intrusion Pathway for Subsurface Vapor Sources to Indoor Air* (June 2015). This guide provides that a chemical generally is considered to be "volatile" if:

1. The vapor pressure is greater than 1 millimeter of mercury (mm Hg) or
2. Henry's law constant is greater than 10^{-5} atmosphere-meter cubed per mole (atm m^3/mol)

Table 10 presents the vapor pressures and Henry's law constants for each COC.

Table 10. Soil and Pipeline OU Vapor Intrusion Evaluation

COCs	Vapor Pressure[1] (mm Hg)	Henry's Law Constant[1] (atm-m3/mol)	Does COC meet volatile definition? (Y or N
2,4,6-TNT	8.0×10^{-6}	2.1×10^{-8}	N
2,4-DNT	1.5×10^{-4}	5.4×10^{-8}	N
2,6-DNT	5.7×10^{-4}	7.5×10^{-7}	N
PCBs	6.5×10^{-6}	2.8×10^{-4}	Y
Lead	NA	NA	NA
PAHs[2]			
Benz(a)anthracene	2.1×10^{-7}	1.2×10^{-5}	Y
Benzo(b)fluoranthene	5.0×10^{-7}	6.6×10^{-7}	N
Benzo(k)fluoranthene	9.7×10^{-10}	5.8×10^{-7}	N
Benzo(a)pyrene	5.5×10^{-9}	4.6×10^{-7}	N
Chyrsene	6.2×10^{-9}	5.2×10^{-6}	N
Dibenz(ah)anthracene	1.4×10^{-7}	9.6×10^{-10}	N
Indeno(1,2,3-cd)pyrene	3.5×10^{-7}	1.3×10^{-10}	N

1 - Vapor pressure and Henry's Law constant values are from EPA's Vapor Intrusion Screening Level Calculator.
2 – Total carcinogenic PAHs are presented in the ROD. The individual carcinogenic PAHs are presented here for analysis.

PCBs and the carcinogenic PAH, benz(a)anthracene met one of these criteria. PCBs and PAHs in soils were excavated as part of the cleanup for OU1 and do not remain above remediation goals. Remaining contaminants within OU1 are nitroaromatic compounds that are not considered volatile.

Changes in toxicity and other contaminant characteristics.
Changes in toxicity values for COCs are presented in Table 11 below.

Table 11. Soil and Pipeline OU Toxicity Changes

Contaminant	Toxicity values in ROD[1]	Current Toxicity Values[2]	Changes
2,4,6-TNT	SFo (1/mg/kg-d): $3x10^{-2}$ RfDo (mg/kg-d): 5×10^{-4}	SFo (1/mg/kg-d): $3x10^{-2}$ IUR (1/µg/m^3): NA RfDo (mg/kg-d): $5x10^{-4}$ RfCi (mg/m^3): NA	Cancer: No changes for oral slope factor, IUR is new value Non-cancer: no changes
2,4-DNT	RfDo (mg/kg-d):$2x10^{-3}$	SFo (1/mg/kg-d): $3.1x10^{-1}$ IUR (1/µg/m^3): $8.9x10^{-5}$ RfDo (mg/kg-d): $2x10^{-3}$ RfCi (mg/m^3): NA	Cancer: new values Non-cancer: no changes
2,6-DNT	SFo (1/mg/kg-d): 0.68 RfDo (mg/kg-d): $1x10^{-3}$	SFo (1/mg/kg-d): 1.5 RfDo (mg/kg-d): $3x10^{-4}$	Cancer: more stringent Non-cancer: more stringent
PCBs[3]	SFo (1/mg/kg-d): 7.7	SFo (1/mg/kg-d): 2 IUR (1/µg/m^3): 5.7x10-^{4} RfDo (mg/kg-d): 2x10-^{5} RfCi (mg/m^3): NA	Cancer: more stringent Non-cancer: no changes
Lead	NA	NA	NA
PAHs[4]			
Benz(a)anthracene	SFo (1/mg/kg-d): 7.3	SFo (1/mg/kg-d): 0.73 IUR (1/µg/m^3): $1.1x10^{-4}$	SFo: less stringent IUR: new value

Contaminant	Toxicity values in ROD[1]	Current Toxicity Values[2]	Changes
Benzo(b)fluoranthene	SFo (1/mg/kg-d): 7.3	SFo (1/mg/kg-d): 0.73 IUR (1/µg/m^3): $1.1x10^{-4}$	SFo: less stringent IUR: new value
Benzo(k)fluoranthene	SFo (1/mg/kg-d): 7.3	SFo (1/mg/kg-d): $7.3x10^{-2}$ IUR (1/µg/m^3): $1.1x10^{-4}$	SFo: less stringent IUR: new value
Benzo(a)pyrene	SFo (1/mg/kg-d): 7.3	SFo (1/mg/kg-d): 7.3 IUR (1/µg/m^3): $1.1x10^{-3}$	SFo: less stringent IUR: new value
Chrysene	SFo (1/mg/kg-d): 7.3	SFo (1/mg/kg-d): $7.3x10^{-3}$ IUR (1/µg/m^3): $1.1x10^{-5}$	SFo: less stringent IUR: new value
Dibenz(ah)anthracene	SFo (1/mg/kg-d): 7.3	SFo (1/mg/kg-d): 7.3 IUR (1/µg/m^3): $1.2x10^{-3}$	SFo: no changes IUR: new value
Indeno(1,2,3-cd)pyrene	SFo (1/mg/kg-d): 7.3	SFo (1/mg/kg-d): 0.73 IUR (1/µg/m^3): $1.1x10^{-4}$	SFo: less stringent IUR: new value

1 – Toxicity values were referenced in the ROD were from the 1993 Baseline Risk Assessment.
2 – The most current toxicity values presented in the June 2015 EPA Regional Screening Level (RSL) table were used. Note: inhalation risks were not evaluated in the 1993 Baseline Risk Assessment. Vapor intrusion risks are discussed below.
3 – Aroclor 1254 values used.
4 – Risk was established in the ROD for total carcinogenic PAHs. Individual carcinogenic PAHs are presented here for comparison.
SFo – Slope factor (oral); IUR – Inhalation Unit Risk; RfCi – Inhalation Reference Concentration; RfDo – Reference Dose (oral); NA – not available.
EPA no longer recommends using inhalation toxicity values that are derived from oral data (i.e., no longer using inhalation slope factor [SFi] or inhalation reference doses [RfDi]). Inhalation toxicity values are currently presented as IUR for cancer risks and RfCi for non-cancer risks.

No non-cancer toxicity value changes occurred for 2,4,6-TNT, 2,4-DNT, and PCBs. New cancer toxicity values are available for 2,4,6-TNT, 2,4-DNT and PAHs. Non-cancer toxicity values for 2,6-DNT became more stringent, meaning that it is more toxic for non-cancer effects. New cancer toxicity values (IUR) for PAHs are available. PAHs are currently under review, as part of EPA's Integrated Risk Information System (or IRIS) reassessment program.

To illustrate the potential impact of the changes in toxicity values, Table 12 compares risk-based remediation goals to the EPA Regional Screening Levels (RSLs), which are based on a 10^{-6} residential risk and are calculated using the most current toxicity levels.

Table 12. ROD Remedial Goals for Soil Compared to EPA RSLs

Contaminant	ROD Remediation Goal (mg/kg)	EPA Soil RSL[1] (mg/kg)		RSL<ROD level?
		Cancer	Protective Cancer Risk Range	
2,4,6-TNT	57	21	21 – 2,100	Yes
2,4-DNT	2.5	1.7	1.7 – 170	Yes
2,6-DNT	2.5	0.36	0.36 – 36	Yes
PAHs[2]	10	16	16 – 1,600	No
Benz(a)anthracene	NA	0.16	0.16 -16	NA
Benzo(b)fluoranthene	NA	0.16	0.16 – 16	NA
Benzo(k)fluoranthene	NA	1.6	1.6 – 160	NA
Benzo(a)pyrene	NA	0.016	0.016 – 1.6	NA
Chrysene	NA	16	16 - 1,600	NA
Dibenz(ah)anthracene	NA	0.016	0.016 – 1.6	NA
Indeno(1,2,3-cd)pyrene	NA	0.16	0.16 - 16	NA

1 – June 2015 RSL table used based on 10^{-6} risk.
2 – Risk was established in the ROD for total carcinogenic PAHs. Individual carcinogenic PAHs are presented here for comparison.

The 1996 ROD presents a remediation goal for total carcinogenic PAHs. Individual carcinogenic PAHs are presented for comparison. Current RSL for total carcinogenic PAHs are greater than the ROD remediation goal indicating that this level is still protective. The ROD remediation goals for TNT and the DNT isomers are less than the current RSLs. However, the ROD remediation goals are within the EPA acceptable risk range. Therefore, changes to toxicity do not affect the protectiveness of the remedy.

Changes in land use.
There have been no changes to land use since the last FYR. Area T13 is within a restricted area on the WSTA.

Changes in risk assessment methods.
In February 2014, the EPA provided supplemental guidance that updated the standard default exposure factors (OSWER Directive 9200.1-120). However, the changes in the recommended default exposure factors do not affect the risk estimates in a way that could affect the protectiveness of the remedy.

Expected progress towards meeting RAOs.
Soil remediation conducted in 2004 met the response action objectives described in Section 4.1.2 related to long-term exposure to soils and safety concerns from the pipeline and the proper disposal of debris. Clean soils were used to fill the excavation to the surface elevation, which currently prevents current and future exposure, through ingestion and dermal contact, to contaminated soil. Because the remaining soils are located at depths greater than 10 feet (typical utility depth), any remaining concentrations will not exposure any potential future residents. The Soil and Pipeline OU has met the requirements of UU/UE. Therefore, future FYRs are not required for OU1.

7.2.2. OU 2 Groundwater

Changes in standards, newly promulgated standards, to be considered standards.
Table 13 presents a comparison of the ROD remediation standards and current standards, if available. As noted in the table, remediation standards have not changed since the ROD. Changes in toxicity values which may impact risk-based remediation goals are discussed in further detail below.

Table 13. Comparison of Groundwater OU ROD to Current Standards

COC	ROD remediation standard (µg/L)	Current standard* (µg/L)	Changes
2,4-DNT	0.11	0.11	No change
1,3-DNB	1.0	1.0	No change
NB	17	17	No change
2,6-DNT	1.3	NA	ROD remediation standard is risk-based
2,4,6-TNT	2.8	NA	ROD remediation standard is risk-based
o-NT	37	NA	ROD remediation standard is risk-based
m-NT	37	NA	ROD remediation standard is risk-based
p-NT	37	NA	ROD remediation standard is risk-based

NA – not available, *Current standards are the Missouri Water Standards.

No action- or location-specific Applicable or Relevant and Appropriate Requirement were presented in the ROD.

Changes in exposure pathways.
The 1997 baseline risk assessment (BRA) evaluated risks for exposure of recreational visitors (current and future) through ingestion and wading in contaminated springs and for future residents through ingestion of contaminated groundwater from a drinking water well. The exposure pathways for recreational visitors and residents remain valid. New residential developments near the Site use water from municipal water systems.

The 1997 BRA included an ecological risk assessment whose conclusions indicated that there were no significant impacts as a result of contaminants in Burgemeister Spring (sampling point SP6301). Further, a biological survey of the area indicated the presence of apparently unaffected biota (invertebrates, fishes, and amphibians) at sample locations associated with lab results indicating toxicity. The risk assessment speculated that local populations had adapted to become tolerant of contaminants. The spring was determined to contain generally good aquatic habitat, and the species present are typical of those found in similar habitats throughout the Midwest. No critical habitats or endangered species are impacted by groundwater contamination. Ecological habitat has not changed since the ROD. Therefore, there is no impact to the protectiveness of the remedy.

Inhalation risks related to vapor intrusion have been a concern for many sites. Vapor intrusion was not evaluated in the BRA. Each COC was evaluated per the *OSWER Technical Guide for Assessing and Mitigating the Vapor Intrusion Pathway for Subsurface Vapor Sources to Indoor Air* (June 2015). This guide provides that a chemical generally is considered to be "volatile" if:

1. The vapor pressure is greater than 1 millimeter of mercury (mm Hg) or
2. Henry's law constant is greater than 10^{-5} atmosphere-meter cubed per mole (atm m^3/mol)

Table 14 below presents the vapor pressures and Henry's law constants for each groundwater COC.

Table 14. Groundwater OU Vapor Intrusion Evaluation

COCs	Vapor Pressure [1] (mm Hg)	Henry's Law Constant[1] (atm-m^3/mol)	Does COC Meet Volatile Definition? (Y or N)
2,4-DNT	1.5×10^{-4}	5.4×10^{-8}	N
1,3-DNB	9.0×10^{-4}	4.9×10^{-8}	N
NB	2.5×10^{-1}	2.4×10^{-5}	Y
2,6-DNT	5.7×10^{-4}	7.5×10^{-7}	N
2,4,6-TNT	8.0×10^{-6}	2.1×10^{-8}	N
o-NT	1.9×10^{-1}	1.3×10^{-5}	Y
m-NT	2.1×10^{-1}	9.3×10^{-6}	N
p-NT	1.6×10^{-2}	5.6×10^{-6}	N

1 - Vapor pressure and Henry's Law constant values are from EPA's Vapor Intrusion Screening Level Calculator.

NB and o-NT have Henry's Law constants that are greater than 10^{-5}. The remaining COCs do not meet the criteria above and therefore are not considered volatile. NB was not detected in any sample during the 2014 groundwater monitoring. Inhalation toxicity values for o-NT are not available, which are used to determine whether this compound is sufficiently volatile and toxic to pose inhalation risk via vapor intrusion from a groundwater source. The maximum groundwater concentration of o-NT from the 2014 monitoring was 0.59 µg/L, which is significantly less than the cleanup level and within the EPA acceptable risk range. Therefore, vapor intrusion has no affect on the protectiveness of the remedy. If inhalation toxicity values for o-NT are available in the future, then an evaluation to determine whether indoor air may be impacted should be performed.

Changes in toxicity and other contaminant characteristics.
Table 15 shows changes in toxicity values for OU2 COCs. Changes in toxicity occurred for most COCs except 2,4,6-TNT and 1,3-NB. Non-cancer toxicity values (RfDo) for o-NT, m-NT, and p-NT became more stringent. This means that these chemicals are more toxic related to non-cancer effects. Non-cancer toxicity values for 2,6-DNT and NB became less stringent, meaning that these chemicals were less toxic related to non-cancer effects. Cancer toxicity values (SFo) for 2,4-DNT became more stringent, meaning that this chemical is more toxic related to cancer effects. New cancer toxicity values for o-NT and p-NT became available.

Table 15. Groundwater OU Toxicity Changes

Contaminant	Toxicity values in ROD[1]	Current Toxicity Values[2]	Changes
2,4,6-TNT	SFo (1/mg/kg-d): $3x10^{-2}$ RfDo (mg/kg-d): 5×10^{-4}	SFO (1/mg/kg-d): $3x10^{-2}$ IUR (µg/m3): NA RfDo (mg/kg-d): $5x10^{-4}$ RfCi (mg/m3): NA	Cancer: no changes Non-cancer: no changes
2,4-DNT[3]	SFo (1/mg/kg-d): 0.68 RfDo (mg/kg-d):$2x10^{-3}$	SFo (1/mg/kg-d): 0.31 IUR (µg/m3): $8.9x10^{-5}$ RfDo (mg/kg-d): $2x10^{-3}$ RfCi (mg/m3): NA	Cancer: Less stringent for SFo; new IUR value Non-cancer: no changes
2,6-DNT[3]	SFo (1/mg/kg-d): 0.68 RfDo (mg/kg-d): $1x10^{-3}$	SFo (1/mg/kd-d): 1.5 RfDo (mg/kg-d): $3x10^{-4}$ RfCi (mg/m^3):1.5	Cancer: More stringent Non-cancer: Less stringent
1,3-DNB	RfDo (mg/kg-d):$5x10^{-5}$	RfDo (mg/kg-d): $1x10^{-4}$ RfCi (mg/m^3): NA	Cancer: no changes Non-cancer: no changes
NB	RfDo (mg/kg-d):$5x10^{-4}$	SFo: (1/mg/kd-d): NA IUR (µg/m3): $4x10^{-5}$ RfDo (mg/kg-d): $2x10^{-3}$ RfCi (mg/m^3):$9x10^{-3}$	Cancer: new values Non-cancer: Less stringent

Contaminant	Toxicity values in ROD[1]	Current Toxicity Values[2]	Changes
o-NT	SFo (1/mg/kg-d): NL RfDo (mg/kg-d): $1x10^{-2}$	SFO (1/mg/kg-d): $2.2x10^{-1}$ IUR ($\mu g/m^3$): NA RfDo (mg/kg-d): $9x10^{-4}$ RfCi (mg/m3): NA	Cancer: New value Non-cancer: more stringent
m-NT	SFo(1/mg/kg-d): NL RfDo (mg/kg-d):$2x10^{-2}$	SFo (1/mg/kg-d): NA RfDo (mg/kg-d): $1x10^{-4}$ RfCi (mg/m^3):NA	Cancer: N/A Non-cancer: more stringent
p-NT	SFo (1/mg/kg-d): NL RfDo (mg/kg-d): 1 x 10^{-2}	SFO (1/mg/kg-d): $1.6x10^{-2}$ IUR ($\mu g/m^3$): NA RfDo (mg/kg-d): $4x10^{-3}$ RfCi (mg/m^3): NA	Cancer: New value Non-cancer: more stringent

1 – Toxicity values are from the 1992/1993 BRA

2 – The most current toxicity values presented in the June 2015 EPA RSL table were used.

3 – The 1992/1993 BRA used toxicity values for the 2,4- and 2,6-DNT mixture.

SFo – Slope factor (oral); IUR – Inhalation Unit Risk; RfCi – Inhalation Reference Concentration; RfDo – Reference Dose (oral); NA – not available.

EPA no longer recommends using inhalation toxicity values that are derived from oral data (i.e., no longer using inhalation slope factor [SFi] or inhalation reference doses [RfDi]). Inhalation toxicity values are currently presented as IUR for cancer risks and RfCi for non-cancer risks.

To illustrate the impact of toxicity value changes, Table 16 compares the ROD remediation goals and the current residential tap water risk-based concentrations, which use the most current toxicity values, as presented in the June 2015 EPA RSL table. Any concentration below the cancer RSL indicates that no cancer risk is expected, while concentrations significantly above the cancer RSL may indicate an increase in cancer risk. Any concentration below the non-cancer RSL indicates that no adverse health effect from exposure is expected, while concentrations significantly above the non-cancer RSL may indicate an increased potential for non-cancer effects. The ROD remedial goals are greater than cancer RSLs for 2,4,6-TNT, 2,6-DNT, NB, o-NT, and p-NT. However, ROD remedial goals for these COCs are within the EPA acceptable risk range, except for NB and o-NT. ROD remedial goals are greater than non-cancer RSLs for NB, o-NT, and m-NT. The remediation goal NB is based on the current Missouri Water Standards, which is health-based and not risk-based. NB was not detected in the 2014 groundwater monitoring event. The maximum groundwater concentration of o-NT from the 2014 groundwater monitoring event was 0.55 µg/L, which is significantly less than the ROD remedial goal but still within the EPA acceptable risk range. The maximum groundwater concentration for m-NT from the 2014 groundwater monitoring even was 0.18 µg/L, which is less than the ROD remedial goal and EPA RSL. There are currently no unacceptable exposures to contaminated groundwater and future exposures are not anticipated. Therefore, changes in toxicity do not affect protectiveness of the remedy.

Table 16. ROD Remediation Goals for Groundwater Compared to EPA RSLs

Contaminant	ROD Rem. Goal (µg/L)	Current EPA Tapwater RSL[1] (µg/L)		
		Cancer	Protective Risk Range	Non-cancer
2,4,6-TNT	2.8	**2.5**	2.5 – 250	9.8
2,4-DNT	0.11	0.24	0.24 – 24	38
2,6-DNT	1.3	**0.048**	0.048 - 48	57
1,3-DNB	1.0	-	-	2
NB	17	**0.14**	0.14 – 14	**13**
o-NT	37	**0.31**	0.31 – 31	**16**
m-NT	37	-	-	**1.7**
p-NT	37	**4.2**	4.2 - 420	71

1 – June 2015 EPA RSLs were used
Bold indicates where RSLs are less than ROD Remediation Goals

Changes in land use.
Site land use has not changed since the last FYR. The population of the surrounding communities has increased in the last five years. However, this does not affect the protectiveness of the remedy because new housing developments are required to connect to municipal water sources and there are special use requirements within the Site per Missouri Well Construction Code (10-CSR-23-3-100) that restrict groundwater use in the designated "special areas" within the WSOW. Also, the DA has additional groundwater use restrictions on the WSTA.

Changes in risk assessment methods.
In February 2014, the EPA provided supplemental guidance that updated the standard default exposure factors (OSWER Directive 9200.1-120). However, the changes in the recommended default exposure factors do not affect the risk estimates in a way that could affect the protectiveness of the remedy.

Expected progress towards meeting RAOs.
As part of the remedy, groundwater and springs are monitored annually. For the WSTA, ICs are in place to prevent exposure to contaminated groundwater. ICs for state-owned property are not fully implemented.

7.3. Question C: Has Any Other Information Come to Light That Could Call Into Question The Protectiveness of the Remedy?

No other information has come to light calling into question the protectiveness of the remedy.

7.4. Technical Assessment Summary

The remedial action removed contaminated soils above ROD remedial goals except at Area T13. The remaining soils at Area T13 are at depths where current or future receptors are not exposed to these soils. The remedial action also removed a large mass of contamination, thus reducing contaminants that may migrate to groundwater. In addition, signs are present at Area T13 notifying readers that soil contamination is present above remedial goals and to consult with Army Reserve Environmental staff prior to digging or disturbing ground cover. The location of this area is included on the GIS overlay maintained by the 88th RCS and the installation FDP.

The EPA Superfund Site Lead Policy was superseded by the Revised Interim Soil Lead Guidance for CERCAL sites and RCRA Corrective Action Facilities, which decreased the residential soil screening level to 400 ppm. Exposure pathways identified in the BRA are still valid. Inhalation risks related to vapor intrusion was not evaluated in the BRA. The evaluation conducted for this FYR concluded that the PCBs and a carcinogenic PAH, benz(a)anthracene meet the definition of volatile. However, these contaminants were excavated during the remedial action performed between 1998 and 2004 and no longer remain on site. Toxicity values changed for several COCs. In comparing the ROD remedial goals with current EPA RSLs (which represent risk concentrations at 10^{-6} risk using the most current toxicity values), the remediation goals are within the EPA acceptable risk range. Therefore, toxicity changes do not affect the protectiveness of the remedy. The remedy at OU1 (Soil and Pipeline OU) has met UU/UE conditions. Therefore, future FYRs are not required for this operable unit.

In general, MNA is occurring in the Groundwater OU. Recent trend analysis shows three exceptions. Locations with two or more detections with increasing trends; Spring SP5602 for m-NT and p-NT,

Spring SP6502 for 2,4,6-TNT, and Well USGS4 for m-NT. However, the 2014 sampling results show no exceedances above the clean up levels for these locations and COCs. Analytical results and statistical analysis indicate that: contaminants are attenuating at a rate sufficient to meet cleanup goals in a reasonable time; contaminant migration remains confined to the currently impacted groundwater system; and contaminant levels at potential exposure points (springs) are declining over time.

There were no changes to promulgated standards, upon which the ROD remediation goals were based. Toxicity values changed for several COCs. In comparing the ROD remedial goals with current EPA RSLs (which represent risk concentrations at 10^{-6} for cancer risk using the most current toxicity values), the remediation goals are within the EPA acceptable risk range. In addition, 2014 concentrations of COCs were much lower than EPA RSLs. Therefore, toxicity changes do not affect the protectiveness of the remedy. In addition, ICs have been implemented for the WSTA per the ROD to prevent exposures to contaminated groundwater. However, ICs for state-owned property have not been fully implemented.

No other information has come to light, which calls into question the protectiveness of the remedy.

8. Issues

8.1. OU1 Soil and Pipeline

There are no issues that affect the protectiveness of the remedy.

8.2. OU2 Groundater

Table 17. OU2 Issues

Issues	Affects Current Protectiveness (Y/N)	Affects Future Protectiveness (Y/N)
1. Intuitional controls have not been completed on state-owned property as required in the Phase II RD/RA Work Plan.	N	Y

9. Recommendations and Follow-up Actions

9.1. OU1 Soil and Pipeline

No recommendations and follow-up actions were required since no issues were identified for the Site during this five-year review that affects the current and/or future protectiveness of the remedy.

9.2. OU2 Groundwater

Table 18. OU2 Recommendations

Issue	Recommendations and Followup Actions	Party Responsible	Oversight Agency	Milestone Date	Affects Protectiveness (Y/N)	
					Current	Future
1	Complete institutional controls on state-owned property.	State of Missouri	EPA	September 2016	N	Y

The following recommendations, which could improve some technical aspects of the project, but do not affect protectiveness were identified during this FYR.

- The groundwater LTMP should be finalized.
- Ensure all monitoring wells are secured after each monitoring event.
- The groundwater flow direction around Area T13 is currently unknown. Additional evaluation of this area may be required.
- Recommend proper closure of Well USG2A, by USGS, after determining whether it is still needed in the monitoring program.
- Recommend that MWS110, MWS108, and SP5603 be sampled every two years per criteria in the RD/RA Work Plan Addendum Number 1.
- Recommend that future trend analysis for groundwater only use data beginning from 2004 to present.
- Ensure all inspections including those for ICs are documented in a report.

10. Protectiveness Statements

10.1. OU 1 Soil and Pipeline

The remedy at OU1 Soil and Pipeline is protective of human health and the environment. Exposure to contaminated soils has been eliminated through the excavation of these soils. UU/UE conditions have been met for this OU and FYRs are no longer required.

10.2. OU 2 Groundwater

The remedy at OU2 Groundwater is currently protective of human health and the environment because ICs are in place for WSTA to prevent exposure to contaminated groundwater. However, in order for the remedy to be protective in the long-term, ICs for state-owned property need to be in place.

10.3. Site-Wide

The remedies at the Site are currently protective of human health and the environment. Remedial actions occurred to eliminate ingestion and dermal exposure of contaminated soils for the Soil and Pipeline OU (OU1). ICs are in place for the WSTA preventing exposure to contaminated groundwater. However, ICs on state-owned property need to be in place for the remedy for the Groundwater OU

(OU2) to be protective in the long-term. The Soil and Pipeline OU (OU1) has met RAOs and UU/UE conditions; therefore FYRs are no longer required.

11. Next Review

This is a statutory Site that requires ongoing FYRs because contaminants remain on site above levels that allow for unlimited use and unrestricted exposure. The next FYR for the Groundwater OU will be due within five years of the signature date of this FYR. The Soil and Pipeline OU has achieved RAOs and met UU/UE requirements; therefore, no future FYRs are required.

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Appendix A: List of Documents Reviewed

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List of Documents Reviewed

88th Regional Support Command (88th RSC), 2006, Final Remedial Design/Remedial Action Work Plan for the Final Remedial Action for the Groundwater Operable Unit, Phase II –Institutional Controls, Former Weldon Spring Ordnance Works, Weldon Spring, Missouri. January 31, 2006.

88th RSC, 2014, Future Development Plan, Weldon Spring Local Training Area, Weldon Spring, Missouri. November 2014.

Department of the Army (DA), 2015, Draft Final Groundwater Long-Term Management Plan, Former Weldon Spring Ordnance Works, Weldon Spring, Missouri. March 2015

DA, 2014, Draft Final Land Use Control Implementation Plan Former Weldon Spring Ordnance Works, Weldon Spring, Missouri. July 2014

DA, 2011, Remedial Design/Remedial Action Work Plan Addendum Number 1, Former Weldon Spring Ordnance Works, Weldon Spring Missouri. March 2011.

DA, 1990, Aquifer Characteristics Data Report For The Weldon Spring Site Chemical Plant/Raffinate Pits and Vicinity Properties, Weldon Spring, Missouri. November 1990.

ECC and Burns & McDonnell Engineering Company, Inc (ECC and Burns, 2014), Performance Monitoring Report 007, Round RA-10 (April 2013), Operable Unit 2 – Groundwater, Former Weldon Spring Ordnance Works, Weldon Spring, Missouri. August 2014.

ECC and Burns, 2013, Performance Monitoring Report 006, Round RA-09 (May 2012), Operable Unit 2 – Groundwater, Former Weldon Spring Ordnance Works, Weldon Spring, Missouri. August 2013.

ECC and Burns, 2012, Performance Monitoring Report 005, Round RA-08 (May 2011), Operable Unit 2 – Groundwater, Former Weldon Spring Ordnance Works, Weldon Spring, Missouri. March 2012.

ECC and Burns, 2011, Performance Monitoring Report 004, Round RA-07 (May 2010), Operable Unit 2 – Groundwater, Former Weldon Spring Ordnance Works, Weldon Spring, Missouri. March 2011.

ECC and Burns, 2010a, Final Performance Monitoring Report 003, Round RA-06 (April 2009), Operable Unit 2 – Groundwater, Former Weldon Spring Ordnance Works, Weldon Spring, Missouri. November 2, 2010

ECC and Burns, 2010b, Final Five-Year Review Report, Operable Unit 1 – Soil, Operable Unit 2 – Groundwater, Former Weldon Spring Ordnance Works, Weldon Spring, Missouri. September 29, 2010.

Environmental Protection Agency (EPA), 2005, Preliminary Close-Out Report, Former Weldon Spring Ordnance Plant, St. Charles County, Missouri. August 24, 2005.

HydroGeoLogic, Inc., 2015, Final Performance Monitoring Report 008, Round RA-11 (April 2014), The Former Weldon Spring Ordnance Works, Weldon Spring, Missouri. January 2015.

Missouri Department of Natural Resources (MDNR), 1991, Shallow Groundwater Investigations at the Weldon Spring Training Area, St. Charles County, Missouri. October 1991

MDNR, 1991, Shallow Groundwater Investigations at the Weldon Spring, Missouri, Final Report for Fiscal Years 1988-1990. June 1991.

Pangea, Inc (Pangea, 2004), Former Weldon Spring Ordnance Works Operable Unit 1, Final Remedial Action Report, Weldon Spring, Missouri. September 2004.

USACE, 2004a, Explanation of Significant Differences, Former Weldon Spring Ordnance Works, Weldon Spring, Missouri, Operable Unit 1: Soils and Pipeline. July 2004.

USACE, 2004b, Final Record of Decision for the Final Remedial Action for Operable Unit 2 Groundwater at the Former Weldon Spring Ordnance Works Site, Weldon Spring, Missouri. September 2004.

USACE, 1996, Record of Decision, Former Weldon Spring Ordnance Works, Weldon Spring, Missouri, Operable Unit 1: Soils and Pipeline. September 1996.

U.S. Department of Energy (DOE), 1997, Remedial Investigation for the Groundwater Operable Units at the Chemical Plant Area and the Ordnance Works Area, Weldon Spring, Missouri. July 1997

DOE, 1998, Sampling Plan For Tracer Testing In Support Of The Groundwater Operable Unit. March 1998.

USGS, Hydrologic and Water –Quality Data for the Weldon Spring Ordnance Works, St. Charles County, Missouri -1992-95. Rolla, Missouri. 1996

USGS, 1996, Geohydrology of Weldon Spring Ordnance Works, St. Charles County, Missouri. 1996.

Appendix B: Press Notice

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Press Notice

U.S. Army Corps of Engineers Third Five-Year Review Report for Weldon Spring Former Army Ordnance Works in St. Charles County, Missouri

The U.S. Army Corps of Engineers is conducting the third five-year review of the remedial actions implemented at the Weldon Spring Former Army Ordnance Works located in St. Charles County, Missouri. The purpose of the five-year review is to determine whether the remedy is protective of human health and the environment. In addition, the five-year review report will identify issues, if any, found during the review and make recommendations to address them.

The Former Weldon Spring Ordnance Works is separated into two operable units: Operable Unit 1 (OU1), soil and pipeline; and Operable Unit 2 (OU2), groundwater. The remedy for OU1 included excavation and thermal destruction of nitro aromatic-contaminated soils and wooden pipeline, and also provided for the excavation and stabilization of the lead-contaminated soils that did not meet lead Toxicity Characteristic Leaching Procedure requirements. The remedy for OU2 included monitored natural attenuation and institutional controls.

The Army is preparing this five-year review as required by the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), commonly known as Superfund, and the National Contingency Plan. The report will document the methods used for the review, and the findings and conclusions based on a records review and a site inspection conducted from April 28, 2014 to its signing, anticipated in September 2015.

The document will be available no later than September 2015 at the information repository located at:

St. Charles City/
County Library
Middendorf-Kredell
Branch
2750 Highway K
O'Fallon, Missouri
63368-7859)

For more information or to provide input regarding the Weldon Spring Former Army Ordnance Works, please contact: Miriam Gilmer at 206-764-6669, or via email at: Miriam.g.gilmer@usace.army.mil

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Appendix C: Site Inspection Checklist and Trip Report

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Site Inspection Checklist and Trip Report

Five-Year Review Site Inspection Checklist

I. SITE INFORMATION

Site name: Former Weldon Spring Ordnance Works	**Date of inspection:** January 22-23, 2015
Location: St. Charles County, Missouri	**EPA ID:** MO5210021288
Agency, office, or company leading the five-year review: Army	**Weather/temperature** 22 Jan; cloudy and high of 37 F 23 Jan: sunny and high of 40 F

Remedy Includes: (Check all that apply)

- ☐ Landfill cover/containment
- ■ Access controls
- ■ Institutional controls
- ☐ Groundwater pump and treatment
- ☐ Surface water collection and treatment
- ☐ Other: *e.g. Groundwater monitoring*
- ■ Monitored natural attenuation
- ☐ Groundwater containment
- ☐ Vertical barrier walls

Attachments: ■ Inspection-team roster attached ☐ Site map attached

II. INTERVIEWS (Check all that apply)

1. **O&M site manager** _____ _____ _____
   Name Title Date
   Interviewed ☐ at site ☐ at office ☐ by phone Phone no. _____
   Problems, suggestions; ☐ Report attached _____

2. **O&M staff** _____ _____ _____
   Name Title Date
   Interviewed ☐ at site ☐ at office ☐ by phone Phone no. _____
   Problems, suggestions; ☐ Report attached _____

3. **Local regulatory authorities and response agencies** (i.e., State and Tribal offices, emergency response office, police department, office of public health or environmental health, zoning office, recorder of deeds, or other city and county offices, etc.) Fill in all that apply.

Agency _____
Contact _____ _____ _____ _____
Name Title Date Phone no.
Problems; suggestions; ☐ Report attached _____

Agency _____
Contact _____ _____ _____ _____
Name Title Date Phone no.
Problems; suggestions; ☐ Report attached _____

Agency _____
Contact _____ _____ _____ _____
Name Title Date Phone no.
Problems; suggestions; ☐ Report attached _____

Agency _____
Contact _____ _____ _____ _____
Name Title Date Phone no.
Problems; suggestions; ☐ Report attached _____

4. **Other interviews** (optional) ☐ Report attached.

Interview records conducted with be included in the five-year review report.

III. ON-SITE DOCUMENTS & RECORDS VERIFIED (Check all that apply)

1. **O&M Documents**

☐ O&M manual	■ Readily available	☐ Up to date	☐ N/A
☐ As-built drawings	☐ Readily available	☐ Up to date	■ N/A
☐ Maintenance logs	☐ Readily available	☐ Up to date	■ N/A

Remarks

2. **Site-Specific Health and Safety Plan** ■ Readily available ☐ Up to date ☐ N/A
☐ Contingency plan/emergency response plan ■ Readily available ☐ Up to date ☐ N/A
Remarks

3.	**O&M and OSHA Training Records** Remarks	■ Readily available	☐ Up to date	☐ N/A
4.	**Permits and Service Agreements**			
	☐ Air discharge permit	☐ Readily available	☐ Up to date	■ N/A
	☐ Effluent discharge	☐ Readily available	☐ Up to date	☐ N/A
	☐ Waste disposal, POTW	☐ Readily available	☐ Up to date	■ N/A
	☐ Other permits_____	☐ Readily available	☐ Up to date	■ N/A
	Remarks			
5.	**Gas Generation Records** Remarks	☐ Readily available	☐ Up to date	■ N/A
6.	**Settlement Monument Records** Remarks	☐ Readily available	☐ Up to date	■ N/A
7.	**Groundwater Monitoring Records**	■ Readily available	☐ Up to date	☐ N/A
	Remarks Annual groundwater monitoring reports are not available on-site but are available upon request.			
8.	**Leachate Extraction Records** Remarks	☐ Readily available	☐ Up to date	■ N/A
9.	**Discharge Compliance Records**			
	☐ Air	☐ Readily available	☐ Up to date	■ N/A
	☐ Water (effluent)	☐ Readily available	☐ Up to date	■ N/A
	Remarks			
10.	**Daily Access/Security Logs** Remarks	☐ Readily available	☐ Up to date	■ N/A

IV. O&M COSTS

1. **O&M Organization**

☐ State in-house ☐ Contractor for State
☐ PRP in-house ☐ Contractor for PRP
■ Federal Facility in-house ☐ Contractor for Federal Facility
☐ Other

2. **O&M Cost Records**

■ Readily available ☐ Up to date ☐ Funding mechanism/agreement in place
Original O&M cost estimate_____ ☐ Breakdown attached

Total annual cost by year for review period if available

From_____ To_____ _____ ☐ Breakdown attached
Date Date Total cost

From_____ To_____ _____ ☐ Breakdown attached
Date Date Total cost

From_____ To_____ _____ ☐ Breakdown attached
Date Date Total cost

From_____ To_____ _____ ☐ Breakdown attached
Date Date Total cost

From_____ To_____ _____ ☐ Breakdown attached
Date Date Total cost

3. **Unanticipated or Unusually High O&M Costs During Review Period**

Describe costs and reasons:

None noted.

V. ACCESS AND INSTITUTIONAL CONTROLS ☐ Applicable ☐ N/A

A. Fencing

1. **Fencing damaged** ☐ Location shown on site map ☐ Gates secured ☐ N/A

Remarks Fences are located surrounding the Weldon Spring Training Area (WSTA). However, remaining soil contamination is located at 16-22 ft depth. Groundwater is not accessible to anyone. The gate to the T13 area is locked with access restricted. The gate to the main cantonment area of the training facility is open during business hours. The Busch and Weldon Spring Conservation areas are open to the public.

B. Other Access Restrictions

1. **Signs and other security measures** ☐ Location shown on site map ■ N/A

Remarks There are no signs identifying that there is groundwater contamination beneath the WSTA. There are signs present at T13 identifying soil contamination at a specific depth.

C. Institutional Controls (ICs)

1. **Implementation and enforcement**

Site conditions imply ICs not properly implemented ☐ Yes ■ No ☐ N/A

Site conditions imply ICs not being fully enforced ☐ Yes ■ No ☐ N/A

Type of monitoring (*e.g.*, self-reporting, drive by) _____

Frequency _____

Responsible party/agency _____

Contact _____ _____ _____ _____

Name Title Date Phone no.

Reporting is up-to-date ☐ Yes ■ No ☐ N/A

Reports are verified by the lead agency ☐ Yes ■ No ☐ N/A

Specific requirements in deed or decision documents have been met ☐ Yes ■ No ☐ N/A

Violations have been reported ☐ Yes ■ No ☐ N/A

Other problems or suggestions: ☐ Report attached

Institutional control requirements are described in the 2006 Phase II RD/RA work plan. Not all institutional control mechanisms have been finalized. The Future Development Plan (equivalent to a Master Plan) has been completed, which references remaining soil and groundwater contamination. A Long-Term Management Plan that references the Future Development Plan is currently in draft. A public notice to restrict groundwater use in the Former Ordnance Works has not been published. The deed restriction of groundwater use has not been filed. An informational pamphlet has been developed and distributed to the appropriate agencies.

2. **Adequacy** ☐ ICs are adequate ☐ ICs are inadequate ☐ N/A

Remarks Once ICs are in place, they will be adequate.

D. General

1. **Vandalism/trespassing** ☐ Location shown on site map ■ No vandalism evident

Remarks

2. **Land use changes on site** ☐ N/A

Remarks No changes in land use from the previous five-year review.

3. **Land use changes off site** ☐ N/A

Remarks No changes in land use off-site since the previous five-year review.

VI. GENERAL SITE CONDITIONS

A. Roads ■ Applicable ☐ N/A

1. **Roads damaged** ☐ Location shown on site map ■ Roads adequate ☐ N/A

Remarks Roads to area T13 appear to be in good condition. An unpaved road leads to the area, but it is walkable. Roads within the conservation areas were in good condition.

B. Other Site Conditions

Remarks

VII. LANDFILL COVERS ☐ Applicable ■ N/A

A. Landfill Surface

1. **Settlement** (Low spots) ☐ Location shown on site map ☐ Settlement not evident
   Areal extent_____ Depth_____
   Remarks

2. **Cracks** ☐ Location shown on site map ☐ Cracking not evident
   Lengths_____ Widths_____ Depths_____
   Remarks

3. **Erosion** ☐ Location shown on site map ☐ Erosion not evident
   Areal extent_____ Depth_____
   Remarks

4. **Holes** ☐ Location shown on site map ☐ Holes not evident
   Areal extent_____ Depth_____
   Remarks

5. **Vegetative Cover** ☐ Grass ☐ Cover properly established
   ☐ No signs of stress ☐ Trees/Shrubs (indicate size and locations on a diagram)
   Remarks

6. **Alternative Cover (armored rock, concrete, etc.)** ☐ N/A
   Remarks

7. **Bulges** ☐ Location shown on site map ☐ Bulges not evident
   Areal extent_____ Height_____
   Remarks

8. **Wet Areas/Water Damage** ☐ Wet areas/water damage not evident
☐ Wet areas ☐ Location shown on site map Areal extent_____
☐ Ponding ☐ Location shown on site map Areal extent_____
☐ Seeps ☐ Location shown on site map Areal extent_____
☐ Soft subgrade ☐ Location shown on site map Areal extent_____
Remarks

9. **Slope Instability** ☐ Slides ☐ Location shown on site map ☐ No evidence of slope instability
Areal extent_____
Remarks

B. Benches ☐ N/A ☐ Applicable

(Horizontally constructed mounds of earth placed across a steep landfill side slope to interrupt the slope in order to slow down the velocity of surface runoff and intercept and convey the runoff to a lined channel.)

1. **Flows Bypass Bench** ☐ Location shown on site map ☐ N/A or okay
Remarks

2. **Bench Breached** ☐ Location shown on site map ☐ N/A or okay
Remarks

3. **Bench Overtopped** ☐ Location shown on site map ☐ N/A or okay
Remarks

C. Letdown Channels ☐ Applicable ☐ N/A

(Channel lined with erosion control mats, riprap, grout bags, or gabions that descend down the steep side slope of the cover and will allow the runoff water collected by the benches to move off of the landfill cover without creating erosion gullies.)

1. **Settlement** ☐ Location shown on site map ☐ No evidence of settlement
Areal extent_____ Depth_____
Remarks

2. **Material Degradation** ☐ Location shown on site map ☐ No evidence of degradation
Material type_____ Areal extent_____
Remarks

3. **Erosion** ☐ Location shown on site map ☐ No evidence of erosion
Areal extent_____ Depth_____
Remarks

4. **Undercutting** ☐ Location shown on site map ☐ No evidence of undercutting
Areal extent_____ Depth_____
Remarks

5. **Obstructions** Type_____ ☐ No obstructions ☐ Location shown on site map
Areal extent_____ Size_____
Remarks

6. **Excessive Vegetative Growth** Type_____
☐ No evidence of excessive growth
☐ Vegetation in channels does not obstruct flow
☐ Location shown on site map Areal extent_____
Remarks

D. Cover Penetrations ☐ Applicable ■ N/A

1. **Gas Vents** ☐ N/A ☐ Active ☐ Passive ☐ Properly secured/locked ☐ Functioning
☐ Routinely sampled ☐ Good condition ☐ Evidence of leakage at penetration
Remarks

2. **Gas Monitoring Probes**
☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition
☐ Evidence of leakage at penetration ☐ Needs Maintenance ☐ N/A
Remarks

3. **Monitoring Wells** (within surface area of landfill)
☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition
☐ Evidence of leakage at penetration ☐ Needs Maintenance ☐ N/A
Remarks

4. **Leachate Extraction Wells**
☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition
☐ Evidence of leakage at penetration ☐ Needs Maintenance ☐ N/A
Remarks

5. **Settlement Monuments** ☐ Located ☐ Routinely surveyed ☐ N/A
Remarks

E. Gas Collection and Treatment ☐ Applicable ■ N/A

1. **Gas Treatment Facilities**
   ☐ Flaring ☐ Thermal destruction ☐ Collection for reuse
   ☐ Good condition ☐ Needs Maintenance
   Remarks

2. **Gas Collection Wells, Manifolds and Piping**
   ☐ Good condition ☐ Needs Maintenance
   Remarks

3. **Gas Monitoring Facilities** (*e.g.*, gas monitoring of adjacent homes or buildings)
   ☐ Good condition ☐ Needs Maintenance ☐ N/A
   Remarks

F. Cover Drainage Layer ☐ Applicable ■ N/A

1. **Outlet Pipes Inspected** ☐ Functioning ☐ N/A
   Remarks

2. **Outlet Rock Inspected** ☐ Functioning ☐ N/A
   Remarks

G. Detention/Sedimentation Ponds ☐ Applicable ■ N/A

1. **Siltation** ☐ N/A ☐ Siltation not evident
   Areal extent_____ Depth_____
   Remarks

2. **Erosion** Areal extent_____ Depth_____ ☐ Erosion not evident
   Remarks

3. **Outlet Works** ☐ Functioning ☐ N/A
   Remarks

4. **Dam** ☐ Functioning ☐ N/A
   Remarks

H. Retaining Walls ☐ Applicable ☒ N/A

1. **Deformations** ☐ Location shown on site map ☐ Deformation not evident
   Horizontal displacement_____ Vertical displacement_____
   Rotational displacement_____
   Remarks

2. **Degradation** ☐ Location shown on site map ☐ Degradation not evident
   Remarks

I. Perimeter Ditches/Off-Site Discharge ☐ Applicable ☒ N/A

1. **Siltation** ☐ Location shown on site map ☐ Siltation not evident
   Areal extent_____ Depth_____
   Remarks

2. **Vegetative Growth** ☐ Location shown on site map ☐ N/A
   ☐ Vegetation does not impede flow
   Areal extent_____ Type_____
   Remarks

3. **Erosion** ☐ Location shown on site map ☐ Erosion not evident
   Areal extent_____ Depth_____
   Remarks

4. **Discharge Structure** ☐ Functioning ☐ N/A
   Remarks

VIII. VERTICAL BARRIER WALLS ☐ Applicable ☒ N/A

1. **Settlement** ☐ Location shown on site map ☐ Settlement not evident
   Areal extent_____ Depth_____
   Remarks

2. **Performance Monitoring** Type of monitoring_____
   ☐ Performance not monitored ☐ Evidence of breaching
   Frequency_____ Head differential_____
   Remarks

IX. GROUNDWATER/SURFACE WATER REMEDIES ☐ Applicable ☒ N/A

A. Groundwater Extraction Wells, Pumps, and Pipelines ☐ Applicable ☒ N/A

1. **Pumps, Wellhead Plumbing, and Electrical**
   ☐ Good condition ☐ All required wells properly operating ☐ Needs Maintenance ☐ N/A
   Remarks

2. **Extraction System Pipelines, Valves, Valve Boxes, and Other Appurtenances**
☐ Good condition ☐ Needs Maintenance
Remarks

3. **Spare Parts and Equipment**
☐ Readily available ☐ Good condition ☒ Requires upgrade ☐ Needs to be provided
Remarks

B. Surface Water Collection Structures, Pumps, and Pipelines ☐ Applicable ☒ N/A

1. **Collection Structures, Pumps, and Electrical**
☐ Good condition ☐ Needs Maintenance
Remarks

2. **Surface Water Collection System Pipelines, Valves, Valve Boxes, and Other Appurtenances**
☒ Good condition ☐ Needs Maintenance
Remarks

3. **Spare Parts and Equipment**
☐ Readily available ☐ Good condition ☒ Requires upgrade ☐ Needs to be provided
Remarks

C. Treatment System ☐ Applicable ☒ N/A

1. **Treatment Train** (Check components that apply)
☐ Metals removal ☐ Oil/water separation ☐ Bioremediation
☐ Air stripping ☐ Carbon adsorbers
☐ Filters_____
☐ Additive (*e.g.*, chelation agent, flocculent)_____
☐ Others_____
☐ Good condition ☐ Needs Maintenance
☐ Sampling ports properly marked and functional
☐ Sampling/maintenance log displayed and up to date
☐ Equipment properly identified
☐ Quantity of groundwater treated annually_____
☐ Quantity of surface water treated annually_____
Remarks

2. **Electrical Enclosures and Panels** (properly rated and functional)
☐ N/A ☐ Good condition ☐ Needs Maintenance
Remarks

3. **Tanks, Vaults, Storage Vessels**
☐ N/A ☐ Good condition ☐ Proper secondary containment ☐ Needs Maintenance
Remarks

4. **Discharge Structure and Appurtenances**
☐ N/A ☐ Good condition ☐ Needs Maintenance
Remarks

5. **Treatment Building(s)**
☐ N/A ☐ Good condition (esp. roof and doorways) ☐ Needs repair
☐ Chemicals and equipment properly stored
Remarks

6. **Monitoring Wells** (pump and treatment remedy)
☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition
☐ All required wells located ☐ Needs Maintenance ☐ N/A
Remarks

D. Monitoring Data

1. Monitoring Data
■ Is routinely submitted on time ■ Is of acceptable quality

2. Monitoring data suggests:
☐ Groundwater plume is effectively contained ☐ Contaminant concentrations are declining

D. Monitored Natural Attenuation

1. **Monitoring Wells** (natural attenuation remedy)
☐ Properly secured/locked ☐ Functioning ■ Routinely sampled ■ Good condition
☐ All required wells located ☐ Needs Maintenance ☐ N/A
Remarks A few wells were located within the Busch Conservation Area. One well, MWS110, was observed to be unlocked. However, this well does not appear to have been tampered with. FYR team member locked up well upon departure. All other wells visited were locked.

X. OTHER REMEDIES

If there are remedies applied at the site which are not covered above, attach an inspection sheet describing the physical nature and condition of any facility associated with the remedy. An example would be soil vapor extraction.

XI. OVERALL OBSERVATIONS

A. Implementation of the Remedy

Describe issues and observations relating to whether the remedy is effective and functioning as designed. Begin with a brief statement of what the remedy is to accomplish (i.e., to contain contaminant plume, minimize infiltration and gas emission, etc.).

The OU1 remedy includes the excavation of all contaminated soils. The OU1 ROD states that the purpose of the remedial action is to prevent current or future exposure to the contaminated soils and to reduced contaminant migration into groundwater. Currently area T13 has remaining contaminated soils from depths of 16 to 22 ft. Dermal, ingestion, and inhalation exposure to contaminated soils left at depth is currently being mitigated. However, it is unclear whether contaminated soils at depth are a continuing source to groundwater contamination. The OU2 remedy is MNA. Groundwater monitoring occurs annually. Institutional controls as required in the OU2 ROD are to be addressed during the remedial design. The RD/RA Work Plan Phase II provides an overview of land use controls within the WSTA and areas of the WSOW outside of the WSTA. For the WSTA, an environmental overlay that shows the land use controls, which will be used to manage and approve facility construction projects. The environmental overlay will be provided to appropriate installation offices responsible for installation management and training. In addition, the environmental overlay will be incorporated into the WSTA Master Plan (or similar document.) For areas outside the WSTA, groundwater well restrictions exist in the form of state well construction code. Also, deed restrictive covenants are another land use control. According to AEC, a deed restriction has been drafted and is being reviewed by the state. Once approved it will be recorded with the county. Both areas require the development of information pamphlets or notices related to contamination issues on recreational areas. The Army has provided these pamplets to the appropriate agencies for distribution.

B. Adequacy of O&M

Describe issues and observations related to the implementation and scope of O&M procedures. In particular, discuss their relationship to the current and long-term protectiveness of the remedy.

Groundwater and spring monitoring occurs annually. This appears to be adequate in determining groundwater concentrations for MNA at OU2.

C. Early Indicators of Potential Remedy Problems

Describe issues and observations such as unexpected changes in the cost or scope of O&M or a high frequency of unscheduled repairs, that suggest that the protectiveness of the remedy may be compromised in the future.

Other than the ICs not being in-place at the time, there are no early indicators of potential remedy problems.

D. Opportunities for Optimization

Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy.

The groundwater monitoring was recently optimized. No other opportunities for monitoring or operation of the remedy were noted.

Trip Report
Weldon Spring Former Ordnance Works, St. Charles County, Missouri

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1. INTRODUCTION

a. Date of Visit: January 22 - 23, 2015

b. Location: Former Weldon Spring Ordnance Works, St. Charles County, Missouri

c. Purpose: A site visit was conducted to visually inspect and document the conditions of the remedy, the site, and the surrounding area for inclusion into the Five-Year Review Report.

d. Participants:

Marlowe Laubach	USACE, Seattle/Chemical Engineer	206-764-4480
Lisa Scott	USACE, Seattle/Geologist	206-764-6562
Hoai Tran	EPA Region 7/Remedial Program Manager	913-551-7330
Tony Bridges	88th RSC	618-451-5063
Melanie Tescher	88th RSC/Environmental Protection Specialist	608-388-0308
David Moore	88th RCS/Chief, Environmental Division	608-388-0366
Barry McFarland	88th RCS/Environmental Protection Specialist	316-681-7159 x1419
India Nicholson	AEC/Attorney	210-466-1646
Kelly Russell	AEC/Attorney	210-466-1645
Jonathan Harrington	AEC/Environmental Remedial Manager	210-466-1719
Ruben Zamarripa	MDNR	573-751-7757
Jim Harris	MDNR	573-522-1892
Josephine Newton-Lund	USACE Kansas City/PM	816-389-3912

2. SUMMARY

The site visit included a meeting to discuss the progress of the five-year review, inquire about additional resources and information regarding land use controls, groundwater monitoring, and area T13, status of recommendations made from the previous five-year review, and a site walk.

3. DISCUSSION

January 22, 2015

On January 22, 2015, a meeting was conducted at the Weldon Springs Training Area, Building 30 beginning at 0830. The attendees assembled and conducted introductions. Ms. Laubach went over the agenda for the day including the site features the five-year review team (consisting of Ms. Laubach and Ms. Scott) would like to see. The main discussion points are discussed below.

Interviews: Ms. Laubach indicated that she contacted the people on the interviewee list. Ms. Laubach inquired whether the Missouri DOT (MoDOT) still had any interests on site and if pursuing an interview was needed since the point-of-contract from the last five-year review no longer works at MoDOT. Mr. Tran and Mr. Harris indicated that the MoDOT maintenance yard was transferred to the St. Charles County and that all work that involved the MoDOT had been completed. Also, Ms. Laubach inquired about the high school since her initial phone call did not result in an interview. Mr. Tran indicated that an annual inspection is performed by the

Department of Energy (DOE) and they contact affected parties including the high school. That report would have the appropriate POCs. Ms. Laubach will contact Mr. Tran for that report.

Drinking water wells in the area: An old Army well is referenced in the background sections of the Performance Monitoring Reports. However, this well is no longer in use. Ms. Newton-Lund indicated that this well should be closed. Ms. Laubach inquired whether any drinking water wells were located nearby. Mr. Tran indicated that there was a drinking water well nearby (across the street; a report may be available.)

Area T13: Ms. Scott inquired about whether there is information regarding T13 and its potential effect on groundwater since contamination was left in place. Mr. Barry McFarland stated that he had performed a brief analysis of the existing information and concluded that because the downgradient well MW16 did not have any contaminant detections, this is evidence that the remaining contamination at area T13 is not contributing to groundwater contamination. Ms. Scott will locate the analysis sent and include in our analysis for the five-year review report.

Land use controls: Ms. Laubach inquired about the status of the issues from the previous five-year review. Ms. Russell indicated that the deed restriction was drafted and is in internal review. The Long-Term Management Plan (LTMP) is currently being drafted and anticipated to be available for the Environmental Protection Agency (EPA) and Missouri Department of Natural Resources (MDNR) review the first week in February. Also, a public notice for the groundwater use restriction for the entire Weldon Spring Ordnance Works (WSOW) is at MDNR for review. The 88th will file the notice with the county.

Mr. Harris asked about processes in place to prevent digging/excavation. The 88th indicated that there is a process in place. However, it is uncertain whether this process documented in the LTMP, the FDP (Future Development Plan). The question was then raised, who the point-of-contact was at the facility for day-to-day access on post. It seemed that the actual person changed frequently. Another question was raised regarding area T13 and the institutional controls in place. Because area T13 is now discussed within the FDP which will be referenced in the LTMP as a "No Dig" area, what mechanism will need to be implemented to document this institutional control since the 1996 OU1 ROD does not include institutional controls as a remedy component. The five-year review team will include this evaluation in the report.

Site Walk: After the morning meeting, the group traveled to the location of area T13. The location of area T13 was a little difficult to discern but the group eventually found the location. Two signs were posted on the area which informed of the remaining contamination in this area. Also, there were survey stakes present from a recent survey; green stakes represented the edge of the original excavation and the blue stakes represented a 25 foot buffer. The group then broke for lunch. Ms. Scott asked where MW16 was located and what was considered downgradient. No one in the group was able to give a clear answer.

After lunch, the group went in search of the Burgermeister Springs (sample location SP5301) and a few monitoring wells located near these springs with a brief stop at the Missouri Department of Conservation Regional Office. The group was unable to locate the springs and Ms. Laubach and Ms. Scott will try to locate the springs the next day.

After the meeting, Ms. Laubach and Ms. Scott traveled to the St. Charles County Department of Environmental Health to interview Ms. Hope Woodson, interim director of the department. The interview record for this interview will be included in the Five-Year Review report.

January 23, 2015
On January 23, 2015, Ms. Laubach and Ms. Scott conducted interviews with the secretary of the Board of Trustees with the Weldon Springs Heights Subdivision, and a Retired Army Colonel and community member involved with site cleanup actions for both the Army and Department of Energy. Interview records for these interviews will be included in the Five-Year Review report.

After the interviews, Ms. Laubach and Ms. Scott traveled to the Busch Conservation Area to look for the Burgermeister Springs and a few monitoring wells. The team was able to locate wells MWS106, MWD106, MWS110, and MWS108. Monitoring well MWS106D appeared to have water coming from it as evidenced by the standing water and moss growing on the side of the well housing (photo 6). MWD110 was not locked and photo 8 below shows the inside of the well housing. MWD110 is located along an area road and is easily accessible. There were no signs of tampering. The other wells were found to be secured. All wells appeared to be in good condition. The team could not identify the Burgermeister Spring or other spring sample locations.

The team then drove to the St Charles City/County Library District, Middendorf-Kredell Branch, located at 2750 Highway K, O'Fallon, Missouri. The location of the information repository was determined however a librarian was not available to show the actual documents kept/catalogued at the library.

4. ACTIONS

The USACE will incorporate information obtained from the site visit into the Five Year Review report.

Marlowe Laubach
Chemical Engineer
CENWS-EN-TS-ET

Lisa Scott
Geologist
CENWS-EN-TS-GE

Site Visit Photos

Photo 1. Area T13

Photo 2. T13 sign

Photo 3. Survey flags at Area T13

Photo 4. Current signage at the WSTA

Photo 5. MWS106

Photo 6. MWD106

Photo 7. MWS110

Photo 8. Inside MWS110 well housing

Photo 9. MWS108

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Appendix D: Interview Records

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Interview Records

Five-Year Review Interview Record			
Site: Weldon Spring		**EPA ID No:**	MO5210021288

Interview Type: Visit
Location of Visit: Weldon Spring Training Area
Date: 1/22/15
Time:

Interviewers

Name	Title	Organization

Interviewees

Name	Organization	Title	Telephone	Email
Josephine Newton-Lund	CENWK-PM-ES	Senior Project Manager	816-389-3912	Josephine.m.newton-lund@usace.army.mil

Summary of Conversation

1) What is your overall impression of the project?

The soils remediation and monitoring of groundwater has effectively reduced or eliminated explosives-contaminated soil and groundwater.

2) Is the remedy functioning as expected? How well is the remedy performing?

Yes, based on groundwater results that have shown no significant increasing trend of nitroaromatics, but also signs of a decreasing trend at 7 monitoring pairs.

3) What does the monitoring data show? Are there any trends that show contaminant levels are decreasing?

Section 4.1.1.3 of Performance Monitoring Report 008 dated January 2015 discusses statistical analysis of data most recently obtained in April 2014 and 14 years previously. Mann-Kendall analysis was performed on 101 of 192 monitoring point/constituent pairs. 91 of the pairs were not analyzed because there were no detections over the 14 year monitoring period. Of the 101 monitoring point pairs analyzed, 7 pairs showed a decreasing trend, 71 showed no significant trend, and 23 pairs showed an increasing trend (of which 19 pairs had only one or two detections over the monitoring period). Of the 192 monitoring location/constituent pairs only four or 2 percent had more than two detections and showed an increasing trend. Therefore, it appears that the data indicates primarily no significant increasing trend, but also signs of a decreasing trend at 7 monitoring pairs.

4) Is there a continuous O&M presence? If so, please describe staff and activities. If there is not a continuous on-site presence, describe staff and frequency of site inspections and activities.

Yes, groundwater monitoring is conducted annually in April. Currently, a USACE-KC District contractor is performing the sampling through 2017. The contract is funded by USAEC.

5) Have there been any significant changes in the O&M requirements, maintenance schedules, or sampling routines in the last five years? If so, do they affect protectiveness of the remedy? Please describe changes and impacts.

Not that I am aware of.

6) What are the annual operating costs for your organization's involvement with the site?

USACE-KC District receives an average amount of $8,000 annually to oversee the contractor performing groundwater monitoring and to perform quality assurance oversight of the field sampling. $36,377.96 was spent on preparing a work plan for a new contract in 2013 and $30,814.90 was spent on sampling in 2014. Sampling in 2010 through 2013 was performed by ECC, a USAEC contractor.

7) Have there been unexpected O&M difficulties or costs at the site in the last five years? If so, please give details.

Not that I am aware of.

8) Have there been opportunities to optimize O&M or sampling efforts? Please describe changes and resultant or desired cost savings or improved efficiency.

Yes. Optimization of the groundwater program was evaluated in 2011during the preparation of the second Five-Year Review and in conjunction with PMR 003. Addendum Number 1 to the RD/RA Work Plan was prepared in March 2011 to address several updates to groundwater monitoring. The addendum is attached to this interview record.

9) Are you aware of any changes in Federal/State/County/Local laws and regulations that may impact the protectiveness of the remedy?

No

10) Do you have any comments, suggestions, or recommendations regarding the project?

Completion of land use controls (notice of environmental use restriction on WSTA and restrictive covenant on State properties) is needed this fiscal year.

Additional Site-Specific Questions

Five-Year Review Interview Record			
Site: Weldon Spring		**EPA ID No:**	M05210021288
Interview Type: Email Location of Visit: Date: 2/19/2015 Time:			

Interviewers		
Name	**Title**	**Organization**

Interviewees				
Name	**Organization**	**Title**	**Telephone**	**Email**
Brad Brink	CENWK-ED-EE	Geologist	816-389-3883	Bradley.j.brink@usace.army.mil

Summary of Conversation

1) What is your overall impression of the project?

Soil remediation has removed explosives contamination above remediation goals with the exception of the T-13 area. At the T-13 area, DNT remains in discrete portions of the excavation at depth which was agreed upon by MDNR, EPA, and the Army. Soil remediation appears to have reduced or eliminated leaching of explosive contamination to groundwater.

2) Is the remedy functioning as expected? How well is the remedy performing?

Based on all available data, the remedy appears to be functioning as expected. See response to question 3.

3) What does the monitoring data show? Are there any trends that show contaminant levels are decreasing?

According to Section 4.1.1.3 of Performance Monitoring Report 008 dated January 2015, "The Mann-Kendall analysis was performed on 101 point/constituent pairs. The results indicate that 71 of the pairs showed no significant trend, while 23 pairs showed an increasing trend (of which 19 pairs had only one or two detections over the monitoring period), and 7 showed a decreasing trend."

4) Is there a continuous O&M presence? If so, please describe staff and activities. If there is not a continuous on-site presence, describe staff and frequency of site inspections and activities.

Yes. Groundwater monitoring is conducted annually and a sampling report prepared by the USACE-KCD contractor. USACE-KCD provides QA oversight of the sampling activities and review of the reports.

5) Have there been any significant changes in the O&M requirements, maintenance schedules, or sampling routines in the last five years? If so, do they affect protectiveness of the remedy? Please describe changes and impacts.

None that I am aware of.

6) What are the annual operating costs for your organization's involvement with the site?

Unknown.

7) Have there been unexpected O&M difficulties or costs at the site in the last five years? If so, please give details.

None that I am aware of.

8) Have there been opportunities to optimize O&M or sampling efforts? Please describe changes and resultant or desired cost savings or improved efficiency.

Yes. The following is from the Addendum 1 of the RD/RA Work Plan dated 4 March 2011: "Optimization of the groundwater monitoring program was evaluated during the preparation of the *Five-Year Review Report, Operable Unit 1 – Soil, Operable Unit 2 – Groundwater, Former Weldon Spring Ordnance Works, Weldon Spring, Missouri* (ECC and Burns &McDonnell [BMcD], 2010a) and in conjunction with *Performance Monitoring Report 003, Round RA-06 (April 2009), Operable Unit 2 – Groundwater, Former Weldon*

Spring Ordnance Works, Weldon Spring, Missouri (ECC and BMcD, 2010b) in 2009 and 2010. Optimization included revised sampling frequencies and a revised sampling schedule."

9) Are you aware of any changes in Federal/State/County/Local laws and regulations that may impact the protectiveness of the remedy?

None that I am aware of.

10) Do you have any comments, suggestions, or recommendations regarding the project?

The Army is currently developing a Long Term Management Plan that includes Land Use Controls for groundwater.

Additional Site-Specific Questions
[If needed]

Five-Year Review Interview Record				
Site:	Weldon Spring Former Ordnance Works		**EPA ID No:**	MO5210021288
Interview Type: Teleconference Location of Visit: Teleconference Date: January 20, 2015 Time: 0900 PST				
Interviewers				
Name			**Title**	**Organization**
Marlowe Laubach			Chemical Engineer	USACE
Lisa Scott			Geologist	USACE
Interviewees				
Name	**Organization**	**Title**	**Telephone**	**Email**
John Vogel	Missouri Dept of Conservation	Wildlife regional supvr.	636.300.1953 x4131	John.Vogel@mdc.mo.gov

Summary of Conversation

1) What is your involvement with the site:
I manage the Busch and Weldon Springs Conservation Areas. I have infrequent contact with staff on-site; 15 years ago when I began with MDC, there was an active cleanup going on and I had more interactions. Now with only just the groundwater monitoring, interact with the sampling crews who need to get keys to access monitoring wells on the conservation areas that are locked.

2) What is your overall impression of the project?
Overall, it was a good project. They did a really thorough survey and cleaned all known surface and subsurface contamination. Doing a good job of keeping tabs on the groundwater concentration with the large number of wells installed.

3) What effects have site operations had on the surrounding community?
When the Department of Energy (DOE) project was going, there were having a lot of meetings; since their projects are complete there have been no real community concerns. If there are questions from the community, they are usually related to the radioactive contamination. No issues with the groundwater monitoring.

Effects related to the natural resources side, are that there is infrastructure still around [from the plant facilities]. There are approximately 100 storage bunkers on the Busch conservation area; a lot of underground water piping, water storage tank and pump house on the Weldon Spring conservation area. If they removed these structures, it would be big impact to the conservation areas (negative impact by the disturbances due to removal). We do use some of the bunkers for storage. We are able to manage around [these structures].

4) Are you aware of any community concerns regarding the site or its operation and administrations? If so, please give details.

See question 3 above.

5) Are you aware of any events, incidents, or activities at the site such as vandalism, trespassing, or emergency responses from local authorities? If so, please give details.

Not aware of any issues at the Army site. A couple bunkers in the conservation areas have been vandalized.

6) Do you feel well informed about the site's activities and progress?
From the cleanup and water monitoring side, yes. Not typically aware of construction activities going on at the Army site.

7) Are you aware of any changes in Federal/State/County/Local laws and regulations that may impact the protectiveness of the remedy? Not aware of any changes.

8) Do you have any comments, suggestions, or recommendations regarding the project?
Mr. Vogel asked if there were any other plans with cleanup regarding the groundwater cleanup. [The team responded that a ROD was issued for the groundwater cleanup in 2004 and was signed by EPA and the Army and likely the

Missouri Department of Natural Resources.] Mr. Vogel also asked, "Will there be an inspection of burn pits related to the TNT production?" [The team had not heard of these burn pits and asked where these were located. The team stated that a site inspection will occur on 22 Jan 2015 as part of the five-year review and these burn pits were not on the agenda. Mr. Vogel indicated that these pits were located within the Busch Conservation Area and at a location adjacent to the Weldon Spring Conservation area which is now managed by the county and used as a firing range. These burn pits were remediated (contaminated soils were excavated) and then transferred to the Department of Conservation.]
Additional Site-Specific Questions
. *[If needed]*

Five-Year Review Interview Record			
Site:	Former Weldon Spring Ordnance Works	**EPA ID No:**	MO5210021288

Interview Type: Visit
Location of Visit: St. Charles County Community Health and Environment
Date: January 22, 2015
Time: 1600

Interviewers

Name	Title	Organization
Marlowe Laubach	Chemical Engineer	USACE, Seattle
Lisa Scott	Geologist	USACE, Seattle

Interviewees

Name	Organization	Title	Telephone	Email
Hope Woodson	St. Charles County Community Health and Environment	Interim director	636-949-7477	

Summary of Conversation

Ms. Woodson has been with the county for 12 years and management for 5 years. She has been the interim director since August 2014.

1) What is your overall impression of the project?
I am aware of the project. My predecessor was very involved with the project [during cleanup actions]. [He] spoke highly of the communication and studies [being conducted]. I receive quarterly reports [from DOE].

2) What effects have site operations had on the surrounding community?
None. Our last public inquiry was in 2010. No site interest, just the cancer rates.

3) Are you aware of any community concerns regarding the site or its operation and administrations? If so, please give details.
No.

4) Are you aware of any events, incidents, or activities at the site such as vandalism, trespassing, or emergency responses from local authorities? If so, please give details.
No.

5) Do you feel well informed about the site's activities and progress?
[I] receive quarterly reports [from DOE]; feel that I am informed.

6) Are you aware of any changes in Federal/State/County/Local laws and regulations that may impact the protectiveness of the remedy?
No.

7) Do you have any comments, suggestions, or recommendations regarding the project?
[I] would be interested in receiving reports of the groundwater [monitoring.].

Additional Site-Specific Questions

[If needed]

Five-Year Review Interview Record			
Site:	Former Weldon Spring Ordnance Works	**EPA ID No:**	MO5210021288
Interview Type: Email Location of Visit: Date: 1/27/2015 Time:			

Interviewers		
Name	**Title**	**Organization**
Marlowe Laubach	Chemical Engineer	USACE, Seattle
Lisa Scott	Geologist	USACE, Seattle

Interviewees				
Name	**Organization**	**Title**	**Telephone**	**Email**
Jim Harris	MODNR	Environmental Specialist	573-522-1892	Jim.harris@dnr.mo.gov

Summary of Conversation

1) What is your overall impression of the project?

The project has moved along smoothly except for two issues. 1) The need for a binding document requiring engineering and institutional controls at grid T-13. And 2) The failure to implement the required land-use controls (LUCs) as required by the Operable Unit 2 (OU2) Phase II Remedial Design/Remedial Action (RD/RA). The OU2 RD/RA had a scheduled completion date for the LUCs of October 2006, a commitment in the 2010 FYR to have LUCs in place in 2011 went unfulfilled and a September 2014 completion date in the amended RD/RA schedule was missed.

2) Have there been routine communications or activities (site visits, inspections, reporting activities, etc.) conducted by your office regarding the site? If so please give purpose and results.

The parties have been having conference calls for the past year. The department has conducted site visits during groundwater monitoring events to oversee well purging and sampling procedures. Army contractors were found to be in compliance with the Sampling and Analysis Plan. The department also participated in a portion of the five-year review site visit.

3) What does the monitoring data show? Are there any trends that show contaminant levels are decreasing?

Groundwater monitoring data indicates nitroaromatic contaminant levels have declined however; trend analysis has not identified a downward trend.

4) Have there been any complaints, violations, or other incidents related to the site requiring a response by your office: If so, please give details of the events and results of the responses.

Due to the lack of progress implementing LUCs the parties met in December 2013 and the regulators agreed to allow the Army to amend the RD/RA schedule. The Army submitted an amended RD/RA schedule which was approved in February 2014. The new schedule moved the deadline for implementing the LUCs from October 2006 to September 2014. The Army missed the deadline for completing the LUCs per the Federal Facility Agreement and the newly amended RD/RA schedule date of September 2014.

5) Do you feel well informed about the site's activities and progress?

Communication on groundwater sampling events and reporting has been good however; information on the development of the LUCs has been poor but is improving. Monthly teleconferences have been held for the past year. Currently, no timetable is in place for the Army to implement the LUCs.

6) Are you aware of any changes in Federal/State/County/Local laws and regulations that may impact the protectiveness of the remedy?

A review of the EPA Regional Screening indicates the toxicity values for contaminants of concern have changed and a thorough evaluation of soil and groundwater remedial objectives is needed.

7) Do you have any comments, suggestions, or recommendations regarding the project?

-A binding requirement for engineering and institutional controls at site T-13 is needed and recommended
-A thorough review of remedial goals for soil and groundwater is needed due to potential changes toxicity values
-The LUCS required by the Phase II RD/RA must be implemented , they are long over due

Additional Site-Specific Questions
[If needed]

Five-Year Review Interview Record			
Site:	Former Weldon Spring Ordnance Works	**EPA ID No:**	MO5210021288

Interview Type: Email
Location of Visit:
Date:
Time:

Interviewers

Name	Title	Organization
Marlowe Laubach	Chemical Engineer	USACE, Seattle
Lisa Scott	Geologist	USACE, Seattle

Interviewees

Name	Organization	Title	Telephone	Email
Hoai Tran	EPA Region 7	Remedial Project Manager	913-551-7330	Tran.hoai@epa.gov

Summary of Conversation

1) What is your overall impression of the project?

For the soil operable unit (OU1), physical construction has been completed. The area of remaining soil contamination, T-13, was inspected during this five-year review and was well marked with signs. The remedy for the groundwater operable unit (OU2) has not been completely implemented at this time.

2) Have there been routine communications or activities (site visits, inspections, reporting activities, etc.) conducted by your office regarding the site? If so please give purpose and results.

EPA, MDNR and the Army have regular monthly conference calls to work on implementing the remaining institutional controls. EPA, MDNR and the Army attended the five-year review site inspection on January 22, 2015.

3) What does the monitoring data show? Are there any trends that show contaminant levels are decreasing?

A complete evaluation of site monitoring data will be performed when the five-year review report is submitted for review.

4) Have there been any complaints, violations, or other incidents related to the site requiring a response by your office: If so, please give details of the events and results of the responses.

The Remedial Design/Remedial Action work plan dated February 3, 2014, was amended to establish a new schedule for implementing institutional controls for the OU2 remedy. The Army is past due on some items on the schedule. EPA, MDNR and the Army continue to work on completing the OU2 remedy.

5) Do you feel well informed about the site's activities and progress?

The Army updates EPA and MDNR during monthly calls.

6) Are you aware of any changes in Federal/State/County/Local laws and regulations that may impact the protectiveness of the remedy?

EPA will evaluate protectiveness when the five-year review report is submitted for review. This will include an evaluation of applicable laws and regulations.

7) Do you have any comments, suggestions, or recommendations regarding the project?

The remedy at the site has not been fully implemented. These were recommendations from the last five-year review completed in 2010.

Additional Site-Specific Questions

[If needed]

Five-Year Review Interview Record			
Site:	Former Weldon Spring Ordnance Works	**EPA ID No:**	MO5210021288

Interview Type: Visit
Location of Visit: DOE Interpretation Center
Date: 23 January 2015
Time: 1030

Interviewers

Name	Title	Organization
Marlowe Laubach	Chemical Engineer	USACE, Seattle
Lisa Scott	Geologist	USACE, Seattle

Interviewees

Name	Organization	Title	Telephone	Email
Community Member	N/A	Retiree		Contact info withheld.

Summary of Conversation

The community member interviewed was active Army for 27 years working as a civil sanitary engineer; retiring as Colonel. He has a civil engineering degree and a master's in public health. From 1988 through 1999, he worked as the Environmental Coordinator at Weldon Spring during the cleanup efforts. The interview was conducted at the DOE Interpretative Center where the community member volunteers on the weekends. He showed Ms. Laubach and Ms. Scott a map with the extent of the former Weldon Spring Ordnance Works, and approximate locations of the TNT production areas, water well field, and the area DOE used. In addition, he showed artifacts found during the TNT cleanup work which included an old wooden pipe. Below is a summary of his impression of the site and its impacts to the community.

The location of the high school was the old TNT box factory, which became the school district offices. The box building interiors had wood contaminated from the TNT process. This was cleaned up and now there's a new high school, with a sports facility and bus barn.

The old TNT production area became the Army Training Area in 1958. Today there is are Army Reserve units, a Marine unit, and the National Guard at the facility.

The conservation areas continue to grow. All lakes are manmade created by Conservation Department of Missouri.

There is a well field near the river that was part of the original facility. It was transferred to St. Charles County and was sold to the local water district. Water Treatment Plant No 2 [property] is now owned by St. Charles County; the building was demolished and now is the sheriff's firing range. Treatment Plant No 1 is owned by the water company.

All this work is evidence that the cleanup is accepted by the community.

At burning ground 1 which was part of the waste treatment process [for the TNT manufacturing], the wooden pipelines were dug up. The community member's impression was that we got everything that was known. But there may still be pipe remaining somewhere that we could have missed.

In the last five years, there has been little negative reaction. People live here for years and finally visit [the DOE interpretative center] to see what it's about. People from across the U.S. and internationally have come; it's well known, in a way.

During the cleanup, there was a local activist who was very active with cleanup sites throughout St. Louis. However, not so much activity from her [on this site.]

There's a restrictive well drilling [just to the east of the DOE disposal cell.]

Regarding vandalism, on top of the pyramid (DOE disposal cell), you see fireworks and beer cans sometimes.

The community member said "I felt the job was been a good job. I feel this land was in the service of the country and is did its job. Land is continued to be used."

He mentioned that "I do not keep up today with the Army site."

Additional Site-Specific Questions

[If needed]

Five-Year Review Interview Record			
Site:	Former Weldon Spring Ordnance Works	**EPA ID No:**	MO5210021288

Interview Type: Visit
Location of Visit: St. Louis Bread Company
Date: 23 January 2015
Time: 0900

Interviewers

Name	Title	Organization
Marlowe Laubach	Chemical Engineer	USACE, Seattle
Lisa Scott	Geologist	USACE, Seattle

Interviewees

Name	Organization	Title	Telephone	Email
Community member	Weldon Spring Heights	On the Board of Trustees		Contact info withheld

Summary of Conversation

The community member has resided at Weldon Spring Heights for 45+ years. Her husband served on the community advisory committee for the DOE cleanup. She stated that Weldon Spring Heights was originally built for the officers of the Army facility.

1) What is your overall impression of the project?

I don't know much about the explosive [cleanup] much. The [former trustee] gave me the 2012 annual report for the DOE site. I know that wooden pipes were found and burned. The radioactive contaminants were placed in the pyramid (the DOE disposal cell]. Weldon Spring Heights has its own drinking water well located in the St. Peter's limestone which was built by the Army. Others in the area get water through the Missouri American Water Company. I understand that groundwater is being monitored.

2) What effects have site operations had on the surrounding community?

When [the contamination] first came to light in ~1975 there was lots of concern in the community about the cleanup. However, since the completion of the cleanup, there has not been much concern. Everyone seems to be satisfied with the cleanup.

3) Are you aware of any community concerns regarding the site or its operation and administrations? If so, please give details.

I asked around the community before this meeting and only one person had a concern about radioactive contaminants in the drinking water. There are no other concerns that I am aware of.

4) Are you aware of any events, incidents, or activities at the site such as vandalism, trespassing, or emergency responses from local authorities? If so, please give details.

I am not aware of any, recently. In the past, the waterworks off of 94 (known then as Echo Dome) was a place where people would hangout.

5) Do you feel well informed about the site's activities and progress?

I never hear of anything. People [in the community] wonder sometimes about what is going on, if anything. Some information could be distributed with a reference to a website to inform the community of events, sampling results, etc. would be helpful.

6) Do you have any comments, suggestions, or recommendations regarding the project?

I would like to be more informed of what is happening, if anything, and whether there are any concerns [at the Army and DOE] sites.

Additional Site-Specific Questions

[If needed]

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Appendix E: Institutional Controls

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Institutional Controls

St. Charles County Recorder's Office
Barbara J. Hall
201 North Second Street, Suite 338
St. Charles , MO 63301
(636) 949-7505 www.sccmo.org

Receipt for Services

Cashier	PGOODRICH		**Batch #** 761380
Customer Name	88TH REGIONAL SUPPORT COMMAND 506 ROEDER CIRCLE FT SNELLING, MN 55111	**Date:** 06/08/2015	**Time:** 09:59:01AM
Remarks	PKG RECORD		

Date	Instrument No	Document Type	Transaction Type	GF Number	Pg/Amt
6/8/2015 9:59:01AM	20150608000359740	NOTICE	DE6367 2397		11
Party 1: WELDON SPRING TRAINING AREA		Party 2: WELDON SPRING TRAINING AREA			
		NOTICE		Total:	$73.00
		PUBLIC			
			Credit Card Convenience Fee		1.83
			Postage Fee		0.50
		PUBLIC		Total:	$2.33
				Fee Total:	$75.33
CREDIT	VISA	MELANIE TESCHER			75.33
				Payment Total:	$75.33

PAID

RECORDER OF DEEDS
201 N 2ND ST STE 338
SAINT CHARLES, MO 633

TERMINAL ID. : 03586453
MERCHANT #: 260169020880

VISA

xxxxxxxxxxx9149 S
SALE
BATCH: 000866 INVOICE 4334164642
DATE: Jun 08, 15 TIME: 10:07
SEQ: 0001 AUTH:012834

TOTAL $75.33

CUSTOMER COPY

Notice
11+ - 73.00
L 5
5.4

20150608000359740 NOTICE
Bk:DE6367 Pg:2397
06/08/2015 09:59:01 AM 1/11

CERTIFIED-FILED FOR RECORD
Barbara J. Hall
Recorder of Deeds
St. Charles County, Missouri
BY:PGOODRICH $73.00

1st pg lacks 3" margin & date

Recorder of Deeds Certificate
St. Charles County Missouri

NON-STANDARD DOCUMENT

This document has been recorded and you have been charged a $25.00 non-standard fee pursuant to RSMo 59.310.3. This is the first page of your document—DO NOT REMOVE.

ST. CHARLES COUNTY

Barbara J. Hall
Recorder of Deeds
201 North Second Street, Suite 338
St. Charles, MO 63301

88TH REGIONAL SUPPORT CMD
AFRCSWI ENE (TIGHE)
506 ROEDER CIRCLE
FT SNELLING, MN 55111

20150608000359740 2/11
Bk:DE6367 Pg:2398

Prepared by/Return to:
Weldon Spring Training Area
Army Environmental Command

STATE OF MISSOURI

COUNTY OF ST CHARLES

NOTICE

Whereas, THE UNITED STATES OF AMERICA is the owner of certain property commonly referred to as the Weldon Spring Training Area (WSTA), located in the former Weldon Spring Ordnance Works in St. Charles County, Missouri, more particularly described in the survey attached hereto as Exhibit A and incorporated herein by reference as though fully set forth (hereinafter referred to as "the Property");

Whereas, a release or releases of contaminants on the Property was reported to the Missouri Department of Natural Resources (MDNR) and the Environmental Protection Agency, Region 7 (EPA) [the site is designated as EPA ID Number: EPA ID # MO5210021288] and said releases addressed in this Notice pose a risk to human health and the environment; and

Whereas, in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986, 42 U.S.C. sections 9601 et seq., certain environmental response actions, including land use controls (LUCs), are being performed at the Property to ensure long-term protectiveness until groundwater remediation is completed as documented in an approved Record of Decision (ROD) for Operable Unit 2 (OU2) (Ground water), signed on September 30, 2004; and

Whereas, the WSTA has incorporated these LUCs as they apply to OU2 in a Future Development Plan (FDP) for the 88th Regional Support Command (RSC); and

Whereas, the purpose of this Notice is to provide public notice of these LUCs;

Now, therefore, the WSTA hereby gives notice that the following LUCs apply to the Property (although groundwater contamination does not exist across the entire WSTA, the groundwater LUC boundary encompasses the WSTA from fence line to fence line):

- Activities that that may negatively impact the remediation of groundwater contamination are restricted (¶¶ 2.11.2 & 2.11.4, OU2 ROD 2004; § 3, Remedial Design/Remedial Action (RD/RA) Work Plan, Phase II);

- Activities that may result in the creation of a potential for downward migration of contamination (¶¶ 2.11.2 & 2.11.4, OU2 ROD 2004; § 3, RD/RA Work Plan, Phase II);

- Activities that may result in ingestion or dermal exposure to groundwater contaminated at concentrations above remediation goals are restricted (¶¶ 2.11.2 & 2.11.4, OU2 ROD 2004; § 3, RD/RA Work Plan, Phase II);

- Use of groundwater contaminated above applicable or relevant and appropriate requirements (ARARs) or health based remediation goals as a potable water source is prohibited set forth in the ROD (¶¶ 2.11.2 & 2.11.4, OU2 ROD 2004; § 3, RD/RA Work Plan, Phase II);

- Groundwater well installation is regulated in accordance with and must comply with the basic requirements of the Missouri Well Construction Code (10 CSR 23-3), including 10 CSR 23-3.100 (Sensitive Areas) for Special Area 4 (¶ 2.11.3, OU2 ROD 2004; ¶ 3.1, OU2 RD/RA Work Plan, Phase II).

These restrictions continue in effect as long as contaminants remain on the Property in excess of unrestricted use/unlimited exposure standards and in accordance with the approved OU2 ROD and OU2 RD/RA Work Plan.

Property Interest: This Notice should not be construed to transfer, dispose of, or in any way alienate any real property interest held by the United States in the Property. The filing of this Notice does not in any way create any real property interest in the Property.

Conveyances: Should contaminants remain on the site in excess of unrestricted use and unlimited exposure standards at the time the contaminated Property is conveyed in fee simple to any entity or person that is not an Agency, Department, or instrumentality of the United States of America, the conveyance will comply with all applicable CERCLA 120(h) requirements. Said restrictions cited herein shall be placed within the conveyance documents noting such restrictions and/or prohibitions on use.

Enforcement: This Notice in and of itself creates no independent enforcement authority in the EPA, the Missouri Department of Natural Resources (MDNR), or any third party. This Notice does not limit any enforcement authority that may otherwise be available to EPA, MDNR, or any third party.

Filing: This Notice is recorded in the real property records of the county in which any part of the Property is located.

Further information may be obtained at the information repository at:

St. Charles City/County Library
Middendorf-Kredell Branch
2750 Highway K
O'Fallon, Missouri 63368-7859

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In Witness Whereof, this Notice is given by Weldon Spring Training Area, Missouri on this the 01 day of JUNE, 2015.

By: _____

Title: Chief, Env Div 88 RSC

STATE OF MISSOURI

COUNTY OF ST CHARLES

ACKNOWLEDGEMENT

I, the undersigned Notary Public in and for said County and State, hereby certify that David Lee Moore, whose name is signed to the foregoing Notice, and who is known to me, acknowledged before me this day that, being informed of the contents of the Notice, s/he executed the same voluntarily on the day the same bears date.

Given under my hand and official seal this 1st day of JUNE, 2015.

Samir B Raval
Notary Public

S*E*A*L*

SAMIR BANSILAL RAVAL
NOTARY PUBLIC - MINNESOTA
MY COMMISSION EXPIRES 01/31/16

My Commission expires: 01/31/2016

Exhibit A

HANSON

20150608000359740 5/11
Bk:DE6367 Pg:2401

Hanson Professional Services Inc.
13801 Riverport Drive Suite 300
Maryland Heights, MO 63043
(314) 770-0467
Fax (314) 770-0428
www.hanson-inc.com

Property Description

10D0004037

Client: US Army Corps of Engineers
Kansas City District
601 East 12th Street
Kansas City, Missouri 64106

Page: 1 of 6
Date: 08/01/2014
By: RCA
Checked By: RCA

Project: Weldon Springs Ordnance Works
Weldon Springs, Missouri

STATE OF MISSOURI
RAYMOND C. ARMSTRONG
NUMBER
LS - 2095
REGISTERED LAND SURVEYOR
8/1/14

WELDON SPRING TRAINING AREA (WSTA)

Part of two tracts of land being known as "Industrial Areas" in Sections 34, 35, 36, Township 46 North, Range 2 East, Section 31, Township 46 North, Range 3 East, Sections 1, 2, Township 45 North, Range 2 East, Section 6, Township 45 North, Range 3 East, of the Fifth Principal Meridian, St. Charles County, MO., as described in Deed Book 225 Page 64 and Deed Book 842 Page 1778 in the St. Charles County, Missouri recorder's office, and being more particularly described as follows:

"Beginning" at a point in the South line of said Section 35, said point being 30.75 feet east of the Southwest corner of said Section 35;

Thence, following the fence constructed by the Government, the following courses and distances:

North 22 degrees 19 minutes 20 seconds West, 797.77 feet;

North 00 degrees 09 minutes 30 seconds West, 506.31 feet;

North 13 degrees 03 minutes 40 seconds East, 454.43 feet;

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Bk:DE6367 Pg:2404

South 71 degrees East, 1674.76 feet;

North 70 degrees 27 minutes East, 2143.67 feet;

South 81 degrees 49 minutes 20 seconds East, 606.70 feet;

Thence, leaving the northern line of the aforementioned "Industrial Areas", the following courses and distances:

South 00 degrees 04 minutes 28 seconds East, 1355.98 feet;

South 63 degrees 03 minutes 07 seconds West, 485.67 feet;

South 05 degrees 22 minutes 06 seconds East, 474.62 feet;

South 29 degrees 11 minutes 22 seconds West, 384.67 feet;

South 04 degress 34 minutes 10 seconds East, 189.65 feet;

South 48 degrees 12 minutes 56 seconds East, 618.60 feet;

South 70 degrees 25 minutes 08 seconds East, 105.03 feet;

South 00 degrees 02 minutes 16 seconds West, 749.79 feet;

North 89 degrees 59 minutes 22 seconds East, 810.47 feet to a point on the southern line of the aforementioned "Industrial Areas";

Thence, South 45 degrees 58 minutes West, a distance of 857.50 feet, more or less, to the intersection with the line between Townships 45 and 46 North, said point being 869.9 feet, more or less, west of a stone at the northeast corner of cemetery in the Northwest Quarter of the Northeast Quarter of Section 6, Township 45 North, Range 3 East of the Fifth Principal Meridian;

Thence, West along said line between Townships 45 and 46 North, back to the "**Point of Beginning**".

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ALSO

"Beginning" at a point in the South line of the aforementioned Section 35, said point being 30.75 feet east of the Southwest corner of said Section 35;

Thence, following the fence constructed by the Government, the following courses and distances:

South 22 degrees 19 minutes 20 seconds East, 423.20 feet;

South 58 degrees 59 minutes 10 seconds East, 740.27 feet;

South 76 degrees 18 minutes East, 279.50 feet;

North 68 degrees 02 minutes 40 seconds East, 1379.01 feet;

South, 65.20 feet;

South 35 degrees 51 minutes 20 seconds East, 44.05 feet;

South 03 degrees 12 minutes 10 seconds West, 461.82 feet;

South 62 degrees 43 minutes 50 seconds East, 302.74 feet;

South 79 degrees 17 minutes East, 283.95 feet;

South 21 degrees 14 minutes East, 47.21 feet;

North 64 degrees 59 minutes East, 14.90 feet;

South 68 degrees 23 minutes 50 seconds East, 663.83 feet;

North 87 degrees 00 minutes 10 seconds East, 2393.27 feet;

South 73 degrees 42 minutes 30 seconds East, 775.23 feet;

North 83 degrees 03 minutes 30 seconds East, 1731.58 feet;

South 85 degrees 46 minutes 30 seconds East, 347.15 feet;

North 42 degrees 00 minutes East, 133.32 feet;

South 71 degrees 23 minutes East, 2113.63 Feet;

East, 534.15 feet;

South 65 degrees 55 minutes East, 432.00 feet;

East, 727.60 feet;

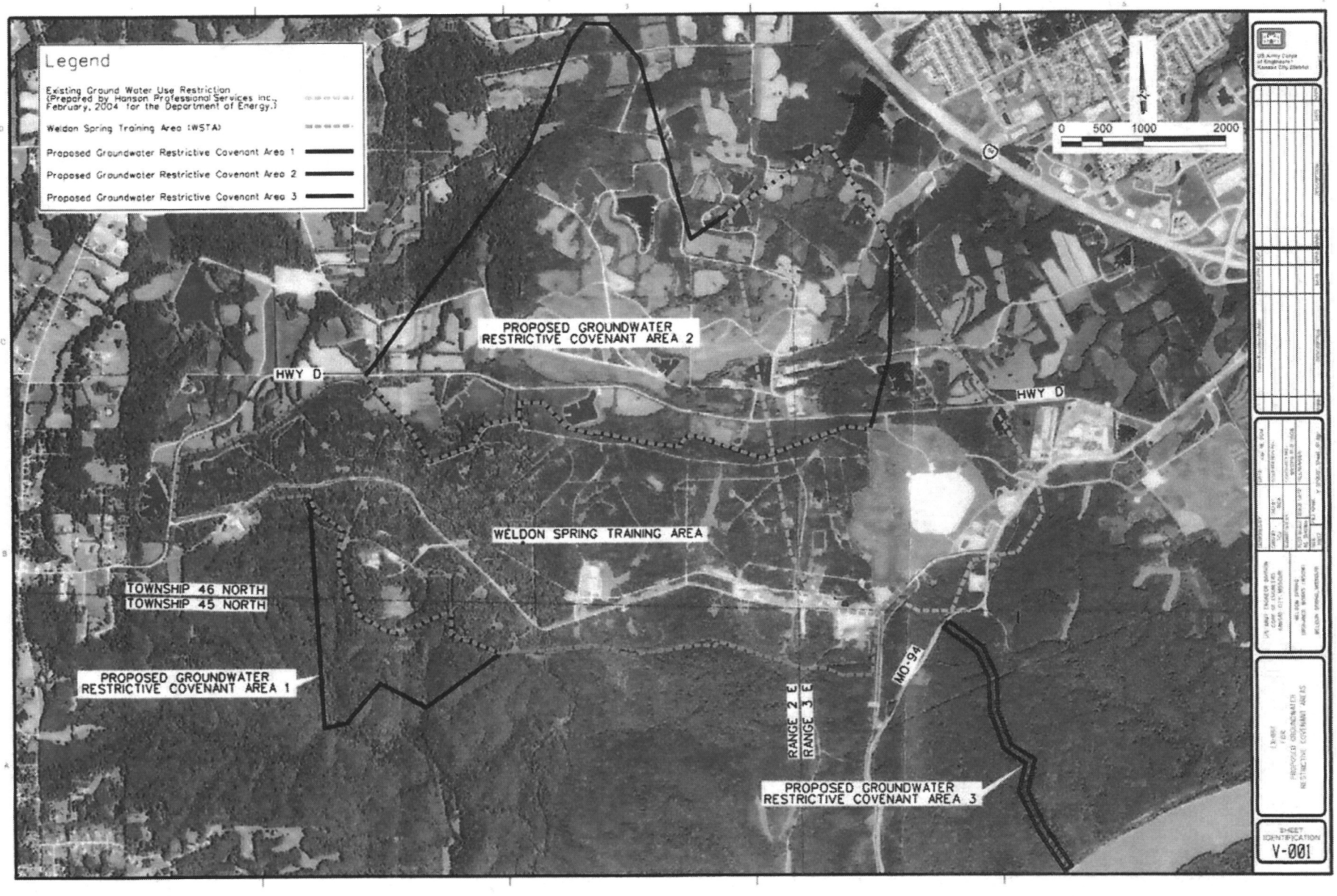
North 04 degrees 09 minutes 10 seconds East, 603.45 feet;

North 14 degrees 42 minutes 10 seconds East, 152.55 feet;

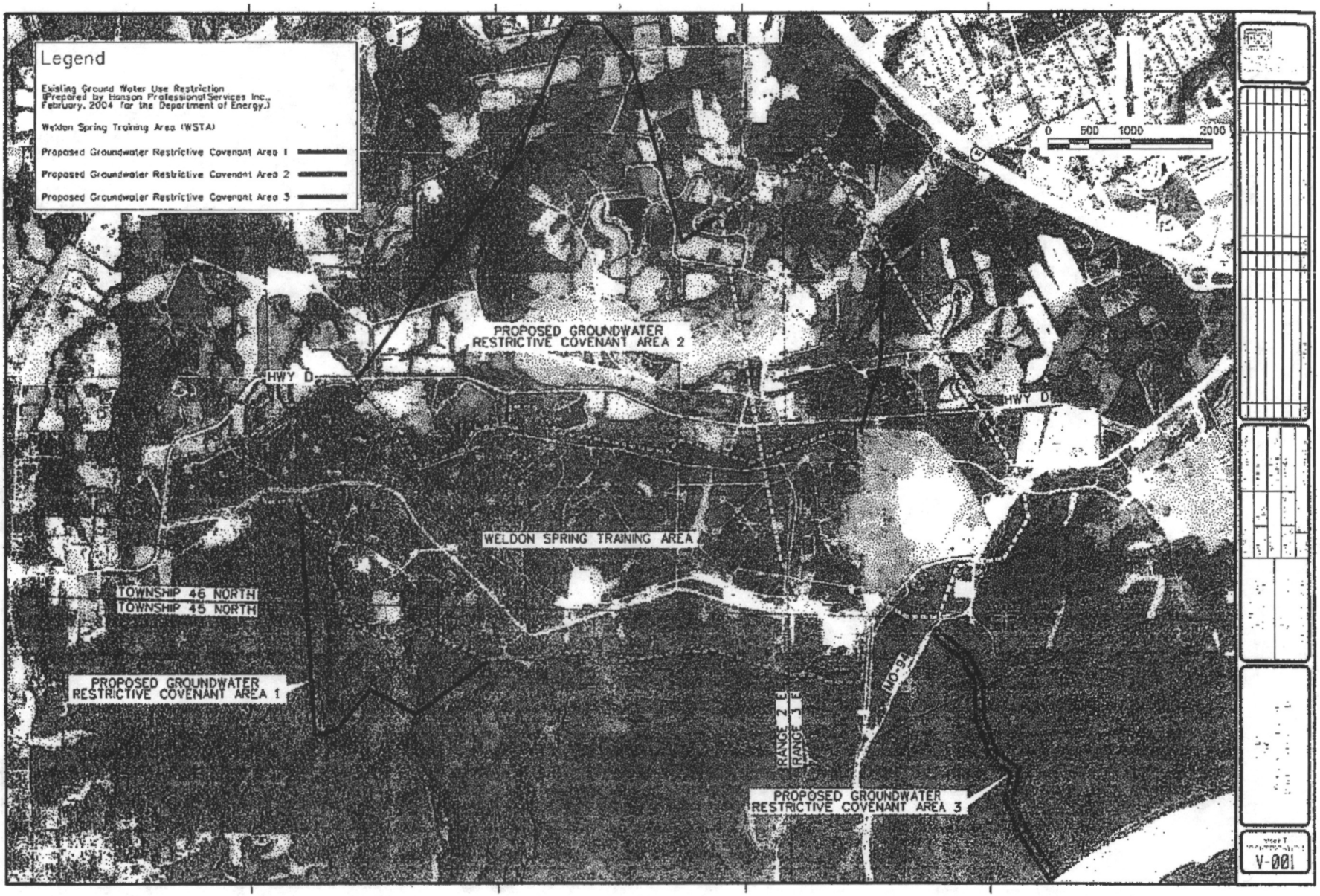
North 04 degrees 09 minutes East, 700.39 feet;

North 45 degrees 58 minutes East, 164.70 feet, more or less, to the intersection with the line between Townships 45 and 46 North, said point being 869.9 feet, more or less, west of a stone at the northeast corner of cemetery in the Northwest Quarter of the Northeast Quarter of Section 6, Township 45 North, Range 3 East of the Fifth Principal Meridian;

Thence, West along said line between Townships 45 and 46 North, back to the **Point of Beginning**.



RECORD AS IS



RECORD AS IS

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CONTAMINATION CONCERNS ON THE AUGUST A. BUSCH MEMORIAL AND WELDON SPRING CONSERVATION AREAS

The August A. Busch Memorial and Weldon Spring conservation areas have historically had contamination issues as a result of activities by the U.S. Department of the Army and U.S. Atomic Energy Commission (now the U.S. Department of Energy). Major cleanup activities by both of these federal agencies have addressed most of the contamination issues. These two highly used public Conservation Areas comprise close to 15,000 acres of what was once a 17,232-acre Army facility that produced TNT and DNT explosives, and surround a 219-acre Department of Energy area that once processed uranium, a radioactive material. The U.S. Department of Energy still owns 228 acres in the area, including a 9-acre quarry and the U.S. Army owns 1,655 acres that is used as a training area.

SITE HISTORY

In 1940 as the United States prepared for World War II, the U.S. Department of the Army acquired 17,232 acres of land for the production of explosives. Residents of three small towns in the area (Howell, Hamburg and Toonerville) were forced to relocate when their property was seized by the Department of the Army. The Army then constructed roads, numerous buildings and 100 storage bunkers in the surrounding area to support the production process. From 1941 until 1945, the Atlas Powder Company, under contract with the U.S. Department of the Army, operated a trinitrotoluene (TNT) and dinitrotoluene (DNT) production plant known as the Weldon Spring Ordnance Works (WSOW). TNT and DNT were temporarily stored in the area bunkers before being shipped to off-site munitions plants. In August of 1945, termination of production at the WSOW was ordered. From 1946 through 1966, the U.S. Army worked to shut down and clean up the site. As a part of this effort, many of the production buildings were burned in place.

Destruction of WSOW building

Burning was the safest way to dispose of structures that were contaminated with explosive dust and residue.

Weldon Spring Quarry prior to cleanup

Limestone from the Weldon Spring Quarry, located four miles south of this site, was used to construct the roads and building foundations for the WSOW. Afterward, the quarry was used to dump the debris generated from the cleanup efforts of the WSOW. Additional contaminated material from various U.S. Department of the Army and U.S. Atomic Energy Commission operations was dumped into the Weldon Spring Quarry. During this time period, dumping contaminated material and other debris into quarries was an acceptable practice.

In the late 1940s and early 1950s, most of the WSOW land was sold to public entities. In 1947, the Missouri Department of Conservation (MDC) purchased approximately 6,944 acres of the original WSOW property and created the August A. Busch Memorial Conservation Area. The University of Missouri purchased 7,920 acres for agricultural research. The U.S. Atomic Energy Commission acquired 219 acres from the Army. The remainder of the land was retained by the Army. In 1978, MDC purchased 7,200 acres from the University of Missouri and created the Weldon Spring Conservation Area.

In 1955, the U.S. Atomic Energy Commission (AEC) began construction of the Weldon Spring Uranium Feed Materials Plant on the land it acquired from the U.S. Department of the Army. The plant operated from 1957 until 1966 and was a uranium processing facility, which assayed "yellow cake" (uranium ore concentrate), converted it into uranium metal, and shipped it off for further processing at other sites. The uranium processed at the Weldon Spring plant was ultimately used in both nuclear weapons and nuclear fuels. In December of 1966, the AEC ceased operations at the plant. Minimal maintenance was performed between 1967 and 1986, and the area entered into a state of decay. During operation of the WSOW and the Weldon Spring Uranium Feed Materials Plant, and during the time the areas were abandoned, radioactively and chemically contaminated materials made their way into the soil, surface water and groundwater in the surrounding area. This contamination led to major environmental cleanup programs.

CLEANUP PROCESS

Two major environmental cleanup projects took place in the area: (1) the U.S. Department of Energy (DOE) headed up the cleanup process for the uranium processing activities and (2) the U.S. Army Corps of Engineers led the cleanup activities involved with the TNT and DNT production areas.

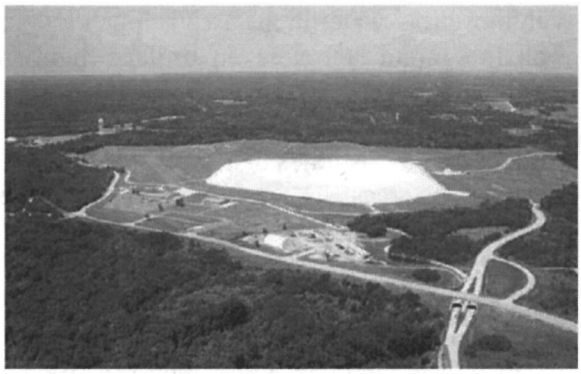
Department of Energy Cleanup Activities

The Uranium Feed Materials Plant was a challenging task to clean up. Radioactive and chemical contaminants were present throughout the site in buildings, equipment, soils, surface water and groundwater. In addition, there were many buildings in various states of disrepair, live power lines in poor shape, decaying asbestos pipes, deteriorating 55-gallon drums of chemicals and many other hazardous problems.

The Weldon Spring Quarry was a separate cleanup issue. Since the quarry had been used as a dump site for chemical and radiological waste in the past, it was full of contaminated materials and debris. The quarry is located close to the St. Charles County well field, which supplies drinking water to parts of St. Charles County. Protecting the drinking water well field from becoming contaminated was a driving force behind the cleanup of the quarry.

Weldon Spring Quarry after cleanup

Former Weldon Spring Uranium Feed Materials Plant (WSFMP)



Department of Energy Disposal Cell (Site of former WSFMP)

The DOE initiated cleanup activities in 1986 of the 219-acre Weldon Spring Uranium Feed Materials Plant site and the 9-acre Weldon Spring Quarry. After significant public input, a disposal cell was built on the site to contain radioactively and chemically contaminated materials from the Weldon Spring Uranium Feed Materials Plant, the quarry and the Weldon Spring Ordnance Works. The disposal cell was engineered and built to contain the contaminated materials for at least 1,000 years and to withstand the maximum expected earthquake and rainfall events for this location. A total of 1.48 million cubic yards of waste were placed into the cell and the cell was completed in 2001. The DOE cleanup was a multi-million dollar project that involved intense monitoring activities of the cleanup itself, and the surrounding soil, air and water resources. The Department of Energy was required by the Environmental Protection Agency (EPA) to conduct various health impact and monitoring studies before, during, and after the cleanup.

Risk assessments are a type of study that was conducted as part of the cleanup. Risk assessments provide information as to what possible impacts there could be from the contamination to human health and the environment. The EPA risk assessment experts seek to determine an acceptable level for each contaminant present. For humans, this is a level at which ill health effects are unlikely and the probability of getting cancer from the contamination is very small. Each waste site is unique in terms of the contaminants present and their potential health effects. Therefore, the EPA requires risk assessments on a site-by-site basis. The risk assessment estimates the current and possible future health impacts.

One of the risk assessments looked into possible impacts for a recreational visitor to the site. This was done because most of the property surrounding the site is owned by the Missouri Department of Conservation and is used by the public for recreational activities such as hunting, fishing, hiking, wildlife viewing, or participating in other outdoor activities on the area. For study purposes, it was assumed that the recreational user would visit the area 20 times each year for 30 years. It was also assumed that the typical visitor would drink about 2 cups of water from a spring, and get spring water on their hands, arms and lower legs each visit. The recreational user in this study could have up to an additional 2 chances in a million of developing cancer. This is in addition to the probability of anyone in the U.S. getting cancer from natural and other sources, which is estimated to be about 1 chance in 3 by the American Cancer Society. Another way of measuring the potential health impacts from radioactive contamination is by estimating the dose in millirem (mrem) per year. The estimated dose from drinking and coming into contact

with the spring water in the area is much less than 1 mrem/year. For comparison, a chest X-ray is about 8 mrem each time; an airplane flight cross-country is about 4mrem/trip; and smoking 20 cigarettes a day will give your lungs a dose of about 5,300 mrem/year.

There were other studies that evaluated possible contamination in fish and wildlife on the conservation areas. These studies looked to see if contamination was building up in the bodies of fish and wildlife that area fishermen and hunters might eat. A separate assessment looked into possible health impacts from eating fish from the area lakes and gave an estimate of an additional 4 chances in 10 million of developing cancer. This study was also based on the visitor coming to the area 20 times per year for 30 years and catching fish to eat each time. The calculations included different types and amounts of fish eaten. Results showed the risks of consuming fish or wildlife taken from the area were below the EPA's target range for unacceptable human risk levels. This basically means that it is safe to eat fish and wildlife from the area.

Groundwater monitoring was another major part of the cleanup project. Approximately 200 wells have been installed and sampled over the life of the project to monitor contaminants in the groundwater. A large number of these wells are still used for ongoing groundwater monitoring. The only parts of the wells that are visible are the protective casings above ground, which are painted yellow or orange. The well system made it possible to identify locations of contamination in the groundwater below the site and in the surrounding area.

Groundwater monitoring well with protective casings

Other studies conducted during the cleanup included chemical and radiological soil sampling, off-site lake and stream sediment sampling, and numerous geological studies.

Department of the Army Cleanup Activities

The Army is addressing the WSOW cleanup in two projects, one that deals with the contaminated soils, and one that addresses the groundwater contamination. In 1996 the Army committed to cleaning up TNT, DNT and other associated contaminants. Cleanup levels of the contaminants were based on risk assessment studies similar to those conducted by the DOE.

The cleanup included removal of TNT- and DNT-contaminated soils, and underground wooden pipelines that were used to carry TNT wastewater from the production lines to the wastewater treatment plants. An incinerator operated on the site in 1998 and 1999, and treated approximately 46,000 cubic yards of soil and almost 82,000 feet of wooden pipeline. After incineration, the ash was tested to confirm that cleanup standards had been met. The ash was then used to backfill the excavated areas where contamination was removed. In addition to the material that was incinerated, approximately 13,000 cubic yards of contaminated soils were placed in the DOE Disposal Cell. This cleanup was completed in 1999.

In addition, TNT and DNT contamination was also detected in the groundwater at the site. Monitoring wells have been installed to determine the extent of the groundwater contamination. Due to the type of bedrock below the site, the Army is using monitored natural attenuation to address the contaminated groundwater. This process monitors the contaminant levels in the groundwater over time to ensure that contaminant concentrations are decreasing due to natural chemical degrading and dilution processes.

POST CLEANUP ERA

The Department of Energy and Department of the Army have worked to clean up as much of the contamination at the site as is possible at this time. However, chemically and radioactively contaminated groundwater still exists in the groundwater below the former WSOW and WSUFMP. Due to the type of bedrock that exists below the site, there is no effective method of decontaminating the groundwater. The next best option is to monitor the contamination and let nature take its course to dilute the levels of some contaminants while others slowly degrade. Some of the radioactive contaminants degrade so slowly that they will not decay for more than 4 billion years. There is still an intensive groundwater monitoring program in place with over 150 wells and several springs, to keep track of contaminant levels and to monitor for any unexpected changes. Since the cleanup project was started, most of the contaminant levels in the groundwater have been on a downward trend.

The EPA sets standards for the maximum level of contaminants that can be in drinking water. For uranium, the maximum level is 30 micrograms per liter. Since there are no wells on the area that supply drinking water, the only place a person could come into contact with contaminated water is at natural springs on the area, such as Burgermeister Spring on the Busch Area. Water tested at some springs shows the concentration of uranium to be below the drinking water standard, while at others the uranium levels are above the EPA standard. Test results for uranium in all of the springs that are monitored generally range between 1.5 micrograms/liter and just over 100 micrograms/liter. None of the spring water on the area is contaminated at high enough levels to cause immediate harm to anyone. However, spring water can be contaminated with a variety of chemicals (herbicides and insecticides) and almost all springs are contaminated with biological organisms (*E-coli* and *giardia*). Therefore, remember it is never safe to drink from any spring without analyzing the quality of the water, no matter how clean the water looks!

Burgermeister Spring

In addition to the groundwater monitoring program, the Department of Energy continues to monitor other aspects of this cleanup site. An inspection of the site and some surrounding areas takes place each year. Inspectors look at the disposal cell, Weldon Spring Quarry, monitoring

wells, springs and many other areas to make sure things are in order. There is also a special type of review performed every 5 years that examines the project more in depth and evaluates the cleanup to make sure it is still protective of human health and the environment based on new laws and technologies. The Department of the Army has a similar program in place for site inspection, groundwater monitoring and project reviews. The EPA and Missouri Department of Natural Resources also participate in the review process with the DOE and Army.

Radiological contamination in fish and wildlife has been tested by the Department of Energy, Department of Conservation and independent labs. Results have been improving since the cleanup activities began, and they have never been above action levels. Consequently, consumption warnings have never been applied to area lakes due to radiological contaminants. The Department of Conservation plans to continue the fish tissue monitoring program. This program would sample different species of fish from select lakes on the Busch Area as well as the Femme Osage Slough on the Weldon Spring Area. The goal of the sampling is to monitor fish for any buildup of contaminants that might be passed to visitors who catch and eat fish from area lakes. This program includes monitoring that is not related to DOE or Army activities. Mercury is the most common contaminant leading to fish consumption warnings in Missouri. Some fish samples from 2001 resulted in mercury levels exceeding the EPA standard of 300 parts per billion (ppb), including Busch Area Lake 35 in 2001 (669 ppb). Levels of mercury exceeding the EPA standard can be found in many lakes and streams including seemingly pristine areas such as the Current River and Eleven Point River in which smallmouth bass have been found in excess of 600 ppb. Comparably, the Food and Drug Administration has reported mercury in tuna to exceed 1000 ppb. All lakes in Missouri are under a general fish consumption advisory for pregnant women, nursing mothers and children under 12 for the consumption of largemouth bass larger than 12 inches. For information on mercury and fish please contact the Missouri Department of Health and Senior Services at (573) 751-6400 or www.dhss.mo.gov or the Missouri Department of Conservation Environmental Services at (573) 815-7900. The Busch Area provides a great local resource to catch and safely consume fish. We will continue to monitor fish from the area to ensure fish are safe for consumption.

If you explore the Busch and Weldon Spring conservation areas, you will still find remnants of the Weldon Spring Ordnance Works. All 100 storage bunkers still exist on the Busch Area. Most of the bunkers are welded shut, but approximately 20 of them are used by the Department of Conservation for storage of signs, lumber, equipment and other supplies. You might also see old fire hydrants, manhole covers, fences and building foundations left over from the 1940s.

Storage Bunker

A final outcome of the Department of Energy's cleanup project was the creation of both recreational and educational opportunities. The Hamburg Trail is a hiking and biking trail that links the Katy Trail State Park to the Weldon Spring and Busch conservation areas. The trail is seven miles long and provides access to other trails on both areas. Part of the trail was originally used to haul the contaminated material from the Weldon Spring Quarry to the disposal cell. The Weldon Spring Site Interpretive Center was built near the disposal cell by the Department of Energy. The interpretive center's mission is to provide long-term educational and research opportunities for the surrounding community. Displays in the interpretive center cover historic and scientific information about the surrounding area and the cleanup project. The Weldon Spring Site Interpretive Center is open seven days a week and is free to the public. Detailed information and reports about the history of the former WSOW and cleanup and monitoring performed by the Department of Energy can be found at the website http://www.wssrap.com or can be viewed at the Weldon Spring Site Interpretive Center located at 7295 Highway 94 South, St. Charles, Missouri 63304, phone: (636)300-2600. Reports describing restoration actions by both the Department of Energy and the Department of the Army may also be viewed at the Middendorf-Kredell Branch of the St. Charles County Library located at 2750 Highway K, O'Fallon, Missouri 63368, phone: (636)978-7926.

Environmental and Cultural Considerations at Weldon Spring Training Area

Protect Threatened and Endangered Bats

Indiana bats are federally listed as an endangered species and northern long-eared bats are listed as threatened because of loss of habitat and the disease white-nose syndrome.

Facts about bats:

- Bats fly through openings and wooded areas at night in the summer to eat insects and roost under loose bark on trees during the day.
- Bats forage in wooded areas at night in the summer and roost under exfoliating bark in trees during the day.
- Bats make high frequency sounds to locate their prey.
- Bats eat mosquitoes and other flying insects, so more bats mean less bug bites.
- Indiana bats are small and weigh about the same as three pennies.

Trees used by the Indiana bat and northern long-eared bat for roosting include various oak, elm, hickory, cottonwood, and honey locust.

Indiana bat

Northern long-eared bat

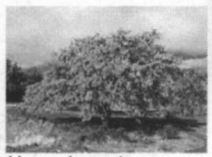
Oak

Elm

Hickory

Loose bark

Cottonwood



Honey Locust

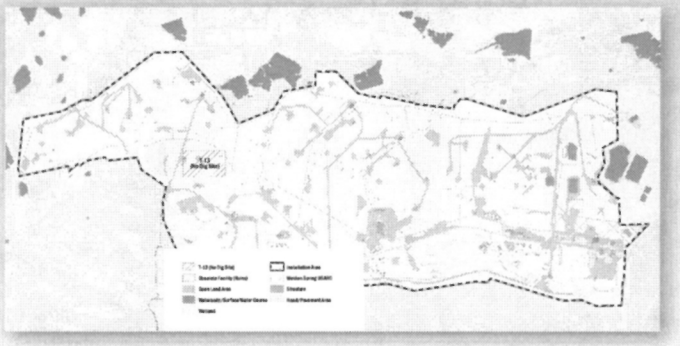
Between April 1 and November 15* When Bats May be Roosting and Feeding on Flying Insects:

**These dates may change – check with your Environmental Manager before conducting any training activities.*

- Minimize night training with pyrotechnics, obscurants, and illumination devices.
- Do not cut or disturb standing trees with loose or peeling bark.
- Obtain approval in advance for any tree cutting from the 88th RSC Environmental Division.
- Record the location of any bats observed leaving trees, then leave the area and notify the Natural Resources Coordinator.

Cease work and notify the Natural Resource Coordinator — 88th RSC (612) 713-3470 or (608) 388-0308 if bats are observed fleeing a tree during any clearing activities.

Protect the Environment



Soils

The WSTA occupies a small portion of the former 17,232-acre Weldon Spring Ordnance Works, which produced trinitrotoluene and dinitrotoluene for the Armed Services.

Remedial actions were completed in June 2004. The WSTA soils were restored to unrestricted use with the exception of a small area designated T-13.

The T-13 site encompasses less than 1 acre in the western area of the facility south of Route A. Institutional controls have been designated for T-13, and "no digging" signs are posted around the perimeter of the site.

Groundwater

Groundwater at WSTA is contaminated with nitroaromatic compounds from explosives manufacturing. Well construction, groundwater withdrawal, and potable use of groundwater are not allowed at WSTA.

Invasive Species Prevention

- Wash vehicles before you bring them on WSTA.

Litter Prevention

- Remove your trash – there are no dumpsters on WSTA.

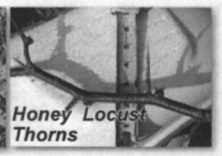
Protect Yourself — Be Aware of Biological and Physical Hazards

Biological Hazards

- Ticks and chiggers
- Poison ivy
- Black locust thorns

Ticks

Poison Ivy



Honey Locust Thorns

Physical Hazards

- Watch where you walk – look for unmarked holes, rebar, and concrete debris.
- Be aware – watch for signs of possible sinkholes.

88TH REGIONAL SUPPORT COMMAND
WELDON SPRING LOCAL TRAINING AREA – WELDON SPRING, MISSOURI

FUTURE DEVELOPMENT PLAN

FINAL SUBMITTAL
NOVEMBER 2014

CONTRACT NUMBER: W912DY-12-D-0047
TASK ORDER NUMBER: 0008

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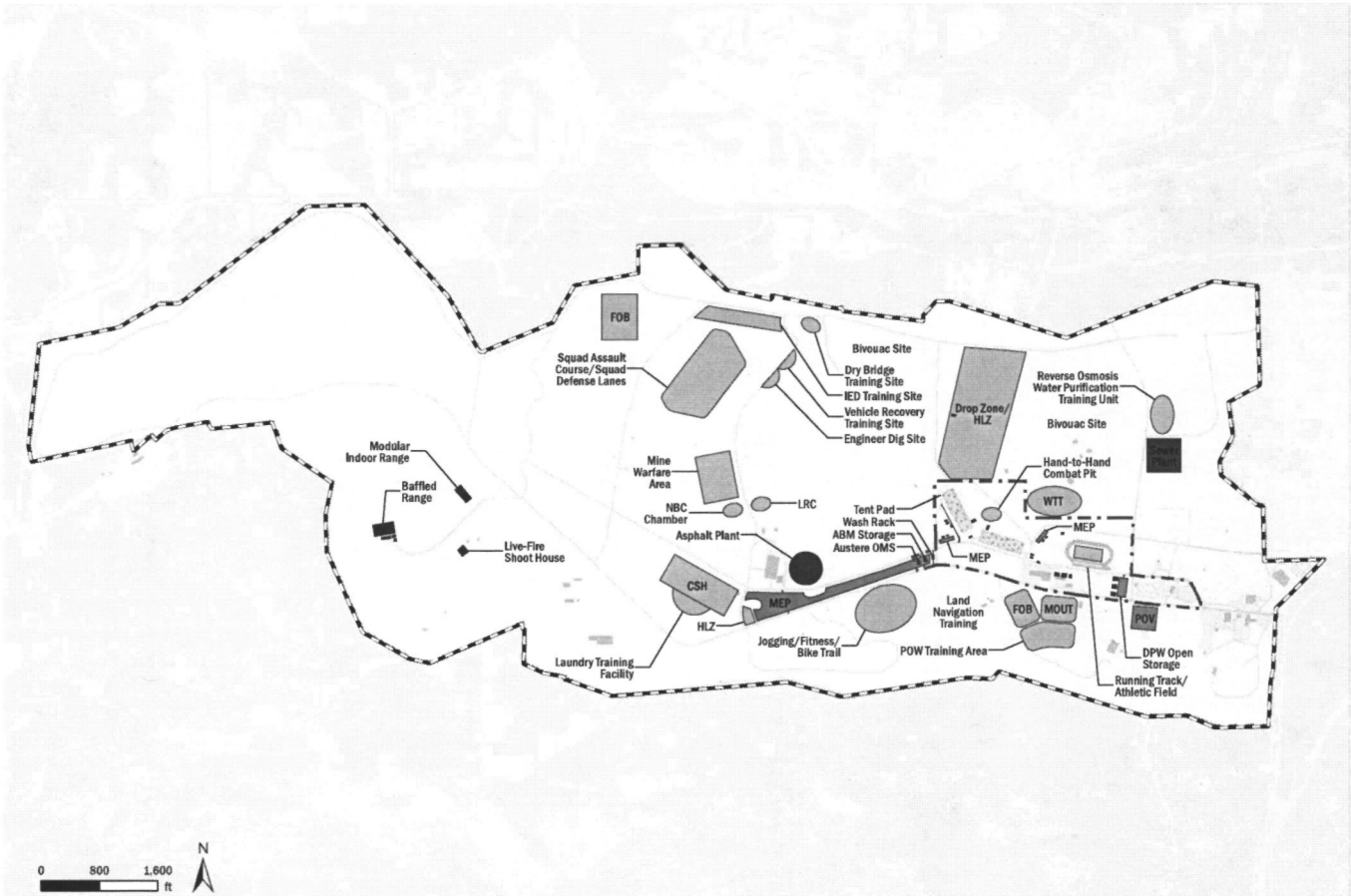
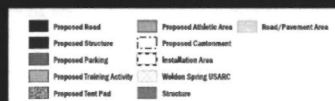
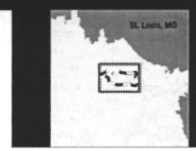


FIGURE ES.1

PREFERRED PLAN LTA





PHASING

Phase 1

Phase 1 provides the highest-priority facilities for Weldon LTA

- Repair the baffled range.
- Construct a range observation tower.
- Establish an ammunition holding area (AHA) utilizing a modular vault.
- Designate a site for the pump station and the bulk water supply point.
- Construct two toilet/shower buildings.
- Construct concrete pad for the containerized kitchen (CK).
- Construct two covered training/mess shelters.
- Expand the existing tent pad site.
- Develop 10 acres military equipment parking (MEP) between Soldiers Drive and Tank Trail.
- Establish electric lines for the tent pad site.
- Construct two simulator buildings; one for the Engagement Skills Trainer (EST) 2000 and another for the High Mobility Multipurpose Wheeled Vehicle (HMMWV) Egress Assistance Trainer (HEAT).
- Construct two Southwest Asia (SWA) huts.
- Construct storage building for environmental section.
- Improvements and baffling for Range 2.
- Construct covered training area/mess shelter.

Phase 1 includes low-cost and no-cost projects that can be completed as the resources become available.

- Construct a forward operating base site (FOB).
- Establish a site for a combat support hospital (CSH) training site.
- Construct a small Military Operations on Urban Terrain (MOUT) site.
- Complete LTA road improvements, such as culvert repair and erosion repair.

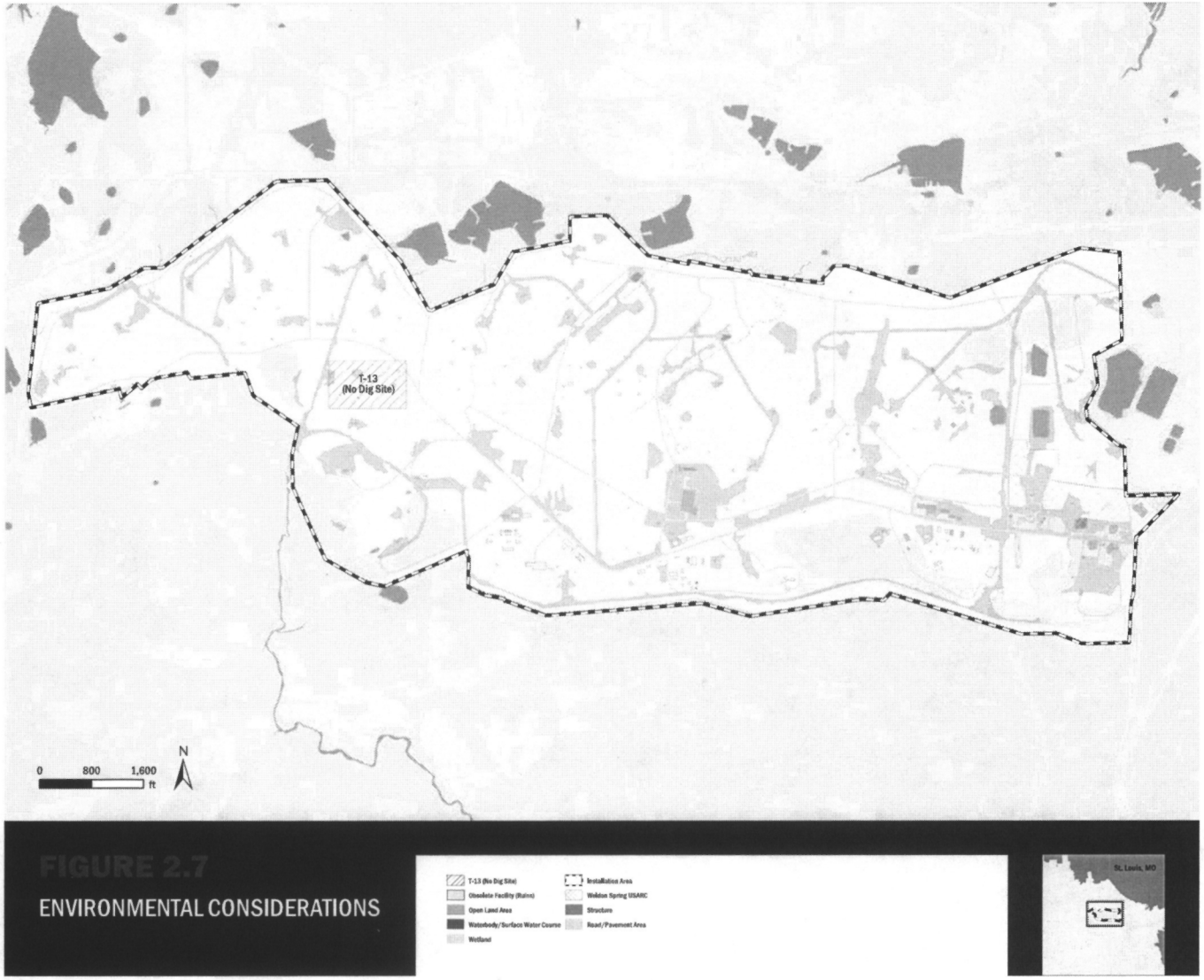


FIGURE 2.7

ENVIRONMENTAL CONSIDERATIONS

ENVIRONMENTAL

Weldon Spring LTA is part of the former WSOW, which is on the EPA's National Priorities List (NPL) and is an active remediation site.

Water

Groundwater at the LTA is contaminated with nitroaromatic compounds from explosives manufacturing. Well construction, groundwater withdrawal, and potable use of the groundwater is not allowed at Weldon Spring LTA.

Soil

With the exception of two areas, soils at Weldon Spring LTA have been remediated. Because of residual nitroaromatic soil contamination located 15-20 feet below the ground surface, no digging is allowed at area T-13. Some soils around the former site of building S-28, which is now being developed for the new USARC/OMS, are impacted with petroleum hydrocarbons and no digging is allowed in this area. Asbestos and lead-based paint generated from burning and demolition of old WSOW buildings may be present throughout the LTA. Any soil-disturbing activities outisde of approved areas require an environmental review.

Historical Structures

Buildings S-61, S-9, S-38, S-104, S-8, G-142, and G-42 are considered significant. Although most buildings have been previously documented in a Historic Context report, compliance with Section 106 of the National Historic Preservation Act is still required with the state historic preservation office prior to any future undertakings that involve impacts to any buildings, building remnants, or towers.

Endangered Species

Training activities that could disturb potential endangered Indiana bat maternity roost trees should take place between 16 November and 31 March. If actvities must take place between 1 April and 15 November, advance approval must be received from the 88th RSC Environmental Division Natural Resources staff. If bats are observed on or leaving a tree, immediately establish a 100-foot no activity standoff radius and immediately notify the facility coordinator and 88th RSC Environmental Division Natural Resource staff for further guidance.

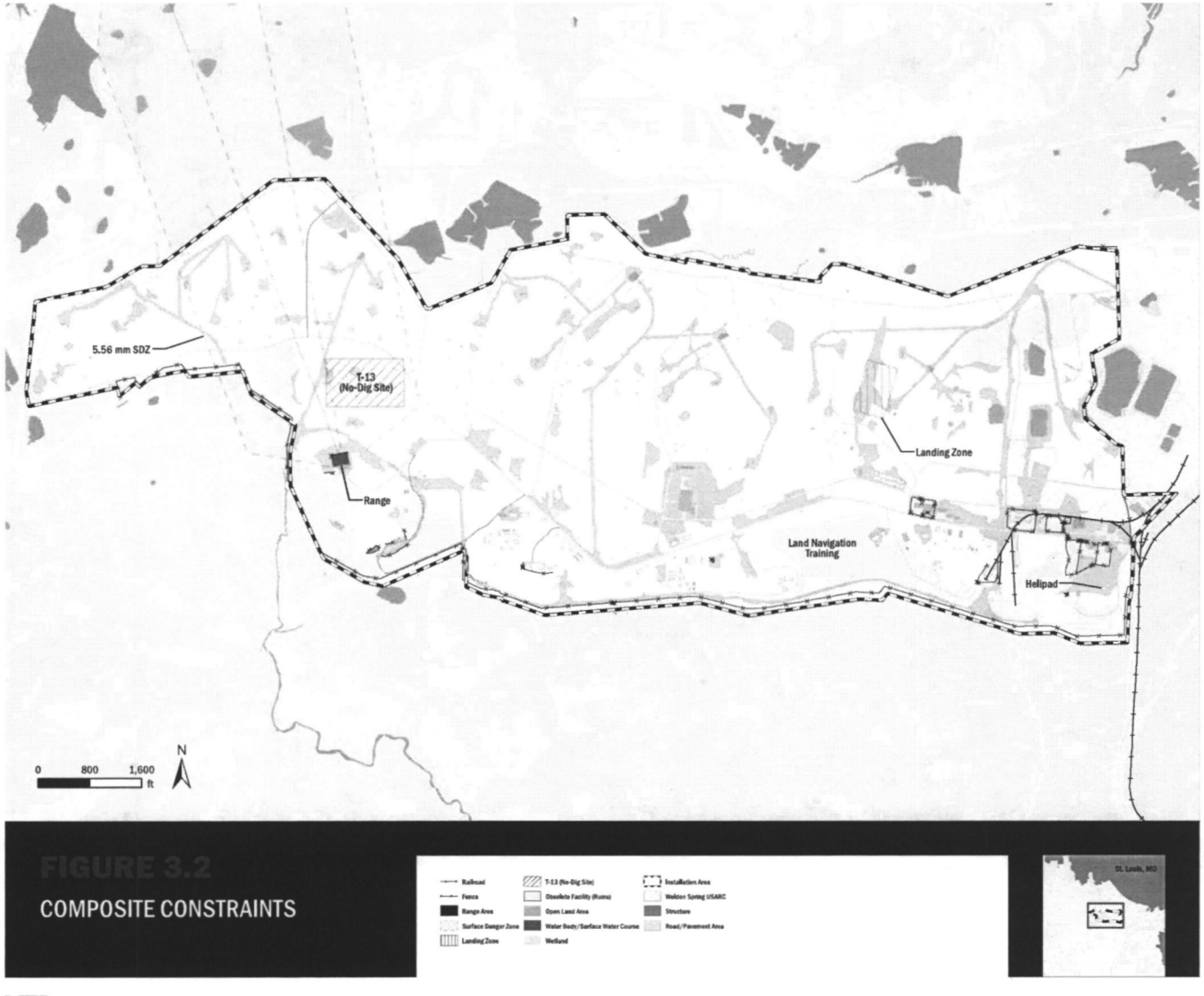


FIGURE 3.2

COMPOSITE CONSTRAINTS

COMPOSITE CONSTRAINTS

WELDON SPRING LTA

The primary development constraints at Weldon Spring LTA result from soil and groundwater contamination.

Water

Groundwater contamination exists at the site because of past uses. Institutional controls restrict the use of groundwater. The restriction states, "The 88th RSC has made a policy that all of the Weldon Spring LTA is under groundwater restrictions – groundwater wells cannot be constructed at Weldon Spring LTA without approval by the Environmental Division, and no one is permitted to use the groundwater for washing or drinking."

Soil

A 5-acre parcel of land within TA 2, known as T-13, has soils contaminated with nitroaromatics resulting from Weldon Spring Ordnance Plant operations. Soil-disturbing activities are prohibited within T-13.

Weldon Spring LTA contains many ruins and abandoned facilities that may contain hazardous building materials. Because of the widespread nature of these facilities and plant industrial activities, the 88th RSC Environmental staff must be consulted before any soil-disturbing activities take place.

Topography

Terrain within Weldon Spring LTA consists of rolling hills with moderate slopes. Much of the LTA is thickly forested. While the terrain and vegetative cover enhance the training environment, clearing and grading for construction will increase construction costs.

Wetlands

Weldon Spring LTA has several large ares that are designated wetlands. While it is possible to develop wetland through the Section 404 permitting process, it is better to retain wetlands for their ecosystem benefits and to ensure a wide range of training environments for Soldiers on foot.

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Appendix F: Groundwater Tables

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Groundwater Tables

Table 19. Groundwater Elevation Data
(Source: HydroGeoLogic, 2015)

Date	Well ID	Northing*	Easting*	Top of PVC Casing (ft amsl)	Depth to Water (ft BTOC)	Water Table Elevation	Formation Screened
4/7/2014	**MWS01**	1044817.076	752396.7197	597.83	14.51	583.32	weathered Burlington-Keokuk
4/7/2014	MWV01	1044823.195	752408.9169	597.84	13.25	584.59	overburden
4/7/2014	MWD02	1044361.702	752276.9989	605.88	20.15	585.73	unweathered Burlington-Keokuk
4/7/2014	**MWS02**	1044360.959	752262.7797	605.25	19.64	585.61	weathered Burlington-Keokuk
4/7/2014	MWV02	1044361.536	752245.5596	604.57	17.29	587.28	overburden
4/7/2014	**MWS03**	1043162.168	751532.5145	635.39	40.12	595.27	unweathered Burlington-Keokuk
4/7/2014	**MWS04**	1042986.548	752400.9594	624.09	20.99	603.10	weathered Burlington-Keokuk
4/7/2014	MWD05	1039717.366	751198.2149	600.68	25.52	575.16	Fern Glen/Chouteau
4/7/2014	**MWS05**	1039707.394	751199.3297	600.60	35.85	564.75	unweathered Burlington-Keokuk
4/7/2014	MWD06	1044461.152	748528.2289	621.56	20.65	600.91	unweathered Burlington-Keokuk
4/7/2014	**MWS06**	1044451.404	748527.7699	621.32	20.68	600.64	unweathered Burlington-Keokuk
4/7/2014	**MWS07**	1044235.484	749896.3657	641.49	44.84	596.65	weathered Burlington-Keokuk
4/7/2014	**MWS08**	1040845.584	747298.4344	690.36	32.89	657.47	weathered Burlington-Keokuk
4/7/2014	MWV08	1040851.802	747311.6208	690.15	19.38	670.77	overburden
4/7/2014	MWD09	1044914.465	746039.9473	636.08	18.78	617.30	unweathered Burlington-Keokuk
4/7/2014	**MWS09**	1044902.449	746060.8528	635.37	17.90	617.47	weathered Burlington-Keokuk
4/7/2014	MWV09	1044908.505	746051.1066	635.79	19.82	615.97	overburden
4/7/2014	**MWS10**	1044891.711	744052.3661	654.19	25.30	628.89	weathered Burlington-Keokuk
4/7/2014	**MWS11**	1043482.954	744007.5614	676.35	31.65	644.70	weathered Burlington-Keokuk
4/7/2014	**MWS12**	1042908.924	746322.1509	657.11	21.06	636.05	weathered Burlington-Keokuk
4/7/2014	**MWS13**	1042177.382	744336.063	692.18	43.73	648.45	weathered Burlington-Keokuk
4/7/2014	MWV13	1042185.22	744338.5271	692.39	42.70	649.69	overburden
4/7/2014	**MWS14**	1040174.548	744834.2535	705.07	38.18	666.89	weathered Burlington-Keokuk
4/7/2014	MWD15	1045204.885	742144.0785	655.76	33.33	622.43	weathered Burlington-Keokuk
4/7/2014	**MWS15**	1045189.758	742148.3585	656.72	34.69	622.03	weathered Burlington-Keokuk
4/7/2014	**MWS16**	1043257.209	741250.4971	651.24	27.40	623.84	weathered Burlington-Keokuk
4/7/2014	MWV16	1043269.591	741252.8124	651.78	26.70	625.08	overburden
4/7/2014	**MWS17**	1041381.3	742692.4357	659.60	22.42	637.18	unweathered Burlington-Keokuk
4/7/2014	MWV17	1041385.413	742683.0766	660.28	14.30	645.98	overburden
4/7/2014	MWD18	1041701.755	740657.3462	601.55	21.62	579.93	Kimmswick

Date	Well ID	Northing*	Easting*	Top of PVC Casing (ft amsl)	Depth to Water (ft BTOC)	Water Table Elevation	Formation Screened
4/7/2014	MWS18	1041713.567	740655.3722	601.91	21.83	580.08	Choteau/Bachelor/Sulfur Springs
4/7/2014	MWV18	1041692.098	740659.1052	601.43	20.4	581.03	overburden
4/7/2014	**MWS19**	1045738.475	739685.1894	648.66	27.24	621.42	weathered Burlington-Keokuk
4/7/2014	**MWS20**	1044715.528	739909.9585	668.48	40.99	627.67	weathered Burlington-Keokuk
4/7/2014	**MWS21**	1041810.377	753339.1686	642.28	32.70	609.58	weathered Burlington-Keokuk
4/7/2014	**MWS22**	1043493.303	744532.8638	664.14	20.18	643.96	weathered Burlington-Keokuk
4/7/2014	MWV22	1043485.406	744523.7235	663.81	19.81	644.00	overburden
4/7/2014	MWD23	1042719.563	742818.2918	710.80	62.28	648.52	unweathered Burlington-Keokuk
4/7/2014	**MWS23**	1042717.608	742836.1423	710.32	54.57	655.75	weathered Burlington-Keokuk
4/7/2014	MWS24	1043775.301	744798.0741	657.29	25.20	632.09	weathered Burlington-Keokuk
4/7/2014	MWV24R	1044583.674	745966.2167	642.19	24.29	617.90	overburden
4/7/2014	MWD25	1041616.613	750264.8618	683.84	61.52	622.32	unweathered Burlington-Keokuk
4/7/2014	**MWS25**	1041627.483	750283.1721	683.46	57.78	625.68	weathered Burlington-Keokuk
4/7/2014	MWS26	1040141.694	750636.0078	675.19	DRY	-	weathered Burlington-Keokuk
4/7/2014	**MWS27**	1042715.588	740785.1247	625.28	23.98	601.30	weathered Burlington-Keokuk
4/7/2014	MWV27	1042715.588	740785.1247	625.93	17.89	608.04	overburden
4/7/2014	**MWS28**	1043446.017	738062.187	683.17	36.22	646.95	weathered Burlington-Keokuk
4/7/2014	MWV28	1043448.082	738071.302	683.16	36.24	646.92	overburden
4/7/2014	**MWS29**	1044641.983	737779.631	659.57	13.55	646.02	weathered Burlington-Keokuk
4/7/2014	MWV29	1044650.941	737774.582	659.43	13.20	646.23	overburden
4/7/2014	**MWS30**	1042272.819	746508.811	674.06	36.30	637.76	weathered Burlington-Keokuk
4/7/2014	MWS31	1043796.591	747930.98	643.73	DRY	-	weathered Burlington-Keokuk
4/7/2014	**MWS32**	1042314.511	747961.717	658.31	32.10	626.21	weathered Burlington-Keokuk
4/7/2014	**MWS33**	1042728.913	745837.375	667.48	27.00	640.48	weathered Burlington-Keokuk
4/7/2014	MWD34	1043223.599	746704.0476	NA	21.15	-	unweathered Burlington-Keokuk
4/7/2014	MWS102	1031962.52	747762.9361	481.13	DRY	-	Decorah
4/7/2014	MWS103	1037835.924	742441.5014	529.67	DRY	-	Sulfur Springs/Kimmswick
4/7/2014	MWV103	1037841.884	742436.5	529.59	15.95	513.64	overburden
4/7/2014	**MWS104**	1048173.227	760618.6565	566.85	13.67	553.18	weathered Burlington-Keokuk
4/7/2014	MWD105	1046891.19	753975.2411	575.45	19.84	555.61	unweathered Burlington-Keokuk

Table 20. 2014 Analytical Results
(Source: HydroGeoLogic 2015)

Field Sample ID	Date Sampled	Laboratory SDG-ID	Constituent (µg/L)										
			1,3-Dinitrobenzene	2,6-Dinitrotoluene	2,4-Dinitrotoluene	2-amino-4, 6-Dinitrotoluene	4-amino-2, 6-Dinitrotoluene	o-Nitrotoluene	m-Nitrotoluene	p-Nitrotoluene	1,3,5-Trinitrobenzene	2,4,6-Trinitrotoluene	Nitrobenzene
		Remediation Goal	1	1.3	0.11	NA	NA	37	37	37	NA	2.8	17
Monitoring Wells													
OU2-MW4007-042014	4/10/2014	FA14159-7	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U
OU2-MWD09-042014	4/8/2014	FA14049-9	0.11 U	0.44 U	0.11 U	0.11 U	**0.57**	0.11 U	0.11 U	0.11 U	**0.099 J**	0.11 U	0.11 U
OU2-MWD15-042014	4/9/2014	FA14159-1	0.10 U	**0.61**	0.10 U	**1.4**	**2.7**	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U
OU2-MWD34-042014	4/10/2014	FA14159-5	0.20 U	0.40 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	**1.1**	0.10 U	0.10 U
OU2-MWD34-1-042014	4/10/2014	FA14159-6	0.20 U	0.40 U	**0.14 J**	0.10 U	0.10 U	**0.46**	0.10 U	**0.15 J**	**1.1**	0.10 U	0.10 U
OU2-MWS01-042014	4/9/2014	FA14159-2	0.098 U	0.098 U	0.098 U	0.098 U	0.098 U	0.098 U	0.098 U	0.098 U	0.098 U	0.098 U	0.098 U
OU2-MWS04-042014	4/8/2014	FA14049-11	**0.30**	0.38 U	0.097 U	**2.1**	**1.9**	0.097 U	0.097 U	0.097 U	**4.2**	**0.21**	0.097 U
OU2-MWS103-042014	4/10/2014	FA14159-8	0.096 U	0.19 U	0.096 U	0.096 U	0.096 U	**0.24**	0.096 U	**0.19**	0.096 U	0.096 U	0.096 U
OU2-MWS108-042014	4/10/2014	FA14159-9	0.099 U	0.099 U	0.099 U	0.099 U	0.099 U	0.099 U	0.099 U	0.099 U	0.099 U	0.099 U	0.099 U
OU2-MWS110-042014	4/10/2014	FA14159-10	0.098 U	0.20 U	0.098 U	**0.22**	**0.34**	**0.16 J**	0.098 U	**0.12 J**	**0.11 J**	0.098 U	0.098 U
OU2-MWS116-042014	4/10/2014	FA14159-10	0.098 U	0.098 U	0.098 U	0.098 U	0.098 U	0.098 U	0.098 U	0.098 U	0.098 U	0.098 U	0.098 U
OU2-MWS12-042014	4/8/2014	FA14049-15	0.095 U	**12.2**	0.095 U	**1.2**	**2.4**	**0.55**	0.095 U	**0.36**	**1.7**	**1.4**	0.095 U
OU2-MWS15-042014	4/9/2014	FA14049-14	0.095 U	1.7 U	0.095 U	**4.4**	**10.3**	0.095 U	0.095 U	0.095 U	0.095 U	**0.36**	0.095 U
OU2-MWS21-042014	4/9/2014	FA14049-12	0.098 U	0.40 U	**0.46**	0.098 U	0.098 U	**0.59**	0.098 U	**0.57**	0.098 U	0.098 U	0.098 U
OU2-MWS21-1-042014	4/9/2014	FA14049-13	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U
OU2-MWS31-042014	4/9/2014	FA14159-4	0.096 U	**0.26**	0.096 U	**1.4**	**1.2**	0.096 U	0.096 U	0.096 U	**0.98**	0.096 U	0.096 U
OU2-MWV01-042014	4/9/2014	FA14159-3	0.096 U	**0.26**	**0.13 J**	**0.61**	**1.5**	0.096 U	0.096 U	0.096 U	0.096 U	**0.16 J**	0.096 U
OU2-MWV09-042014	4/8/2014	FA14049-10	**0.46 J**	**2.9**	**11.4**	**7.1**	**5.3**	0.095 U	0.095 U	0.19 U	**9.4**	**4.8**	0.095 U
OU2-USGS4-042014	4/10/2014	FA14159-12	0.099 U	0.60 U	0.099 U	**1.8**	**1.7**	0.099 U	0.099 U	0.099 U	**1.4**	0.099 U	0.099 U
Springs													
OU2-SP5303-042014	4/9/2014	FA14049-6	0.10 U	0.10 U	0.10 U	**0.33**	**0.95**	0.10 U	0.10 U	0.10 U	0.10 U	**7.7**	0.10 U
OU2-SP5303-1-042014	4/9/2014	FA14049-7	0.10 U	0.10 U	0.10 U	**0.32**	**0.87**	0.10 U	0.10 U	0.10 U	0.10 U	**7.9**	0.10 U
OU2-SP5304-042014	4/9/2014	FA14049-8	0.10 U	0.10 U	0.10 U	**0.3**	**0.6**	0.10 U	0.10 U	0.10 U	0.10 U	**0.22**	0.10 U
OU2-SP5602-042014	4/8/2014	FA14049-4	0.10 U	**3.3**	**0.76**	**0.75**	**1.5**	**0.41**	**0.18 J**	0.20 U	**0.16 J**	**2.2**	0.10 U
OU2-SP5603-042014	4/8/2014	FA14049-3	0.096 U	0.096 U	0.096 U	0.096 U	0.096 U	0.096 U	0.096 U	0.096 U	0.096 U	0.096 U	0.096 U
OU2-SP5605-042014	4/8/2014	FA14049-5	0.099 U	0.099 U	0.099 U	**0.51**	**1.4**	0.099 U	0.099 U	0.099 U	**0.09 J**	**5.5**	0.099 U
OU2-SP6301-042014	4/8/2014	FA14049-2	0.097 U	0.097 U	0.097 U	0.097 U	0.097 U	0.097 U	0.097 U	0.097 U	0.097 U	0.097 U	0.097 U
OU2-SP6502-042014	4/8/2014	FA14049-1	0.098 U	0.098 U	0.098 U	0.098 U	0.098 U	0.098 U	0.098 U	0.098 U	0.098 U	0.098 U	0.098 U

Notes:
BOLD = detection
Shaded = result greater than or equal to Remediation Goal
J = The analyte was detected at the reported concentration; the quantitation is an estimate. U = Not detected. The associated number indicates the analyte limit of detection.
NA = not applicable
µg/L = micrograms per liter

Table 21. Statistical Analysis Summary
(Source: HydroGeoLogic 2015)

Well	Constituent	Spring Basin	Objective	Mean (µg/L)	Confidence Interval		RG (µg/L)	RG (ln) y	m	b	r^2	Estimated Time to Reach RG		
					Upper Limit (µg/L)	Lower Limit (µg/L)						2014 x = (y-b)/m	2009 (x)	2004 (x)
MWS12	2,4-DNT	B	OB-1	107.6	118	23.82	0.11	-2.207275	0.108	3.3221	0.1068	*	*	*
	2,6-DNT	B	OB-1	62.59	79.96	31.07	1.3	0.2623643	-0.0269	3.9372	0.0167	137	*	*
	o-NT	B	OB-1	314.2	443.2	185.2	37	3.6109179	-0.1349	6.0878	0.134	18	22	*
	p-NT	B	OB-1	159.3	207.4	59.9	37	3.6109179	-0.1013	4.9664	0.0694	13	-	*
MWV09	2,4,6-TNT	B	OB-1	17.72	23.13	12.31	2.8	1.0296194	-0.186	3.6092	0.7703	14	16	18
	2,4-DNT	B	OB-1	27.72	45	11.4	0.11	-2.207275	-0.2154	3.9636	0.4256	29	22	163
	2,6-DNT	B	OB-1	4.087	5.195	1.811	1.3	0.2623643	-0.1048	1.884	0.2471	15	14	29
SP5303	2,4,6-TNT	F	OB-3	33.21	40.47	4.072	2.8	1.0296194	-0.1075	3.3444	0.0852	22	*	*
SP5605	2,4,6-TNT	D	OB-3	19.22	27.35	11.09	2.8	1.0296194	-0.1772	3.5377	0.4713	14	21	9
USGS4	2,6-DNT	B	OB-1	1.931	2.501	1.36	1.3	0.2623643	-0.1447	1.3126	0.7288	7	10	*

Notes:
All monitoring point/constituent pairs presented above exhibited a 99 percent confidence that concentrations would fall between the calculated upper and lower limits for which both limits were above the RG.

- = analysis not run on monitoring point
* = upward trend in concentrations observed, years could not be estimated
(µg/L) = micrograms per liter
2,4,6-TNT = 2,4,6-trinitrotoluene
2,4-DNT = 2,4-dinitrotoluene
2,6-DNT = 2,6-dinitrotoluene
b = y intercept
m = calculated slope
o-NT = o-nitrotoluene
p-NT = p-nitrotoluene
r2 = coefficient of determination. General measure of how well future outcomes are predicted by the linear regression model.
RG = remediation goal
x = time in years from OU 1 source removal (October 1999).
y = the natural log of the RG

Table 22. Summary of RA-01 to RA-11
(Source: HydroGeoLogic 2015)

Monitoring Location[1]	Objective[1]	Analyte	Sampling Round / Sampling Event / Remediation Goals (µg/L)[2]	RA-01 Aug-05	RA-02 May-06	RA-03 Sep-06	RA-04 May-07	RA-05 Aug-08	RA-06 Apr-09	RA-07 May-10	RA-08 May-11	RA-09 May-12	RA-10 May-13	RA-11 Apr-14	Consecutive Increases in Concentration[3]
				Concentration (µg/L)											
MWV01	OB-1	2,4-Dinitrotoluene	0.11	NS	**0.105 J**	NS	NS	NS	**0.085 J**	**0.87 J**	0.070 U	0.051 U	**0.034 J**	**0.13 J**	Yes
MWS04	OB-1	2,4-Dinitrotoluene	0.11	**0.08 J**	**0.087 J**	**0.156 J**	**0.12 J**	**0.085 J**	0.10 U	**0.077 J**	**0.056 J**	**0.089**	NS	0.097 U	No
MWV09	OB-1	2,4,6-Trinitrotoluene	2.8	**24.1**	**8.52**	**23.5**	**7.6**	**6.3**	**6.7**	**6.7**	**5.5**	**2.1**	**0.88**	**4.8**	No
		2,4-Dinitrotoluene	0.11	**47.9**	**0.84**	**56**	**0.42**	**15.2**	**3.0 J**	**7.00**	**0.72 J**	**18.7**	**0.55 J**	**11.4**	No
		2,6-Dinitrotoluene	1.3	**4.69**	**2.43**	**5.44**	**2.1**	**1.3**	**3.1 J**	1.0 U	**0.56 J**	**15.9**	0.098 U	**2.9**	No
		1,3-Dinitrobenzene[5]	1	**0.76**	0.158 U	**1.09**	**2.38 J**	0.2 U	1.0 U	1.0 U	0.82 UJ	**0.44 J**	0.54 UJ	**0.46 J**	No
MWS12	OB-1	1,3-Dinitrobenzene	1	0.16 U	**8.31**	0.158 U	**17**	**2.2 J**	**2.6 J**	**5.7 J**	12.2 U*J	**0.51 J**	**0.59 J**	0.095 U	No
		2,4,6-Trinitrotoluene	2.8	**0.56 J**	**5.51**	**0.678 J**	**14**	1.7 U	**2.2 J**	**6.2 J**	**11.9**	**1.9 J**	**1.2**	**1.4**	No
		2,4-Dinitrotoluene	0.11	**5.26**	**242**	**9.91**	**440**	**89.8**	**86.1 J**	**198**	**375 J**	**20.9**	**19.3 J**	0.095 U	No
		2,6-Dinitrotoluene	1.3	**8.54**	**117**	**13.9**	**160**	**45.7**	**25.5 J**	**97.4**	**147**	**18.3**	**7.1 J**	**12.2**	No
		o-Nitrotoluene	37	**165 J**	**504**	**201**	**780**	**417**	**1.6 J**	**409 J**	**543**	**95.8 J**	0.53 R	**0.55**	No
		m-Nitrotoluene[5]	37	**10.4**	**43.3**	**14.70**	**63**	**29.70**	1.0 UJ	**27.70**	**45.3**	**8.4 J**	0.53 R	0.095 U	No
		p-Nitrotoluene	37	**52.8 J**	**264**	**43.3 J**	**480**	**202**	**2.0 J**	**221**	**400**	**28 J**	0.53 R	**0.36**	No
MWS15	OB-1	2,4-Dinitrotoluene	0.11	0.158 U*	0.158 U*	0.158 U*	0.25 U*	0.1 U	**0.083 J**	**0.035 J**	NS	0.051 U	NS	0.095 U	No
		2,4,6-Trinitrotoluene[5]	2.80	**0.48**	0.158 U	0.158 U	0.25 U	**1.5**	0.10 U	**3.4**	NS	**1.4**	NS	**0.36**	No
		2,6-Dinitrotoluene[5]	1.30	**0.85**	**2.04**	**1.32**	**1.10**	**0.67**	**1.3 J**	**0.78 J**	NS	**0.67**	NS	1.7 U*	No
MWS21	OB-1	2,4-Dinitrotoluene	0.11	0.16 U*	0.158 U*	0.158 U*	0.25 U*J	0.1 U	0.10 U	0.22 U*	NS	0.05 U	NS	**0.46**	No
USGS4	OB-1	2,4-Dinitrotoluene	0.11	**0.09 J**	**0.095 J**	0.158 U*	**0.082 J**	NA[4]	**0.11 J**	**0.18**	0.10 UJ	0.061 U	0.051 UJ	0.099 U	No
		2,6-Dinitrotoluene	1.3	**1.73**	**2.02**	**1.7**	**1.8**	NA[4]	**0.85 J**	**0.99 J**	**0.55 J**	0.56 U	**0.25 J**	0.60 U	No
SP5303	OB-3	2,4,6-Trinitrotoluene	2.8	**42.3**	**72.1**	**203**	0.25 U	**84.50**	**3.3**	**16.1**	**1.8 J**	**4.8**	**1.5 J**	**7.9**	No
		2,4-Dinitrotoluene[5]	0.11	**0.11 J**	**0.208**	**0.39 J**	0.25 U*	**0.18**	0.10 U	**0.086 J**	0.065 UJ	0.055 U	0.05 UJ	0.10 U	No
SP5602	OB-3	2,4,6-Trinitrotoluene[5]	2.80	**3.60**	**6.88**	**0.44 J**	**5.6 J**	**0.20**	**0.31 J**	**3.8**	**1.5 J**	**3.0**	**0.85**	**2.2**	No
		2,4-Dinitrotoluene	0.11	0.16 U*	0.158 U*	**0.117 J**	0.25 U*	0.1 U	**0.45**	**0.11**	0.080 UJ	**0.12**	**0.12 J**	**0.76**	No
		2,6-Dinitrotoluene	1.3	**0.84**	**2.23**	**0.71**	**1.6 J**	**0.66**	**0.47 J**	**3.0**	0.080 UJ	**1.5**	**0.44 J**	**3.3**	No
SP5605	OB-3	2,4,6-Trinitrotoluene	2.8	**33.8**	**14.6**	NS	**26 J**	**21.1**	**2.50**	**4.6**	**3.0 J**	**1.5**	**1.8 J**	**5.5**	Yes
		2,6-Dinitrotoluene[5]	1.3	**1.47**	**1.47**	NS	**1.5 J**	**1**	1.0 U	**0.44 J**	1.0 U	**0.22 J**	**0.53 R**	0.099 U	No

Notes:

[1] = Monitoring Locations and Objectives per RD/RA WP Table 2-2 (USACE, 2005) and RD/RA WP Addendum No. 1 (ECC/BMcD, 2011).

[2] = Remediation Goals per RD/RA WP Table 1-1 (USACE, 2005).

[3] = Exhibiting two consecutive increases in concentration in three consecutive sampling rounds.

[4] = USGS4 was sampled during Round RA-05; however, both sample bottles were broken during shipment to the laboratory.

[5] = not listed in RD/RA WP Table 2-2; added based on subsequent data showing detections above the remediation goal.

BOLD = Detection

Shading = Detection exceeding Remediation Goal

J = estimated value

µg/L = micrograms per liter

NA = not analyzed

NS = not sampled

U = Not detected. The associated number indicates the analyte limit of detection.

U* = Not detected. The associated number indicates the analyte limit of detection. Reporting limit above Remediation Goal.

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