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From Science to Solutions

October 30, 2009

Document Control Center
c/o Yolande J.C. Norman, Project Manager
Division of Waste Management and Environmental Protection
Office of Federal and State Materials and Environmental Management Programs
U.S. Nuclear Regulatory Commission
Mail Stop T-8F5
11545 Rockville Pike
Rockville, Maryland 20852

Dear Ms. Norman:

Through discussions with the U.S. Nuclear Regulatory Commission and the U.S. Army and at the direction of the U.S. Army, Science Applications International Corporation (SAIC) is submitting 3 hard copies and 2 electronic copies on CD-ROM of the *Final Field Sampling Plan (FSP) Addendum 8 – Depleted Uranium Impact Area Site Characterization: Soil Sampling and Analysis using Direct Push Technology, Partition Coefficient Study for Glacial Till Stratigraphic Layer*. Note, one of the hard copies has been provided directly to Mr. Keith McConnell, Deputy Director (Decommissioning and Uranium Recovery Licensing Directorate, Division of Waste Management and Environmental Protection, Office of Federal and State Materials and Environmental Management Programs) in accordance with your request. If you have any questions, please contact Mr. Paul Cloud, Jefferson Proving Ground (JPG) License Radiation Safety Officer, U.S. Army JPG at (410) 436-2381, E-mail address: paul.d.cloud@us.army.mil.

Sincerely,

Joseph N. Skibinski

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Brooks Evens
SAIC Central Records Project File (transmittal memo only)

FIELD SAMPLING PLAN ADDENDUM 8

Depleted Uranium Impact Area Site Characterization: Soil Sampling and Analysis using Direct-Push Technology, Partition Coefficient Study for Glacial Till Stratigraphic Layer
Jefferson Proving Ground, Madison, Indiana

FINAL

Prepared for:

U.S. Department of Army
Installation Support Management Activity
5183 Blackhawk Road
Aberdeen Proving Ground, Maryland 21010-5424

and
U.S. Army Corps of Engineers
Louisville District
600 Dr. Martin Luther King, Jr. Place
Louisville, Kentucky 40202-2230

Submitted by:
Science Applications International Corporation
12100 Sunset Hills Road
Reston, Virginia 20190

Contract No. W912QR-08-D-0008
Delivery Order No. 0010

October 2009

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Nuclear Regulatory Commission License No. 24-32591-01

October 2009

FINAL

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Dennis R. Chambers Radiation Safety Officer	Telephone	Date
Charles L. Klinger (sms)	(717) 901-8805	October 30, 2009
Charles L. Klinger Field Manager, Certified Professional Soil Scientist (#32079)	Telephone	Date
Tad Fox	(330) 405-5820	October 30, 2009
Tad C. Fox Licensed Indiana Professional Geologist (Registration # IN2244)	Telephone	Date

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CERTIFICATION 4

CONTRACTOR STATEMENT OF INDEPENDENT TECHNICAL REVIEW

Science Applications International Corporation (SAIC) has prepared this Field Sampling Plan (FSP) Addendum 8 for performing site characterization at Jefferson Proving Ground's (JPG's) Depleted Uranium (DU) Impact Area, located in Madison, Indiana. Notice is hereby given that an independent technical review has been conducted that is appropriate to the level of risk and complexity inherent in the project, as defined in the Quality Control Plan (QCP). During the independent technical review, compliance with established policy principles and procedures, utilizing justified and valid assumptions, was verified. This included review of assumptions; methods, procedures, and material used in analyses; alternatives evaluated; the appropriateness of data used and level of data obtained; and reasonableness of the results, including whether the product meets the customer's needs consistent with law and existing U.S. Army Corps of Engineers (USACE) policy.

Joseph N. Skibinski
Project Manager
Science Applications International Corporation

October 30, 2009
Date

Joseph E. Peters
Quality Assurance Officer
Science Applications International Corporation

October 30, 2009
Date

Michael L. Barta
Independent Technical Review Lead
Science Applications International Corporation

October 30, 2009
Date

Significant concerns and explanation of the resolutions, if identified, are documented within the project file. As noted above, all concerns resulting from independent technical review of the project have been considered.

Lisa D. Jones-Bateman
Vice President
Science Applications International Corporation

October 30, 2009
Date

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LIST OF ACRONYMS AND ABBREVIATIONS

ARCPACS	American Registry of Certified Professionals in Agronomy, Crops, and Soil
ASTM	American Society for Testing and Materials
BLS	Below Land Surface
BU	Business Unit
CD	Compact Disc
CFR	*Code of Federal Regulations*
CHP	Certified Health Physicist
cm	Centimeter(s)
cm^2	Square Centimeter(s)
cm^3	Cubic Centimeter(s)
CoC	Chain of Custody
cpm	Counts per Minute
CSP	Certified Safety Professional
CWM	Chemical Warfare Materiel
DQO	Data Quality Objective
DU	Depleted Uranium
E&I	Engineering and Infrastructure
EC&HS	Environmental Compliance & Health and Safety
EPA	U.S. Environmental Protection Agency
FSP	Field Sampling Plan
ft	Feet/Foot
FTP	Field Technical Procedure
FWS	U.S. Fish and Wildlife Service
gal	Gallon(s)
GPS	Global Positioning System
HASP	Health and Safety Plan
HDPE	High-Density Polyethylene
HPT	Health Physics Technician
I.D.	Identification
IDW	Investigation-derived Waste
in.	Inch(es)
$in.^3$	Cubic Inch(es)
JPG	Jefferson Proving Ground
K_d	Partition or Distribution Coefficient
kg	Kilogram(s)
L	Liter(s)
lbs	Pound(s)
m	Meter(s)
m^2	Square Meter(s)
MEC	Munitions and Explosives of Concern
mL	Milliliter(s)
NRC	U.S. Nuclear Regulatory Commission
NUREG	U.S. Nuclear Regulatory Commission Regulation
OE	Ordnance and Explosives
pCi/g	Picocuries per Gram
PM	Project Manager
PNNL	Pacific Northwest National Laboratory
POC	Point of Contact
QA	Quality Assurance

LIST OF ACRONYMS AND ABBREVIATIONS (Continued)

QAAP	Quality Assurance Administrative Procedure
QAPP	Quality Assurance Project Plan
QC	Quality Control
QCM	Quality Control Manager
QCP	Quality Control Plan
R_d	Distribution Ratio
RESRAD	Residual Radiation
RSO	Radiation Safety Officer
SAIC	Science Applications International Corporation
SHSO	Site Health and Safety Officer
SOP	Standard Operating Procedure
TOC	Total Organic Carbon
USACE	U.S. Army Corps of Engineers
USGS	U.S. Geological Survey
UXO	Unexploded Ordnance

1. INTRODUCTION

Jefferson Proving Ground (JPG), located in Madison, Indiana, is pursuing termination of their U.S. Nuclear Regulatory Commission (NRC) Source Material License, SUB-1435, which authorizes possession of depleted uranium (DU). To support the decommissioning and license termination process, the Army is performing additional characterization of the DU Impact Area, a 2,080-acre area located north of the firing line. The DU Impact Area is the location where DU penetrators impacted after being fired from three fixed-gun positions located on the firing line.

This document is Addendum 8 to the Field Sampling Plan (FSP) [SAIC 2005a]. Science Applications International Corporation (SAIC) has prepared this Addendum in accordance with the scope of work for "Continued Site Characterization of the Depleted Uranium Impact Area" under U.S. Army Corps of Engineers (USACE) Contract No. W912QR-08-D-0008, delivery order number 0010, dated 1 January 2009.

This FSP Addendum documents and provides details that were not addressed, or have been modified from the information presented in the original FSP (SAIC 2005a), in order to ensure the collection of soil samples from within the glacial till stratigraphic layer and conduct analyses to evaluate the layer's partition coefficient (K_d).

The data quality objectives (DQOs) for the site-specific partition coefficient study were defined in FSP Addendum 7 (SAIC 2008). These actions provide critical, site-specific information for incorporation into modeling to evaluate contaminant fate and transport, which in turn will affect the resultant doses to the average member of the critical group required by 10 *Code of Federal Regulations* (*CFR*) 20, Subpart E.

This Addendum follows the same format and includes relevant sections of the FSP by reference. This document is to be used in conjunction with the existing FSP, not as a replacement. SAIC assumes no liability for the use of this information for any other purpose than as stated in this Addendum or the original FSP.

The information provided in this FSP was developed for use by SAIC and subcontractors to complete the collection and laboratory analysis of soil samples, and collection of other related field data. The updated project organization and responsibilities are presented in Section 2. Direct-push sampling and analysis is summarized in Section 3. The K_d study is presented in Section 4. Section 5 discusses the forms used to document field operations. Section 6 summarizes sample handling, packaging, and shipment requirements. Information concerning the handling of investigation-derived waste (IDW) is provided in Section 7. Section 8 describes radiological responsibility and licensing. The references used in preparing this Addendum are provided in Section 9. The following appendices provide supporting documentation:

Appendix A – SAIC Field Forms—This appendix (provided on accompanying compact disc [CD]) includes copies of applicable field forms that will be followed during the field program described in this Addendum.

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2. PROJECT ORGANIZATION AND RESPONSIBILITIES

SAIC personnel and subcontractors are required to comply with all of the policies and procedures specified in this FSP Addendum, associated plans (SAIC 2005a, b, and c), the Health and Safety Plan (HASP) Addendum 7 (under development), and other related project documents. The following summarizes the roles and responsibilities of the SAIC personnel conducting and overseeing the collection and analysis of environmental media, and associated field measurements:

Mr. Joseph N. Skibinski is SAIC's JPG Project Manager (PM). He is responsible for all activities conducted at JPG, including the sampling and analysis, as well as for all external coordination.

Mr. Tad C. Fox is SAIC's Hydrogeology and Multimedia Sampling and Analysis Lead for the sampling and analysis activities, hydrology, and hydrogeologic investigation activities. He is responsible for providing professional guidance associated with the sampling, hydrology, and hydrogeologic investigations. Mr. Fox is a Licensed Professional Geologist in the state of Indiana.

Mr. Charles L. Klinger will serve as the Field Manager and Site Health and Safety Officer (SHSO). Mr. Klinger has managed field operations and served as SHSO for numerous sites over the past 14 years. Mr. Klinger is a Certified Professional Soil Scientist (certification #32079) with the American Registry of Certified Professionals in Agronomy, Crops, and Soil (ARCPACS). When Mr. Fox is not at JPG, Mr. Klinger will be the primary POC for SAIC. He is responsible for ensuring work activities are conducted in accordance with the procedures and policies specified in this FSP Addendum, the HASP Addendum 7 (under development), and other related project documents.

Mr. Randy C. Hansen will serve as the Project Health and Safety Officer. He is a Certified Safety Professional (CSP) and a Certified Health Physicist (CHP) and has supervised the safety and radiation protection programs for remedial action projects involving radiological contamination to include experience supporting field operations at JPG. Mr. Hansen has served as a radiological risk assessor and will perform dose modeling using the Residual Radiation (RESRAD)-OFFSITE computer code in support of JPG decommissioning efforts.

Mr. Dennis R. Chambers will serve as the Radiation Safety Officer (RSO). He is a CHP in SAIC's St. Louis office and will provide radiation protection and health physics support for JPG decommissioning efforts. Mr. Chambers is responsible for providing oversight of the health physics technicians (HPTs) providing health and safety monitoring and site-specific training.

Mr. Joseph E. Peters will be the Quality Control Manager (QCM) for all of SAIC's work at JPG. He will ensure that data collection is accomplished following the established procedures specified in the project plans and in compliance with established SAIC procedures.

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3. HYDRAULIC DIRECT-PUSH TECHNOLOGY SAMPLING

Soil sampling is scheduled to occur at JPG in the fall of 2009 and is an integral part of the field effort as defined in this Addendum. This section summarizes the soil sampling activities to be conducted using direct-push technology (DPT) at JPG during the fall of 2009 to address critical data needs. Soil samples collected under this FSP Addendum, as described in this section, will be used to obtain soil to determine the site-specific partition coefficient (K_d) for uranium (Section 4).

The six planned samples are sufficient to cover the range of conditions affecting partitioning present in the till stratigraphic layer. This number is equivalent to the number of desorption tests for each soil type and exceeds the number of adsorption tests for each of the predominant soil types present in the DU Impact Area.

Section 3.1 describes the approach to be used in selecting locations for soil sampling and protocols to be used. Section 3.2 provides an overview of field activities planned for supporting the K_d study. Section 3.3 summarizes soil sampling procedures, including associated instruments, equipment, and supplies. Section 3.4 contains decontamination procedures that will be completed during soil sampling activities.

3.1 SAMPLE LOCATION SELECTION

The sample locations will be selected within areas cleared for previous drilling inside the DU Impact Area. Sample locations are planned adjacent to wells that were observed during drilling to have overburden with characteristics of glacial till above bedrock, and with sufficient thickness to produce the necessary sample volume. These locations are expected to produce till samples that are likely to have had minimal impact from site-related DU due to their depth below ground surface and the relatively impermeable nature of the till.

The selected locations also cover the predominant soil type groupings present within the DU Impact Area and provide a relatively widespread geographic distribution.

The soil sampling requires implementation of radiological protection screening (Appendix A) and anomaly avoidance activities as specified in the HASP (under development).

3.2 OVERVIEW OF SOIL SAMPLING TO BE PERFORMED

Soil samples from locations within and around the DU Impact Area will be collected to determine the site-specific partition coefficient (K_d) for uranium within the till. General sampling procedures and rationale are summarized below.

Figure 3-1 shows the planned DPT sample locations relative to monitoring well locations. Table 3-1 summarizes the numbers and general locations where soil samples will be collected and which laboratories will perform the respective analyses. Figure 3-1 and Table 3-1 specify eight locations that include six primary locations plus two backup locations in the event sampling is not possible at the first six (e.g., flooding).

Additional samples of glacial till are needed to support the adsorption tests in the K_d study. The use of DPT to install 6 boreholes to approximately 15 to 25 feet (ft) below land surface (BLS) is planned

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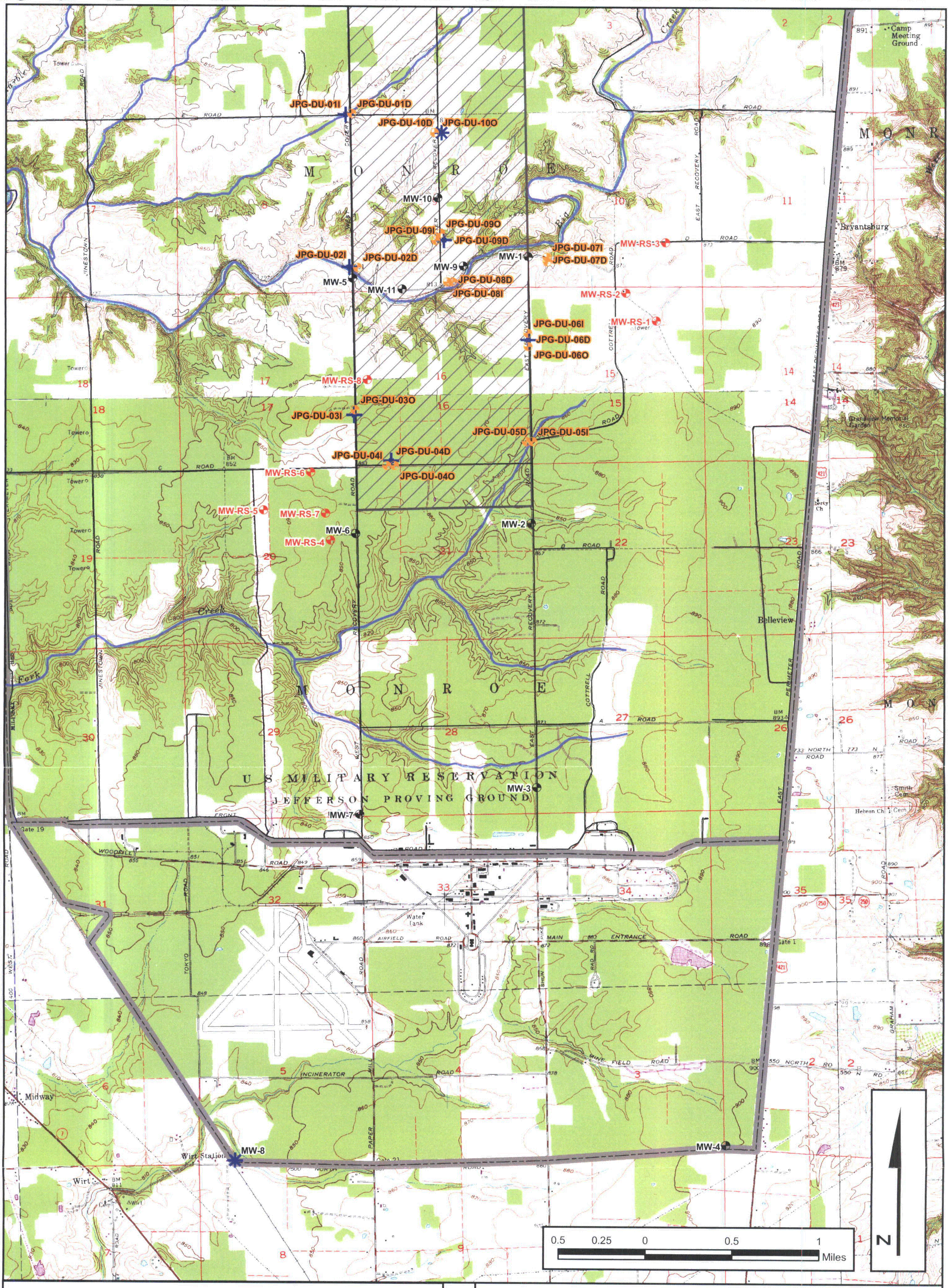

Legend

- RANGE WELL
- DU WELL
- MONITORING WELL
- ROADS
- DU IMPACT AREA
- HYDROLOGY
- INSTALLATION BOUNDARY
- PLANNED DPT SOIL SAMPLE LOCATION
- BACKUP DPT SOIL SAMPLE LOCATION

SAMPLE LOCATIONS	
JEFFERSON PROVING GROUND MADISON, INDIANA	
SAIC An Employee-Owned Company	PROJECT: \GIS_DATA\JPG\Projects\FSP\Planned DPT Soil Samples.mxd
DATE: 10/30/2009	FIGURE: 3-1

Figure 3-1. Proposed Soil Sampling Locations for Extent and Depth Evaluation

Table 3-1. Numbers of Soil Samples, Summary of Sampling Locations, and Designated Laboratories for Sample Analysis Jefferson Proving Ground, Madison, Indiana

Category	Locations	Soil Series/Type	Samples	Remarks	Laboratory
			K_d Testing		
K_d	JPG-DU-01I	Cincinnati[a]	1 kg	At least 1 kg (2.2 lb) of soil will be obtained within till ~60 inches BLS	TestAmerica/Empirical
K_d	JPG-DU-02I	Ryker[a]	1 kg	At least 1 kg (2.2 lb) of soil will be obtained within till ~56 inches BLS	TestAmerica/Empirical
K_d	JPG-DU-03I	Cobbsfork[a]	1 kg	At least 1 kg (2.2 lb) of soil will be obtained within till ~85 inches BLS	TestAmerica/Empirical
K_d	JPG-DU-04D	Avonsburg[a]	1 kg	At least 1 kg (2.2 lb) of soil will be obtained within till ~85 inches BLS	TestAmerica/Empirical
K_d	JPG-DU-06D	Avonsburg and Cobbsfork[a]	1 kg	At least 1 kg (2.2 lb) of soil will be obtained within till ~85 inches BLS	TestAmerica/Empirical
K_d	JPG-DU-09D	Cincinnati[a]	1 kg	At least 1 kg (2.2 lb) of soil will be obtained within till ~60 inches BLS	TestAmerica/Empirical
K_d	JPG-DU-10O	Avonsburg and Cobbsfork[a]	1 kg	At least 1 kg (2.2 lb) of soil will be obtained within till ~85 inches BLS	TestAmerica/Empirical
K_d	MW-8	Cobbsfork[b]	1 kg	At least 1 kg (2.2 lb) of soil will be obtained within till ~85 inches BLS	TestAmerica/Empirical
Total[c]	8		**8 kg**		

[a] SAIC 2007a.
[b] SAIC 2002.
[c] The total number of sample locations shown includes six planned (in decreasing order of preference) and two backup locations (JPG-DU-100 and MW-8).
BLS = Below Land Surface.
DU = Depleted Uranium.
JPG = Jefferson Proving Ground
kg = Kilogram.
MW = Monitoring Well.

within areas previously cleared for munitions and explosives of concern (MEC). The upper 15 ft will be surveyed for anomaly avoidance in 2-foot increments using a downhole magnetometer (Section 3.3). Once the desired depth is reached, soil samples will be collected and retrieved using continuous sampling equipment. The maximum depth anticipated is 30 ft BLS.

Rainwater samples also will be collected for use in the K_d study as a leachant. The rainwater will be collected from JPG using plastic sheeting suspended form tall poles and directed into a plastic drum. Rainwater was selected as the leachant to be consistent with the K_d study for the overlying loess layer and because the potential impact to shallow till is more likely from rainwater percolating through shallow soil rather than groundwater due to the depth (typically greater than 20 ft) to groundwater.

All boreholes will be abandoned with bentonite chips or pellets to prohibit vertical migration of potential contamination through the borehole. The field manager will determine if it is necessary to tremie bentonite pellets in from the bottom of the hole to avoid bridging. Decontamination will be accomplished in accordance with the field technical procedures (FTPs) as listed in Section 3.4.

Soils collected for the K_d study will be obtained by SAIC and transmitted to TestAmerica together with rainwater. Soil and rainwater also will be submitted to Empirical Laboratories for nonradiological analyses associated with the K_d study. Soil samples will be submitted to TestAmerica in 1-gal plastic bags (approximately one bag needed for each soil type). Additional details regarding the K_d study are provided in Section 4. Soil and water samples will be submitted to Empirical Laboratories using containers described in Section 5.

3.3 DIRECT-PUSH SOIL SAMPLING PROCEDURES

Subsurface samples will be collected using approved sampling protocols, ensuring that the volume and mass of samples achieve project requirements.

Radiation exposure rate measurements will be taken at 1 m (3.3 ft) above the sample location and recorded on the field logbook. Any comments and notations that may be necessary for interpretation of the results should be recorded on the form or in the logbook. The soil sampling instructions are as follows:

Subsurface soil samples will be collected by means of hydraulic direct-push samplers (e.g., Geoprobe® 6620DT-1). The hydraulic device may be used to advance Shelby tubes or macro-core samplers for the collection of glacial till samples. The standard equipment for subsurface sample collection will be attached to the hydraulic device. The borehole is advanced by attaching additional Shelby tube or lengths of extension rod to the Shelby tube or macro-core barrel and pushing the entire pipe string downward. The macro-core sampler may be fitted with a clear acetate sleeve for ease of retrieving samples.

Hydraulic-push borings will be created using a truck-mounted hydraulic system of sufficient size and power to advance the macro-core to the required depth. The total depth of each borehole will be determined by the target depth(s) for sampling for each soil type/area. These parameters are listed below:

- Cincinnati soils: ~36 in. (90 cm) to glacial till;
- Cobbsfork soils: ~85 in. (216 cm) to glacial till;
- Avonsburg soils: ~23 to 56 in. (58 to 142 cm) to glacial till; and
- Ryker soils: ~20 to 60 in. (51 to 102 cm) to glacial till.

The depth to till will be assessed during DPT activities by the certified soil scientist. Samples will be collected from an interval within the till and below the loess overburden. Based on the above estimated depths to glacial till, sample intervals are estimated to average between 8 and 10 ft BLS. Anomaly avoidance procedures for soil sampling and use of DPT in areas with potential MEC will be followed. Sampling is planned in previously cleared areas. The team will complete a hand-held, magnetometer-assisted, subsurface survey of the proposed sample locations at a depth of 2 ft and 4 ft. If an anomaly is detected, sampling personnel will select a new borehole location at least 3 ft away. Any anomalies detected will be prominently marked with survey flagging or non-metallic pin flags for avoidance. If the subsurface sampling depth is greater than the geophysical instrumentation (e.g., hand-held magnetometer) detection capabilities, the team must incrementally complete the downhole geophysical survey every 2 ft to a depth of 15 ft in undisturbed soil. For downhole surveillance, a Schonstedt MG-220/230 is planned due to the diameter of the DPT borehole.

The sampling procedures are summarized below:

1. The sampler will don clean nitrile or similar gloves.

2. DPT samples will be collected using a new or properly cleaned (Section 3.4) Shelby tube or macro-core sampler acetate liner.

3. The collected sample will be transferred from the sample collection equipment to a clean, new plastic sheeting or plastic trash bag for completion of soil descriptions.

4. Locations of samples will be measured using GPS.

5. Photographs of the soil samples and the collection locations will be taken.

6. Samples will be transferred from the sampler into 1-gal plastic bags for K_d study samples. Twigs, leaves, pebbles, debris, and possible penetrator fragments that are not components of the matrix of interest will be removed.

7. The plastic bags will be wiped clean so that a label and security seal may be placed on them. The bags then will be placed into a cooler for shipment to the analytical laboratory.

Upon removal of the soil from the ground, soil descriptions will be recorded. Soil samples also will be subjected to radiological surveys to qualitatively assess whether elevated count rates indicative of contaminant migration or the existence of subsurface lenses of contamination may be present. The radiological surveys will be completed for each 6-in. sample interval and will be recorded in the field logbook.

Each sample to be analyzed by an offsite laboratory will be prepared, packaged, and sample integrity maintained in accordance with applicable project procedures summarized below. Soil collected for the K_d study will be placed in new 1-gal plastic bags, marked with a unique I.D. number, date and time of collection, location, depth intervals, and collector's name. A strict chain-of-custody (CoC) will be maintained for all samples. Quality control (QC) samples will be collected and analyzed in accordance with the Quality Assurance Project Plan (QAPP) [Appendix A of the FSP (SAIC 2005a)].

Samples will be prepared and shipped to laboratories, which are appropriately licensed by NRC, or an Agreement State, for analysis. Upon receipt, the laboratory will immediately initiate laboratory analysis consistent with the specifications made on the CoC form.

All field procedures, data collection, sampling, and analysis will be completed in accordance with the FSP (SAIC 2005a), this FSP Addendum, the Quality Control Plan (QCP) [SAIC 2005c], and HASP Addendum 7 (under development). Table 3-2 references SAIC's field technical procedures (FTPs) that will be followed during field operations defined in this Addendum. Electronic copies of the FTPs have been included on the attached CD.

Table 3-2. Relevant SAIC Field Procedures for Soil Sampling Jefferson Proving Ground, Madison, Indiana

Number	Title	Latest Revision	Date
FTP-400	Equipment Decontamination	1	6/8/2001
FTP-405	Cleaning and Decontaminating Sample Containers and Sampling Equipment	1	8/15/2000
FTP-451	Field Measurement Procedures: Operation of Radiation Survey Equipment	2	10/13/1993
FTP-525	Soil Sampling Using an Auger	1	8/11/2000
FTP-526	Soil Sampling in Standing Water	0	5/15/2000
FTP-550	Soil Sampling Using a Spade or Scoop	1	8/11/2000
FTP-651	Hazardous Materials/Dangerous Goods Shipping for Field Work	2	11/20/2006
FTP-691	Composite Procedures	0	6/30/1993
FTP-1215	Field Logbooks and Field Forms	1	1/31/2007
FTP-1225	Field Demobilization Checklist for Project-Generated Waste	0	12/24/2003
EC&HS 4.1	Incident Reporting and Investigation	1	1/23/2008
EC&HS 12.1	Medical Surveillance	0	12/17/2007
EC&HS 13	Personal Protective Equipment	NA	5/2008
EC&HS 15	Hearing Conservation and Noise Control	NA	5/2008
EC&HS 19.1	Radiation Protection	0	11/17/2002
EC&HS 110	Vehicle Operation	2	6/2007
EC&HS 120	UXO/OE/CWM Safety	0	5/2002
EC&HS 130	Subsurface Asset and Hazard Avoidance	2	1/23/2006
EC&HS 140	Subcontractor Environmental Compliance and Health and Safety	3	10/25/2007
EC&HS 150	Manual Lifting	1	2/23/2006
EC&HS 170	Fall Protection	2	6/27/2007
EC&HS 200	Bloodborne Pathogen Exposure Control	0	5/17/2007
EC&HS 230	Hand and Power Tool Safety	0	11/20/2007
TP-DM-300-12	Handling and Control of Sampling Documentation	3	5/26/2006
QAAP 12.1	Control of Measuring and Test Equipment	3	7/3/2002
QAAP 15.1	Control of Nonconforming Items and Services	7	3/13/2002

CWM = Chemical Warfare Materiel.
EC&HS = Environmental Compliance and Health and Safety.
FTP = Field Technical Procedure.
NA = Not Applicable.
OE = Ordnance and Explosives.
QAAP = Quality Assurance Administrative Procedure.
UXO = Unexploded Ordnance.

3.4 DECONTAMINATION

Decontamination will be conducted in accordance with requirements in FTP-405. Generally, nondedicated equipment will be decontaminated after each piece of sampling equipment is used. The procedure for decontamination of equipment will be as follows:

1. Wash with approved water and phosphate-free detergent using various types of brushes required to remove particulate matter and surface films.
2. Rinse thoroughly with approved potable water.
3. Rinse thoroughly with deionized water.
4. Allow equipment to dry as long as possible.
5. Place equipment on clean plastic if immediate use is anticipated, or wrap in aluminum foil or bags to prevent contamination if longer-term storage is required.

Decontamination water will be directed out of the work area and surface discharged. Nondedicated equipment will be subjected to radiological monitoring to confirm the absence of contamination prior to reuse. Equipment blanks will be collected at a frequency of one per day and will include all equipment that comes into contact with soil during that day. One field blank will be collected from every source of water used for decontamination during the soil sampling program.

4. PARTITION COEFFICIENT STUDY

The partition (or distribution) coefficient (K_d) is used to determine the rate of contaminant transport relative to that of groundwater and, thus, is a very important site-related input parameter for contaminant modeling. Values for K_d vary greatly between contaminants and also as a function of aqueous and solid phase chemistry and can fluctuate over six orders of magnitude because they are "a lumped parameter representing a myriad of processes" (NRC 2006). As a result, NRC encourages licensees to perform site-specific K_d determination when values could be overly conservative. Development of a site-specific K_d value is also the approach recommended by the U.S. Environmental Protection Agency (EPA) [EPA 1999].

The primary objective of this study is to determine site-specific K_d values for uranium to be used for modeling radionuclides leaching from soils at JPG from laboratory-measured K_d values. This will be accomplished by deriving K_d measurements following American Society for Testing and Materials (ASTM) D4319-93, *Standard Test Method for Distribution Ratios by the Short-Term Batch Method.* ASTM withdrew this method without replacement. Due to the lack of a widely accepted laboratory method (e.g., ASTM, EPA), TestAmerica will conduct the K_d study using their SOP, which is based on ASTM D4319-93.

This study includes up to six adsorption tests using soils from the till stratigraphic unit not expected to be impacted by DU with radiotracers or spiked stable tracers to measure adsorption with rainwater as the leachant. The duration of the contact between the leachant and the soil will be extended up to 45 days, which is well beyond the 14-day period recommended in the ASTM method, to ensure that the sorption processes have reached equilibrium.

Laboratory-measured K_d factors also will be compared with published studies involving similar soils. This section summarizes the K_d study planned to begin in the fall of 2009 using soil collected from JPG. Section 6.1 is an overview of analytical methods for the K_d study, Section 6.2 provides additional details with respect to the soil and leachant, and Section 6.3 summarizes how the site-specific K_d will be determined and used in modeling.

4.1 ANALYTICAL METHOD OVERVIEW

As NRC notes in NUREG-1757 (NRC 2006), the soil partition coefficient, K_d, can be a very important input parameter when calculating doses associated with residual quantities of environmental constituents. The K_d is defined as the concentration of a chemical species on the solid fraction divided by the concentration in the aqueous phase:

$$K_d = \frac{S}{C_w},$$

where

S = Mass of chemical species sorbed per unit mass of soil,
C_w = Mass of chemical species per volume of solution.

Use of the K_d to evaluate the leaching of chemicals from contaminated soils assumes that rapid equilibrium is reached between the dissolved and sorbed concentrations of a chemical species, and that these two concentrations are linearly related through the K_d factor. In theory, the K_d is used to characterize the *reversible* adsorption of a chemical species on solid surfaces, including soil minerals and organic matter. However, other chemical processes, including mineral precipitation, diffusion into dead-end pores, and attachment to microbes, can influence the experimental measurement of K_d. Although research efforts have attempted to differentiate adsorption from these other processes, there are no universally accepted standard methods for doing so.

There are two laboratory approaches for measuring K_d: the "batch" and the "column" methods. The "batch" method for measuring K_d consists of equilibrating a measured mass of soil with a selected leaching solution (e.g., rainwater, synthetic, unimpacted site groundwater). In the more commonly used adsorption mode for K_d testing, the contact solution is spiked with a measured mass of the chemical species of interest, which then adsorbs onto the soil during equilibration. It is also possible to use contaminated soils, in which case the chemical species of interest desorbs from the soil into the contact solution. The concentration of the chemical species then is monitored in the contact liquid over time. When this concentration reaches a steady state and is not oversaturated (i.e., solubility limits have not been exceeded), it is assumed that the liquid and solid concentrations are in equilibrium, and K_d is calculated from their ratio. The liquid concentration is directly measured, while the solid concentration usually is inferred from a mass balance knowing the initial mass of chemical species in the soil/water mixture.

In the "column" procedure for measuring K_d, a soil column (i.e., a cylinder packed with soil) is flushed with the contact solution under a controlled flow rate. The K_d factor then is determined by analyzing the breakthrough of the chemical species of interest at the effluent end of the soil column. The "column" procedure is a closer simulation of the physical processes occurring in the field; however, the experimental set-up and data interpretation are more difficult when compared to the "batch" procedure. Moreover, batch and column loading of uranyl complexes was compared in one study, and no significant differences were observed (Bostick et al. 2002). Thus, the "batch" procedure is more commonly used when a large number of tests are needed to characterize spatial variability. Consistent with the RESRAD data collection manual (Yu et al. 1993), laboratory K_d measurements will be determined using a laboratory SOP based on ASTM D4319-93, *Standard Test Method for Distribution Ratios by the Short-Term Batch Method.*

ASTM D4319-93 explains that the "distribution coefficient" (or K_d) is derived from the laboratory measured "distribution ratio" (R_d). The test method is simply a measurement technique for determining the distribution ratio or degree of partitioning between liquid and solid, under a certain set of laboratory conditions, for the species of interest. The R_d is used for estimating the value of K_d for given underground geochemical conditions based on a knowledge and understanding of important site-specific factors. The measured R_d values will be evaluated statistically and using geochemical speciation modeling to define the K_d values used in RESRAD-OFFSITE and other fate and transport modeling codes. The uranium speciation modeling is planned to be conducted using either EPA's MINTEQA2 or the U.S. Geological Survey's (USGS') PHREEQC geochemical model with sampling data from the groundwater wells and soil samples and results from the corrosion study speciation tests and K_d study to determine the predominant uranium species, mass distribution among dissolved species, adsorbed species, and multiple solid phases.

4.2 SOIL AND LEACHANT FOR DETERMINATION OF KD

Collection of soil and water to be used as leachant is an integral part of the Fall 2009 field activities. Soil and rainwater collected at JPG will be used by TestAmerica for the K_d study. Soil and rainwater also will be provided to Empirical Laboratories for nonradiological analyses associated with the K_d study using containers described in Section 6.

Soil will be collected and processed as specified in Section 4 with a total of 1.5 to 2 kilograms (kg) of soil being provided for each sample. Soil will be collected from the till stratigraphic unit underlying areas with the Avonsburg and Cobbsfork, Cincinnati and Rossmoyne, and Grayford and Ryker soil types.

Leachant to be used in laboratory K_d testing will be supplied by SAIC. The rainwater will be collected from JPG using plastic sheeting directed into a plastic drum. Ten liters (L) of water will be placed directly into a 10-L container. In addition to the 10-L container, 1-L water samples will be provided for ^{234}U, ^{235}U, and ^{238}U activity analyses, and one 500-milliliter (mL) sample container will be collected for determination of major cation analysis (Ca, K, Mg, and Na) and another 500-mL container for anion (Cl^-, NO_3, and SO_4) analysis.

Upon receipt of soil and water from JPG, TestAmerica will analyze subsamples taken from soil and water aliquots for total and isotopic uranium using Eichrom resin technology, which provides results comparable to the methods outlined in ASTM D3972-90M.

Nonradiological soil and water parameters to be measured by Empirical Laboratories include:

- Moisture content (ASTM D2216-05);
- Soil pH (ASTM D4972-01/EPA 9045C);
- Particle size distribution (ASTM D422-63);
- Total organic carbon/soil (SW9060A; E 415.1);
- Total carbon/soil (SW9060A);
- Total iron (Fe)/soil and water (SW 6010);
- Total manganese (Mn)/soil and water (SW 6010);
- Major cations/water (SW 6010);
- Major anions/water (E 300.0); and
- Alkalinity (E310.1).

The soil and water samples will be handled, packaged, and shipped to TestAmerica in accordance with specifications in Section 6.

4.3 DETERMINATION OF K_D

Before K_d testing is initiated, the subcontractor laboratory must review analytical results depicting the radionuclide concentrations in the soil samples and select samples containing the appropriate concentrations of uranium. To ensure that appropriate spiking solutions are used and that test results are not biased by solubility limits, TestAmerica will confirm soil samples have total uranium less than 360 pCi/g. This limit is based on the highest concentration (989 mg/kg) successfully tested by Pacific Northwest National Laboratory (PNNL 2002) in multiple K_d tests run with various pH levels, carbonate concentrations, uranium concentrations, and total ionic strengths.

For each soil sample subjected to adsorption testing, the laboratory will prepare soil/water mixtures to enable sampling of each mixture for uranium analysis of the supernatant at predetermined time intervals (e.g., 3, 7, 10, 14, 21, 28, 35, and 45 days). These time intervals/analyses test periods are believed to be sufficient to allow steady-state concentrations in the supernatant to be observed with the achievement of steady state anticipated about mid-way through the test period. Completed data from each time interval up through day 14 will be evaluated by TestAmerica in coordination with the SAIC PM to determine whether a steady state already has been achieved (i.e., verifying the same concentration in two subsequent samples upon completion of each test regimen) for particular samples such that testing on subsequent intervals for that sample(s) could be suspended without adversely affecting project results.

Total and isotopic uranium in the supernatant/contact liquids will be quantified using an alpha spectrometry method with individual samples being prepared using Eichrom resin technology. Total uranium will be calculated using a published specific activity value for ^{238}U and assuming that all mass originates from ^{238}U.

The results of the K_d study, to include uranium isotopic concentrations in the supernatant and in the soil and water samples provided to the laboratory, will be provided in a summary report. The K_d values provided in this report will serve as the basis for applicable RESRAD-OFFSITE input parameter values. TestAmerica will identify any outliers and recommend an approach for computation of the K_d. SAIC will evaluate possible outliers and, if present, consider eliminating the outliers from the determination of the resultant mean. Individual K_d values also will be obtained and used for sensitivity analyses. After evaluating and possibly eliminating outliers, SAIC will evaluate the results of the K_d study using geochemical speciation models and conduct sensitivity analyses in additional models. Pending confirmation following completion of the studies and planned data analyses, the mean K_d value is proposed for use in RESRAD-OFFSITE dose modeling with additional K_d values to be used in the supporting modeling.

5. FIELD OPERATIONS DOCUMENTATION

Sufficient information will be recorded in the logbooks to permit reconstruction of all site sampling activities conducted. Information recorded on other project documents will not be repeated in the logbooks except in summary form where determined necessary. All field logbooks will be kept in the possession of field personnel responsible for completing the logbooks, or in a secure place when not being used during fieldwork. Upon completion of the field activities, all logbooks will be submitted to the PM to become part of the final project file.

The logs, diagrams, and forms that will be completed during soil sampling are included in Appendix A. The SAIC requirements related to field documentation are described in the SAIC FTPs listed in Table 5-1. These FTPs are provided in electronic format on the attached CD.

Table 5-1. Relevant SAIC Procedures for Field Documentation
Jefferson Proving Ground, Madison, Indiana

Number	Title	Latest Revision	Date
FTP-625	CoC	1	06/08/2001
FTP-1215	Field Logbooks and Field Forms	1	01/31/2007
FTP-1220	Documenting and Controlling Field Changes to Approved Work Plans	2	4/20/2007

CoC = Chain of Custody.
FTP = Field Technical Procedure.
SAIC = Science Applications International Corporation.

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6. SAMPLE HANDLING, PACKAGING, AND SHIPPING

Sample handling, packaging, and shipping practices will be conducted in accordance with established SAIC procedures. The SAIC sample packaging and shipping requirements are described in the SAIC FTPs listed in Table 6-1. These FTPs are provided in electronic format on the attached CD.

Table 6-1. Relevant SAIC Procedures for Sample Handling, Packaging, and Shipping Jefferson Proving Ground, Madison, Indiana

Number	Title	Latest Revision	Date
FTP-405	Cleaning and Decontaminating Sample Containers and Sampling Equipment	1	8/15/2000
FTP-625	CoC	1	6/08/2001
FTP-650	Labeling, Packaging, and Shipping of Environmental Field Samples	1	2/11/2000
FTP-651	Hazardous Materials/Dangerous Goods Shipping for E&I BU Field Work	2	11/20/2006
FTP-1215	Field Logbooks and Field Forms	1	1/31/2007
QAAP 13.1	Handling, Storage, and Shipping	1	3/13/2002

BU = Business Unit.
CoC = Chain of Custody.
E&I = Engineering and Infrastructure.
FTP = Field Technical Procedure.
QAAP = Quality Assurance Administrative Procedure.
SAIC = Science Applications International Corporation.

Except for 1-gal plastic bags to hold soil for K_d tests, all sample containers will be provided by the analytical support laboratory. The laboratories also will provide the required types and volumes of preservatives with containers as they are delivered to JPG. In the event that sample integrity (e.g., holding times) is compromised, re-sampling will occur as directed by SAIC's PM after discussions with the Army and NRC PMs. Any affected data will be flagged and qualified per data validation instructions and guidance.

6.1 LABORATORY RESPONSIBILITIES

The analytical responsibilities for the JPG DU Impact Area site characterization are shared between SAIC and supporting analytical laboratories. TestAmerica will perform the K_d studies. The analysis of soil and water samples needed for the K_d studies will be handled by TestAmerica. Nonradiological analyses of soil and rainwater associated with the K_d studies will be performed by Empirical Laboratories. Addresses for the supporting laboratory facilities are as follows:

- TestAmerica, Inc., 13715 Rider Trail North, Earth City, MO 63045
- Empirical Laboratories, LLC, 227 French Landing Drive, Suite 550, Nashville, TN 37228.

6.2 SAMPLE CONTAINERS, PRESERVATION, AND HOLDING TIMES

Sample containers, chemical preservation techniques, and holding times are presented in Tables 6-2 and 6-3. Except for the plastic bags listed below, the laboratory will provide specified numbers of containers required for each sampling event. Additional sample volumes will be collected and provided, when necessary, for the express purpose of conducting associated laboratory QC (field blanks, equipment blanks, laboratory duplicates, and MS/MSDs).

Table 6-2. Summary of Sample Contaminant and Sample Preservation Methods for Soil Jefferson Proving Ground, Madison, Indiana

Parameter	Analytical Method	Sample Container		Preservation Methods	Holding Times
		Quantity	Type		
Total and isotopic uranium: ^{234}U, ^{235}U, and ^{238}U	ASTM D3972-90M/SM 7500-UC using SC&A SOP 348 Rev 3	8 oz	Glass jar	None	6 months
Soil for K_d Study	ASTM D4319-93	1-gal	Plastic bag	None	None
Moisture Content	ASTM D2216-05	8 oz	Glass jar	None	7 days
Soil pH	ASTM D4972-01/	8 oz	Glass jar	None	ASAP
Particle Size Distribution	E9045C	8 oz	Glass jar	None	6 months
Total Organic Carbon	ASTM D422-63	8 oz	Glass jar	None	28 days
Total Carbon	SW9060/415.2	8 oz	Glass jar	None	28 days
Total Iron	SW9060/415.2	8 oz	Glass jar	None	6 months
Total Manganese	SW6010	8 oz	Glass jar	None	6 months

ASAP = As Soon As Possible.
ASTM = American Society for Testing and Materials.
DU = Depleted Uranium.
SOP = Standard Operating Procedure.

Table 6-3. Summary of Sample Containment and Sample Preservation Methods for Water Samples Jefferson Proving Ground, Madison, Indiana

Parameter	Analytical Method	Sample Container		Preservation Methods	Holding Times
		Quantity	Type		
Total and isotopic uranium: ^{234}U, ^{235}U, and ^{238}U	ASTM D3972-90M	1	1-L polypropylene bottle	HNO_3 to pH<2	6 months
Anions (nitrate, chloride, and sulfate)	E300/SW9056	1	500-mL polyethylene bottle	Cool, 4°C	48 hours (nitrate) and 28 days (chloride and sulfate)
Metals (calcium, iron, potassium, magnesium, manganese, and sodium)	SW6010	1	500-mL polyethylene bottle	HNO_3 to pH<2 Cool, 4°C	6 months
Alkalinity	E310.1	1	500-mL polyethylene bottle	Cool, 4°C	14 days
TOC	E415.1	2	125-mL amber glass bottles	H_2SO_4 to pH <2 Cool, 4°C	28 days
Leachant for K_d study	ASTM D4319-93	2	5-gal HDPE Carboy	None	None

ASTM = American Society for Testing and Materials.
HDPE = High-Density Polyethylene
L = Liter.
mL = Milliliter.
TOC = Total Organic Carbon.

6.3 SAMPLE IDENTIFICATION

A sample I.D. system will serve as a unique identification code for each sample collected. These sample I.D.s will be assigned before the sampling events begin. The sample numbering system will use letter codes to distinguish matrices and various QC samples. The purpose of this numbering scheme is to provide a tracking system for the retrieval of analytical and field data on each sample. Sample I.D. numbers will be used on all sample labels, field data sheets or logbooks, CoC records, and all other applicable documentation used during each project.

Unique serial number ranges will distinguish sample type categories (i.e., regular field samples versus field duplicates). The general sample identification format is JP-T-CCC. "JP" represents the JPG DU Impact Area site characterization. "T" represents the type of sample ("W" = water, "S" = soil, and "K" = K_d study). One or two additional characters are used to specify the type of sample (see descriptor column in Table 6-4). "CCC" represents the unique sample location numbered sequentially. All sample I.D.s will be maintained in a log by the Field Manager. The following QC test and flagging codes will be used to identify duplicate environmental and field QC blank samples:

- "R" entered in the QC test code field will be used to identify all rinsate blanks collected in the field at a frequency of one blank per day, and
- "F" entered in the QC test code field will be used to identify all source water blanks collected in the field.

Table 6-4. Summary of Sample Identification Scheme Jefferson Proving Ground, Madison, Indiana

Sample Types	Descriptor	First	Last*	Total Locations/ Samples
Soil				
K_d – Avonsburg and Cobbsfork	AC	JP-KAC-009	JP-KAC-013	5 / 5
K_d – Cincinnati and Rossmoyne	CR	JP-KCR-009	JP-KCR-0010	2 / 2
K_d – Grayford and Ryker	GR	JP-KGR-003	JP-KGR-003	1 / 1
Rainwater				
K_d	AC	JP-WK-002	—	1 / 1

*Up to six total samples will be collected from the eight locations specified in Table 3-1 and Figure 3-1. The sample assignments will be made sequentially, as appropriate, based on the applicable soil type.

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7. INVESTIGATION-DERIVED WASTES

Following completion of fieldwork, in the unlikely event that any radioactive waste (e.g., waste exceeding contamination release criteria) is generated, it shall be turned over to the Army for secure storage and proper disposal. No radioactive waste is anticipated to be generated under this work scope.

IDW generated during sampling tasks will consist of decontamination liquids; paper, cardboard, and plastic bagging and containers from sampling materials; Tyvek® coveralls; disposable tubing; and disposable gloves. Decontamination liquids (if used) generated from equipment decontamination will be disposed of on the ground in the general area from which the materials originated. Any other wastes, if determined to be radioactive, will be turned over to the Army and will be surveyed, packaged, stored, and transported in accordance with applicable regulations, and disposed of as normal solid waste if determined not to be radioactive.

Any materials such as disposable gloves, Tyvek®, paper towels, paper and plastic bagging, containers from well materials, plastic sheeting, disposable tubing, and lumber will be surveyed or placed into plastic garbage bags and later surveyed by the HPT to determine if they are radioactive, and placed into the U.S. Fish and Wildlife Service (FWS) dumpster for disposal as normal solid waste if determined to not be radioactive. If IDW disposal is determined to be necessary, the Army might handle it themselves or a change order may be requested to include the services of a qualified and experienced licensed radioactive waste broker (e.g., Clean Harbors or Onyx/Veolia). Radioactive wastes, if generated, will be stored temporarily in a secured location, as directed by the Army, and will remain the property of the Army.

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8. RADIOLOGICAL RESPONSIBILITY AND LICENSING

The possession of radioactive materials at JPG is authorized and governed under a radioactive materials license granted by NRC to the Army. The license number is Source Material License SUB-1435. The current amendment is No. 15, dated 6 March 2008. The license authorizes the possession of up to 80,000 kg (approximately 177,000 lbs) of DU metal, alloy, and/or other forms. Given that NRC regulations generally preclude transfer of radioactive materials to unlicensed organizations and individuals, copies of radioactive materials licenses for all test participants/subcontractors will be obtained prior to shipment of any materials for which a license is required. The Army has requested that SAIC be responsible for the work that is described in this FSP Addendum, and obtain and utilize a license from NRC that authorizes the contractor to provide radiological services for the Army. SAIC has obtained and will utilize such a license.

The SAIC St. Louis office is authorized to provide certain radiological services to clients under a radioactive materials license granted by NRC to SAIC. The license number is 24-32591-01. License condition No. 14 requires that SAIC enter into a written agreement with the Army so that roles, responsibilities, and lines of authority for work at the site are clearly defined. This written agreement will be issued in letter form and must be signed by authorized persons from both SAIC and the Army prior to initiating work under this FSP Addendum. Once the agreement is signed, Figure 8-1 will be used to document the true date and time that responsibilities are transferred between the Army and SAIC.

Samples will be prepared and shipped to laboratories that are appropriately licensed by NRC, or an Agreement State, for analysis.

Section 1 – Acceptance by SAIC Under NRC License No. 24-32591-01

Form ID No. (MM-DD-YYYY-XX):	
Task Description and Working location (be very specific):	
Governing Work Document(s) (e.g., FSP, HASP Addenda):	
Client Contacted (print name):	Method of Notification:
☐ Check to confirm that the client has agreed to remit the working area(s) to SAIC	
SAIC Approval to Accept	
SAIC Name (print):	Signature:
Date Accepted:	Time Accepted:
Follow-on Client Approval to Remit	
Client Name (print):	Signature:

Section 2 – Remittance by SAIC to the Army Under NRC License No. SUB-1435

Client Contacted (print name):	Method of Notification:
☐ Check to confirm that the client has agreed to accept the working area(s) from SAIC	
SAIC Approval to Remit	
SAIC Name (print):	Signature:
Date Remitted:	Time Remitted:
Follow-on Client Approval to Accept	
Client Name (print):	Signature:

Figure 8-1. Acceptance and Remittance of Radiological Responsibility at JPG

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APPENDIX A

SAIC FIELD PROCEDURES

(Provided on Accompanying CD)

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