3. RADIOLOGICAL STATUS OF FACILITY

The radiological status of the Depleted Uranium (DU) Impact Area at Jefferson Proving Ground (JPG) has been determined from historical records, a radiological scoping survey conducted in 1994 (SEG 1995a), a radiological characterization survey conducted in 1995 (SEG 1996), and site characterization activities from 2005 through 2013 (SAIC 2006b,c; SAIC 2007a,b; SAIC 2008a,b,c,d; SAIC 2009; SAIC 2010; Buszka, Lampe, and Egler 2010; Appendix C).

Section 3.1 explains that there are no contaminated structures north of the firing line and presents a description of the methods, procedures, and results of a final status survey of contaminated structures (facilities and grounds) located south of the firing line. Section 3.2 explains that no contaminated systems and equipment were ever present at JPG.

Sections 3.3 through 3.5 summarize the methods and procedures used to determine the radiological status of the DU Impact Area in the Environmental Radiation Monitoring (ERM) program, scoping and characterization surveys, and site characterization program, respectively. Section 3.3 summarizes the results of the radiological characterization of the DU Impact Area. A summary of the facility's radiological status is presented in Section 3.4. In accordance with U.S. Nuclear Regulatory Commission Regulation (NUREG) 1757, this section documents radiological contamination for surface and subsurface soil (Sections 3.6 and 3.7, respectively), surface water and sediment (Section 3.8), groundwater (Section 3.9), and vegetation and biological resources (Section 3.10). Results from the ERM program, scoping and characterization surveys, and site characterization program are discussed in Sections 3.6 through 3.10, as appropriate.

3.1 CONTAMINATED STRUCTURES

There are no radiologically contaminated structures within the DU Impact Area. No structures existed on the site for testing of DU penetrators and no structures are present in the DU Impact Area. Since the DU was only handled while loading guns fired from one of three firing points into the DU Impact Area, there was no means of contaminating any structures along the firing line. Some facilities that previously were contaminated with DU were located south of the firing line. All of them were subject to a survey, remediation, and confirmatory survey after the remediation to verify that all remaining contamination was below U.S. Nuclear Regulatory Commission (NRC) guideline levels (SEG 1995b). Therefore, the only remaining residual contamination at JPG is the DU Impact Area, which is where DU penetrators were fired into a target area of approximately 2,080 acres (ac) (8.4 square kilometers [km^2]).

Support facilities used in licensed activities at JPG included 17 buildings and storage facilities (e.g., magazines) located south of the firing line and the 3 firing points. A final survey of these support facilities was conducted in late 1994 and early 1995 in conjunction with decontamination of these facilities (SEG 1995b,c). The results of the survey supported release with no restrictions of the buildings and magazines from the JPG license. Criteria applicable at the time included limits on surface contamination of beta and alpha emitters, exposure rates, and uranium concentrations in soil (NRC 1987).

Based on historical site information, facilities were grouped as "affected" or "unaffected." The survey identified three structures (Building 610, Building 611, and the Portable Magazine) containing eight areas where direct DU surface contamination exceeded applicable NRC requirements. Prior to decontamination, the maximum measured surface contamination ranged from 28,000 disintegrations per minute (dpm) per 100 square centimeters (cm^2) to 158,000 dpm/100 cm^2. The applicable NRC requirement is 15,000 dpm/100 cm^2 for maximum surface contamination from uranium or other beta emitters. The DU contamination in these eight areas was attributable to the storage of DU penetrators retrieved from the firing range. Remediation of all measured contaminated surfaces in the eight areas was accomplished by a combination of scabbling, jack hammering, and using a needle-gun to remove

contaminated material. This remediation process resulted in the generation of six 55-gallon drums of waste equivalent to a total waste volume of 45 cubic feet (ft^3) (1.3 cubic meters [m^3]), which were sealed, surveyed, and disposed of. The remaining 14 buildings and all 3 firing points were classed as unaffected.

After remediation was complete, a final survey of both affected and unaffected facilities was performed to demonstrate that all surfaces met the NRC requirements of 15,000 and 5,000 dpm/100 cm^2 for maximum and average uranium or beta contamination, respectively. Differing approaches were used for affected and unaffected facilities. For affected facilities, 100 percent of all areas were gridded and scanned, and five points within each grid were surveyed for beta gamma contamination. For unaffected facilities, 10 percent of all areas were scanned, and a minimum of 30 randomly selected locations were surveyed for total and removable activity. A total of 6,426 swabs and beta surface measurements were made on surfaces for all of the previously identified structures. The highest maximum measured value for any area was 3,901 dpm/100 cm^2, which is well below the associated NRC limit of 15,000 dpm/100 cm^2. The highest average measurement for any area was 805 dpm/100 cm^2, which is also well below the associated NRC limit of 5,000 dpm/100 cm^2. In addition, 10 soil samples were collected and analyzed for uranium isotopic distribution for each firing point. The average total uranium concentrations in soil were 1.5, 11.8, and 1.3 picoCuries per gram (pCi/g) for Firing Points J, 500 Center, and K, respectively.

A total of 1,040 gamma dose rate measurements in previously contaminated structures were made after remediation, with the highest structure individual measured values being 14.0 microRoentgens per hour (14.0 μR/hr) for an average measured value, and 20.8 μR/hr for a maximum measured value. Both of these values were well below (< 10 percent of the limit) their respective NRC limits of 200 μR/hr for average dose rate and 1,000 μR/hr for maximum dose rate.

For the measurement of building and soil DU contamination, a Ludlum Model 2350 Data Logger™ was used with one of the following three detectors: 1) 15.5-square inch (in^2) (100-cm^2) gas-flow proportional detector (Ludlum Model 43-68™) for direct beta measurement and scanning 2) 1- × 1-inch (in) (2.54- × 2.54-centimeter [cm]) sodium-iodide activated with thallium (NaI[Tl]) high-energy gamma scintillation detector (Ludlum Model 44-2™) for gamma exposure rate measurements, and 3) Geiger-Müeller (G-M) detector (Ludlum Model 44-40™) with the proportional detector for contamination smear measurements.

All instruments were calibrated in accordance with American National Standards Institute, Inc. (ANSI) N323-1988 and ANSI N42.17A-1989 using sources traceable to the National Institute of Standards and Technology (NIST). The proportional and G-M detectors were calibrated twice daily with a technetium-99 (Tc-99) source, while the NaI(Tl) detector was calibrated twice daily with a cesium-137 (Cs-137) source. All detectors were calibrated so that they were determined to be within ±20 percent of the actual source. Appropriate Scientific Ecology Group (SEG) quality assurance/quality control (QA/QC) procedures were used for the survey.

3.2 CONTAMINATED SYSTEMS AND EQUIPMENT

There are no stationary and permanent radiologically contaminated systems and equipment within JPG. The only systems and equipment that existed on the site for use in conjunction with the DU penetrators were guns of the battle tanks that were used to test fire the projectiles. Tanks used to fire the DU at JPG were transferred to Yuma Proving Ground (YPG) as part of Base Realignment and Closure (BRAC). Since the DU was only handled while loading guns fired from one of three firing points into the DU Impact Area, there was no means of contaminating any stationary and permanent systems and equipment on JPG.

3.3 ENVIRONMENTAL RADIATION MONITORING PROGRAM

The ERM program has been implemented at JPG from 1983 to the present. Under the current ERM program, samples are collected semi-annually from the same 23 locations (Figure 3-1). Samples from different media are collected, including 4 surface soil, 11 groundwater, 8 surface water, and 8 sediment samples (U.S. Army 2000b). The four surface soil samples are collected from the corners of the DU Impact Area. Groundwater samples are collected from wells located several miles from the DU Impact Area (two at the southern boundary of JPG in the cantonment area and two just north of the firing line) and seven that are situated within and around the DU Impact Area (one on the eastern boundary, two near the southern boundary, and two near the center). Four surface water samples are collected on Big Creek, three of which are located inside the DU Impact Area and one which is located at the west perimeter fence. Four surface water samples are collected on Middle Fork Creek, one of which is located at the southeastern corner of the DU Impact Area, two are located between the firing line and the southern boundary of the DU Impact Area, and one is located at the west perimeter fence. Sediment samples are collected at the same locations as the surface water samples.

ERM activities are conducted at JPG to ensure that DU does not pose a threat to human health and the environment through inadvertent or unanticipated release or migration. The ERM program is described in the standard operating procedure (SOP) (U.S. Army 2000b) developed and issued by the U.S. Army Center for Health Promotion and Preventive Medicine (CHPPM), predecessor organization to the U.S. Army Public Health Command's Institute for Public Health. This SOP was designed to meet the requirements of applicable Federal and state regulations, including NRC regulations and requirements under radioactive Materials License SUB-1435 (NRC 1985).

3.4 METHODS AND PROCEDURES FOR SCOPING AND CHARACTERIZATION SURVEYS

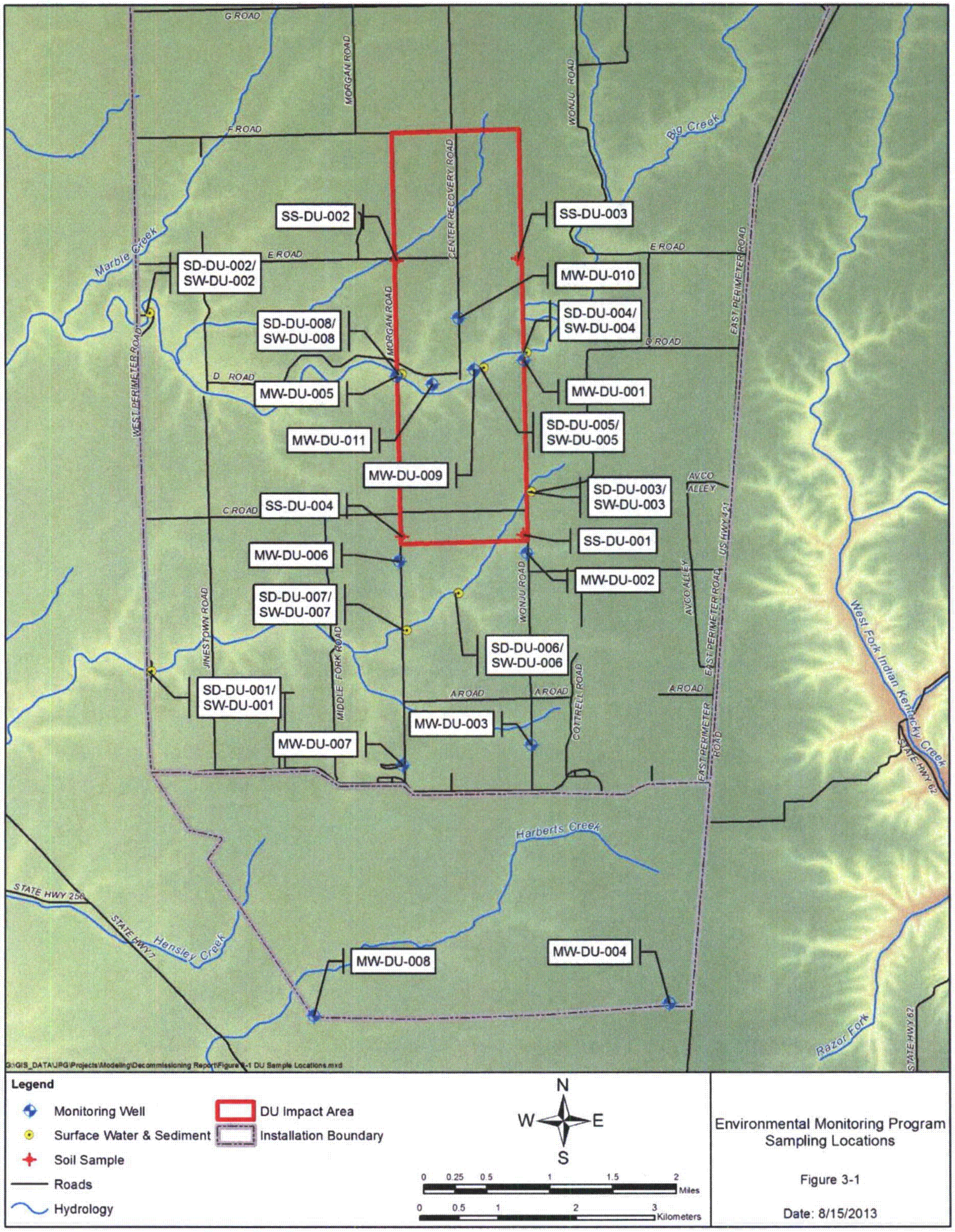
The methods and procedures used in the scoping and characterization surveys of the DU Impact Area are described in Sections 3.4.1 and 3.4.2, respectively. These descriptions are based on the SEG reports (SEG 1995a,b; SEG 1996). Results of the surveys are presented in Sections 3.6 through 3.10, as appropriate.

3.4.1 Scoping Survey

Areas potentially affected by facility operations include the firing lines and the DU Impact Area. A radiological scoping survey of these areas was conducted between 8 October and 23 December 1994. The objective of the study was to confirm and document areas affected by DU projectiles and to identify areas to be included in further studies (SEG 1995a).

The survey was conducted according to a site-specific plan and procedures. The procedures included identification of instrumentation requirements and development of data quality objectives (DQOs) and methods for sample collection and measurement and data reduction and evaluation. The approach to data collection involved measurement of exposure rates at grid locations and collection of soil, groundwater, surface water, sediment, and vegetation samples at locations referenced to a similar grid.

For exposure rate measurements in the DU Impact Area, grid lines were established at separations of 164 feet (ft) (50 meters [m]) in the north-south direction, and measurements were taken 3.3 ft (1 m) above the ground at 33-ft (10-m) intervals along each grid line. For the exposure rate measurements in the firing line area, three north-south grid lines were established for each of the three firing lines. A central grid line was located along the firing line, and two additional grid lines were located 164 ft (50 m) to the east and west of the central line. Exposure rate measurements were taken 3.3 ft (1 m) above ground level at an interval of 33 ft (10 m) along each grid line.



Environmental Monitoring Program Sampling Locations

Figure 3-1

Date: 8/15/2013

Soil, groundwater, surface water, sediment, and vegetation samples were collected on a judgmental basis determined, in part, by locations used in the environmental monitoring program. A total of 62 soil, 11 groundwater, 14 surface water, 13 sediment, and 20 vegetation locations were sampled. Sampling locations are summarized in Figure 3-2.

Exposure rates were measured using a Ludlum Model 44-2™ (1-in × 1-in) sodium iodide (NaI) detector in conjunction with a Ludlum Model 2350 Data Logger™. Detectors and data loggers were calibrated using NIST traceable sources and calibration equipment. Calibration checks were conducted at the beginning and end of each workday. Environmental samples were packaged, surveyed, and shipped to an approved vendor for alpha spectroscopy isotopic analysis. A chain-of-custody (CoC) record was completed for each shipment. Minimum detectable concentrations less than 0.3, 0.07, and 0.06 pCi/g and 0.5 picoCuries per liter (pCi/L) were reported for soil, sediment, and vegetation, and water samples, respectively (SEG 1995a).

Prior to performance of exposure measurements in the DU Impact Area, a background study was performed. Thirty-five locations south of the firing line were measured to determine an average background exposure rate of 12 μR/hr. The result is consistent with results of the site environmental monitoring program.

3.4.2 Characterization Survey

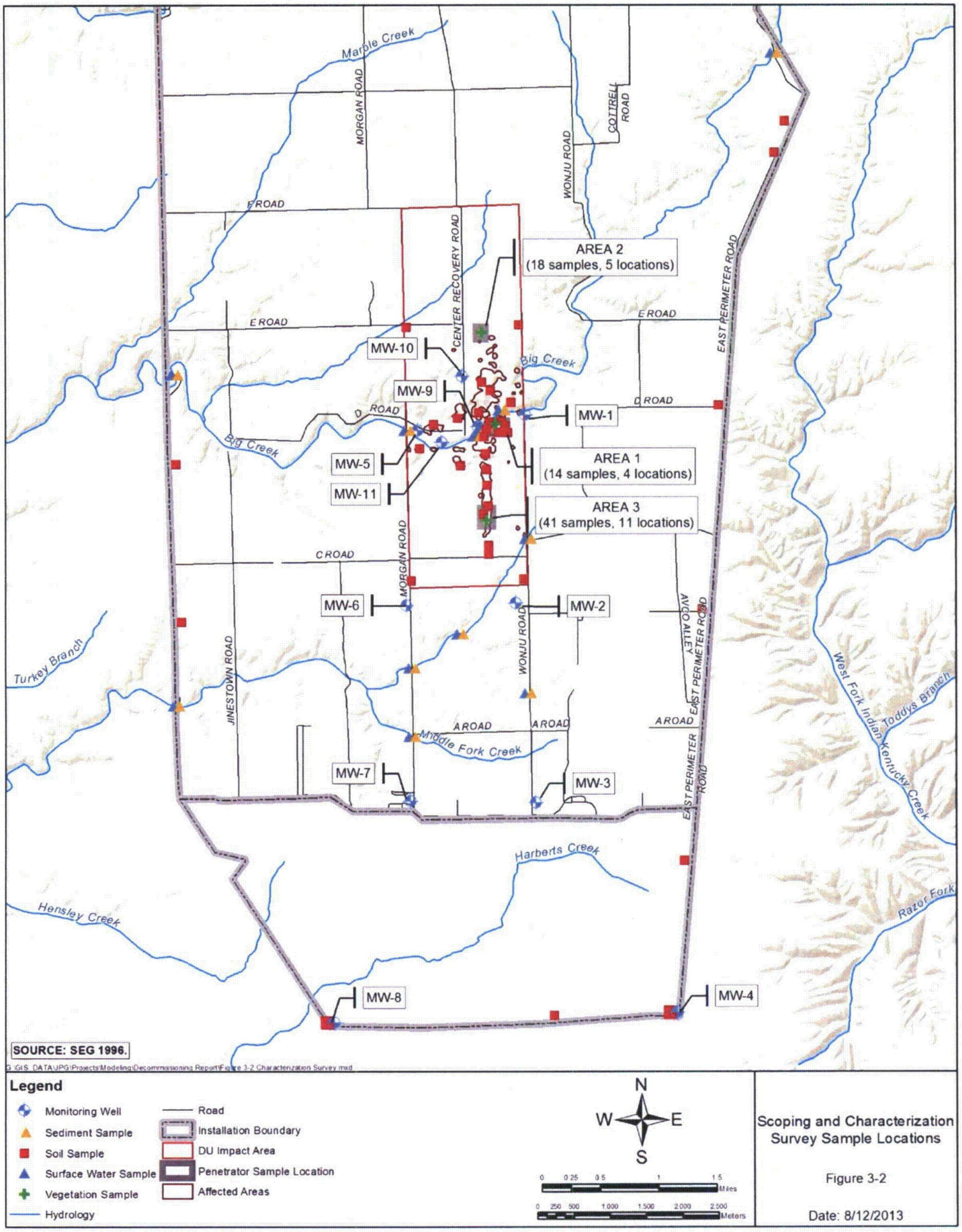
The scoping survey conducted in late 1994 confirmed classification of the DU Impact Area as a radiologically affected area. Additional information on residual contamination in the DU Impact Area was collected in a characterization study conducted in mid-1995. The purpose of the characterization survey was to confirm and document the contamination in a 1,300-ac (5.3-km^2) portion of the DU Impact Area and to estimate costs and techniques for decontamination of the area.

The survey design utilized a combination of randomly and judgmentally selected locations to estimate the size of the affected area and the volume of contaminated soil and to confirm prior results of environmental sampling. Estimation of the volume of contaminated soil involved establishing the depth profile of contamination and development of a correlation between level of contamination in soil and exposure rate. Locations selected based on best judgment included:

- Background soil samples: 10 locations to match the environmental baseline
- Penetrator soil samples: 20 locations beneath DU penetrators
- 500 Center trench exposure rate measurements: 10 locations in 33- by 33-ft (10- by 10-m) grids traversing west to east across the 500 Center trench
- Vegetation samples: 10 locations within 3 ft of the first 10 penetrator soil samples
- Groundwater samples: 11 locations of completed wells
- Surface water: 10 locations determined by configuration of existing streams
- Sediment samples: 10 locations to match surface water sampling locations
- Biological samples: clams, fish, turtle, and deer at locations of convenience.

Locations randomly selected included:

- Twenty soil locations in the DU Impact Area
- Twenty exposure rate/gamma spectroscopy measurements of 33- by 33-ft (10- by 10-m) grids.



Source: SEG 1996

Sampling locations for the characterization survey are also summarized in Figure 3-2. In the case of background, random, and judgmental locations for soil, samples were collected at three depths: 0 to 5.9 in, 5.9 to 11.8 in, and 11.8 to 17.7 in (0 to 15 cm, 15 to 30 cm, and 30 to 45 cm). Samples of soil, groundwater, surface water, sediment, fish, freshwater clams, and turtle were analyzed using alpha spectroscopy to determine concentrations of uranium-234 (U-234), uranium-235 (U-235), uranium-238 (U-238), and the U-234/U 238 isotopic ratio.

Integrated exposure rate measurements and in situ gamma spectroscopy was performed for the 30, 33- by 33-ft (10- by 10-m) square grids. Two exposure rate measurements were made at each location: a 120-second integrated count while walking over the 33- by 33-ft (10- by 10-m) grid and a 60-second integrated count at the same location where soil samples were taken. The Ludlum Model 2350™ was used with a 1- × 1-in (2.44- × 2.44-cm) NaI detector. Exposure rate data were downloaded from the Ludlum Data Logger™ to a personal computer for storage and comparison.

In situ gamma spectroscopy, using the Canberra System, includes a 2- × 2-in (5.08- × 5.08-cm) high-purity germanium crystal with a 5-day duration liquid nitrogen coolant supply; an International Business Machine (IBM®) "Thinkpad" notebook computer; and a laboratory-grade, multi-channel analyzer for real time radionuclide concentration analysis.

To determine whether the measured uranium present was due to the presence of DU or natural uranium, the U-238/U-234 ratio was determined by measuring the concentration of each of these isotopes. At the time of the Characterization Survey, a U-238/U-234 ratio of 2.0 or less was considered representative of natural uranium, whereas higher ratios are indicative of DU. This difference in ratio is due to the fact that the relative abundance of U-238 in DU has been significantly increased after U-235 has been removed from natural uranium since much of the U-234 has been concentrated with the U-235. In addition, the much smaller half-life of U-234, as compared to U-238, results in a much higher specific activity of U-234 even though its natural abundance in uranium is only approximately 0.005 percent as compared to U-238 at > 99 percent. Four other independent studies of the natural U-238/U-234 ratio in soil and water resulted in measured ratio values of 0.8 to 2.0 for soil and 0.025 to 2.0 for water (Fujikawa et al. 2000; Gilkeson and Cowart 1987; Goldstein, Rodrigurez, and Lujan 1997; Osmond and Cowart 1976).

It is important to note that no areas or surfaces within the 2,080-ac (8.4-km^2) DU Impact Area were inaccessible for this survey. Due to the potential presence of unexploded ordnance (UXO), suitable precautions were taken in the field to prevent the occurrence of any accidents involving such UXO. The only other hazard present, which did not hinder the conduct of the survey, was the presence of sometimes rugged and steep terrain.

The characterization survey used three principal instruments at the JPG site: a Ludlum Model 2350 Data Logger™, a Ludlum Model 44-2 NaI(Tl)™ detector, and a Canberra InSpector™ gamma spectroscopy system. The two Ludlum instruments were used to measure and record exposure rates while the Canberra system was used onsite to measure gamma ray emitting radionuclide concentrations in soil samples. An offsite laboratory was used for alpha spectroscopy. All instruments were calibrated semi-annually by Ludlum Measurements, Inc., using NIST traceable sources and calibration equipment. At the beginning and end of each workday, daily calibration checks were conducted with all instrumentation.

This survey was conducted under the controls and protocols of the SEG QA/QC programs and procedures. The calibration, maintenance, accountability, operation, and QC of radiation detection instruments were performed in accordance with procedures that implement the guidelines in ANSI N323 1978 and ANSI N42.17A-1989. Each survey measurement was handled and documented using appropriate and unique identifying numbers. Offsite sample shipments were accompanied by CoC records to track each sample. Replicate laboratory analysis was performed by Lockheed Analytical Services on selected samples. Method blanks were analyzed at a frequency of 5 percent per batch. Each

batch of up to 20 samples had an independent laboratory control sample (LCS) prepared and included. One duplicate sample was prepared for each 10 samples in a batch.

Analysis of the measurement methodology, instrumentation, and data provides ample evidence of the adequacy of the survey for the following reasons: 1) the Ludlum instrumentation used was specifically designed for this application, has the appropriate sensitivity for gamma radiation energy in the range of interest for thorium-234 (Th-234) and protactinium (Pa-234)m, and has an acceptable manufacturer-designated accuracy of ±10 percent; 2) the Canberra instrumentation has been extensively used for in situ radionuclide concentration measurement in soils and has been validated by the Monte Carlo N-Particle (MCNP) radiation transport digital computer code to substantiate an accuracy of ±10 percent for in situ soil measurements in the gamma energy range of 60 to 3,000 kiloelectron volts (keV) (Th-234 emits 93 keV gammas, and Pa-234m emits 1,080 keV gamma rays); and 3) the average background rate of 12 μR/hr and the > 35 pCi/g DU exposure rate of 14.4 μR/hr each provide sufficient counting statistics with the Ludlum instrumentation to acceptably measure these different dose rates because the Ludlum instrument has a sensitivity of 175 counts per minute (cpm) for 1 μR/hr (2,100 cpm for 12 μR/hr versus 2,520 cpm for 14.4 μR/hr).

3.5 SITE CHARACTERIZATION PROGRAM

Although none of the existing reports provides conclusive evidence of elevated levels of DU migrating outside the DU Impact Area, the Army's responses (U.S. Army 2004b) to the NRC-issued Requests for Additional Information (RAIs) (NRC 2004a,b) pointed to an incomplete understanding of the conceptual site model (CSM) and gaps in the current set of site characterization data. Therefore, these RAIs formed the basis of the approach for site characterization that was completed between 2005 and 2013. This site characterization started with the development of a Field Sampling Plan (FSP) (SAIC 2005) and supporting addenda to the FSP (SAIC 2006b,c; 2007a,b; 2008a,b,c,d; 2009).

The FSP included details only for the earlier years of the overall project schedule. Details for the latter years were provided in addenda to the FSP following an iterative and adaptive approach for site characterization. This approach served as a foundational element of the FSP and necessitated frequent meetings, teleconferences, and written transmittals between the Army, NRC, and contractor personnel. The letter dated 26 April 2006 from NRC to the Army stated that "...NRC anticipates having annual (or more frequent) meetings at NRC headquarters, open to the public, to discuss the Army's progress in completing the site characterization and new decommissioning plan. These meetings should occur prior to the initiation of significant planned field activities, such as determining the number and location of new monitoring wells" (NRC 2006a). At least eight meetings and 10 teleconferences involving Army, NRC, and contractor personnel were held to discuss results and conclusions of completed studies, status of ongoing work, and plans for upcoming work. In addition, substantial other correspondence was exchanged to ensure Army/NRC coordination of site characterization activities for the DU Impact Area for Materials License SUB-1435. These meetings, teleconferences, and correspondence are enumerated in Section 1.

The Army submitted the FSP (SAIC 2005) to NRC to augment the Army's strategy for site characterization, including plans to collect data to support offsite transport modeling, which were included in a January 2005 letter to NRC (U.S. Army 2005). The FSP identified the key problems:

- Limited understanding of the nature and extent of contamination in the DU Impact Area
- Limited understanding of the potential fate and transport of DU outside the DU Impact Area.

The enhanced understanding gained by completing tasks specified in the FSP (SAIC 2005) will serve as the basis for modifying the current ERM program and serving as the foundation to initiate

decommissioning. NRC issued the following RAIs and the comment on groundwater action level (NRC 2004a). This information details the data needs addressed in the FSP (SAIC 2005):

- ***Question 1, CSM***—The Army should provide additional information on the CSM that was used originally to locate the sampling points for groundwater, surface water, and stream sediments. The CSM of the hydrologic system for the DU Impact Area should include all potential water-bearing units, surface water systems, caves, springs, and the unsaturated zone that may be impacted by the degradation and movement of the DU penetrators. The Army should provide information on the interrelationship between DU concentrations in the groundwater, surface water, caves, springs, and stream sediments.

- ***Question 2, Groundwater Flow and Well Placement***—There appears to be conflicting information on the direction of groundwater flow. The Army should provide additional information on the adequacy of the placement (and screened interval), number, and spacing of the current 11 monitoring wells to detect DU in groundwater.

- ***Question 3, Well Construction Details***—The Army should provide additional information on the construction, development, and maintenance of the current 11 monitoring wells.

- ***Question 4, Groundwater and Surface Water Relationships***—The Army should provide additional information on the relationship between stream flow in Big Creek and Middle Fork Creek, and DU concentrations in surface water and stream sediments. The Army should describe how DU concentration in the surface water and stream sediments vary during high, average, and low stream flow conditions. The Army also should state if its corrective measures first proposed in 1984, to be taken if the surface water action level is exceeded, are still current.

- ***Question 5, Penetrator Dissolution Rate and DU Solubility***—The Army should provide additional information on the rate of dissolution of the penetrators. The Army also should provide data on the solubility of DU.

- ***Question 6, Groundwater Corrective Measures***—The Army should state if its corrective measures first proposed in 1984, to be taken if the groundwater action level is exceeded, are still current.

- ***Question 7, Uranium Concentrations in Deer***—The Army should provide additional information on the apparent trend of increasing uranium concentration in deer kidneys and bone, and how this relates to the potential for DU in deer meat that is consumed by humans.

- ***Cover Letter Comment on Groundwater Action Level***—The staff has discussed the groundwater action level proposed in the ERM with the Army and the Army has indicated that the action level for DU in groundwater in the impact area should be changed. Please include this modification to the action level with your response to the requests for additional information.

The Army submitted responses to the RAIs in November 2004 (U.S. Army 2004b) and addressed the Army's revised position on the subject action level.

A central concept to understand for the site-specific problem was articulated in the dose assessment in support of the Decommissioning Plan for Materials License SUB-1435 (U.S. Army 2001) that indicated, "Doses to humans and ecosystem receptors can come from any number of exposure pathways beginning when the munitions are tested and lasting until the DU is removed from the system. Thus, the dose to humans from DU must be assessed for a variety of pathways, and for a relatively long time due to slow transport through the soils." Appendix C of the Environmental Report includes the CSM, including a graphical representation and written description of the DU sources, transport mechanisms, potential

exposure pathways, and potential receptors. This CSM has been revised with respect to information obtained during the tiered, time-phased site characterization activities that allowed for decisions at intermediate milestones regarding the need for collecting additional site data. Subsequent tasks and associated activities were planned and detailed as addenda to the FSP (SAIC 2006b,c; 2007a,b; 2008a,b,c,d; 2009). The FSP (SAIC 2005) and related addenda described numerous activities, including four consecutive quarters of groundwater, surface water, and sediment sampling in April 2008, July 2008, October 2008, and February 2009. Extensive soil sampling was completed in October 2008, December 2009, and March 2012. Sampling results are presented in Sections 3.6 through 3.10, as appropriate.

3.6 SURFACE SOIL

Residual contamination of surface soil has been investigated in the scoping and characterization surveys, ERM program, and site characterization. The following sections summarize the results of these programs.

3.6.1 Exposure Rate Measurements From Scoping Survey

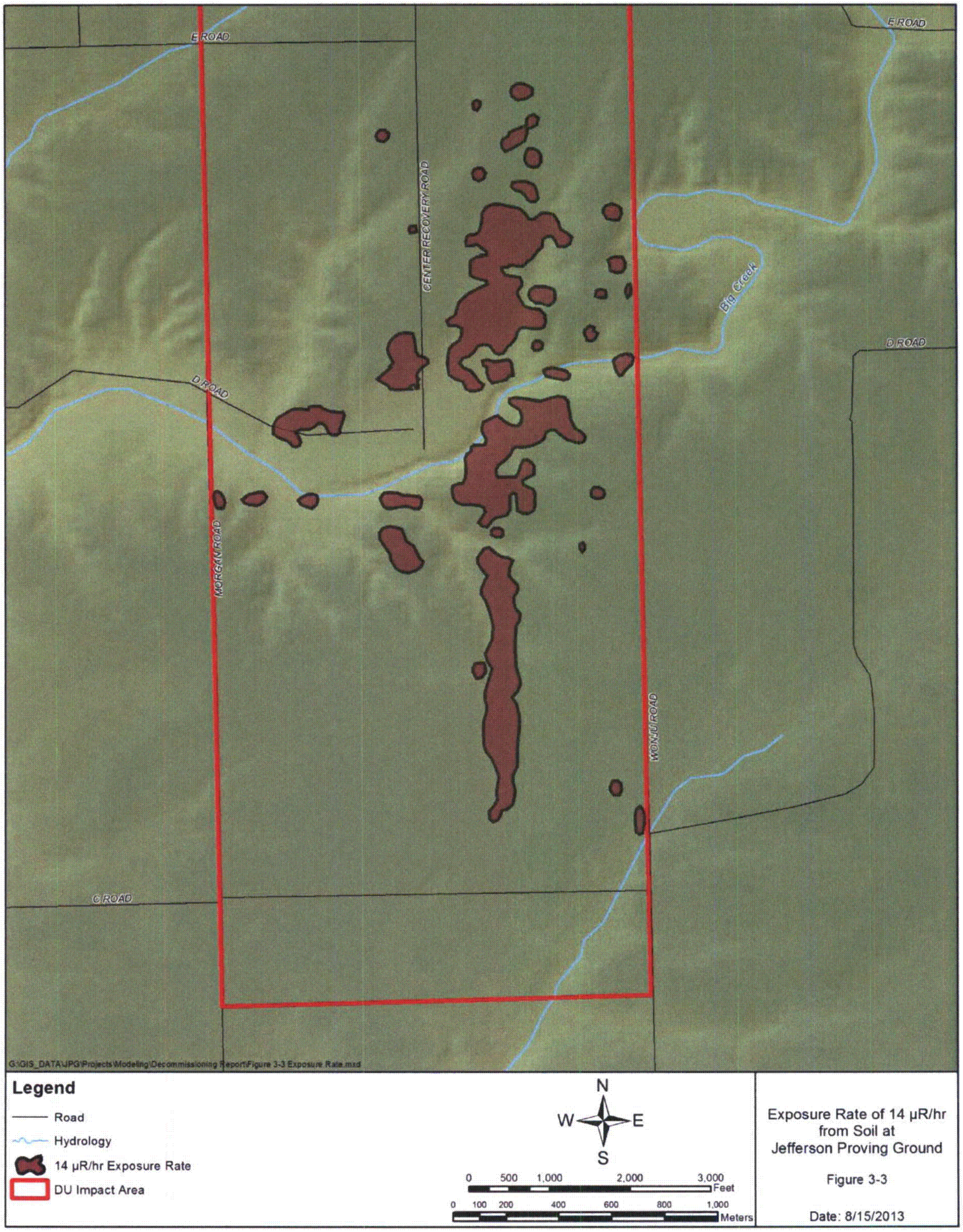
The scoping survey included measurements of exposure rates in an area south of the firing line and in the DU Impact Area. The background study was performed in 1995 prior to conducting measurements in the DU Impact Area. Thirty-five background measurements were taken south of the firing line in an unaffected area. An average background value of 12 μR/hr was established for this area consistent with background levels determined in 1983. Background values ranged from 6 to 8 μR/hr on roads and in creek beds to a high of 10 to 12 μR/hr in open fields and wooded areas (SEG 1995c). For approximately 25,000 measurements of exposure rate in the DU Impact Area, the majority (>95 percent) of measurements were at background levels, but strong indications of the presence of DU were found near the trenches for each firing line. In these areas, exposure rates as high as approximately 3,300 μR/hr were observed.

During the characterization survey, a combination of exposure rate measurements, in situ gamma spectroscopy, and soil sampling was used to further define the affected area. The relationship between the average concentration of DU in the ground and exposure rate was analyzed to determine the isotopic concentration from the in situ gamma spectroscopy data. These measurements were obtained using the same instrument used in the scoping survey (SEG 1995c).

At each location, a single in situ gamma spectroscopy measurement yielded the total inventory of activity for each nuclide presented as an area of activity concentration at the surface. Using these results, the concentrations of Th-234 and Pa-234m were calculated for depth ranges of 0 to 5.9 in (0 to 15 cm) 5.9 to 11.8 in (15 to 30 cm), and 11.8 to 17.7 in (30 to 45 cm) below ground surface (BGS). The specific assumptions used to determine this relationship are discussed in SEG (1996a,b). Statistical analysis of the belowground soil uranium measurements (from Pa-234m data) resulted in a calculated average depth of contamination of 4.3 in (11 cm) in the affected area. This value of 4.3 in (11 cm) corresponds to a 95^{th} percentile (i.e., there is only a 5 percent chance that contamination would exist below 4.3 in [11 cm]). The exposure rate corresponding to a DU concentration of 35 pCi/g is 14.4 μR/hr based on a linear regression analysis of measured data. The contour map showing areas with an exposure rate greater than 14.4 μR/hr is shown in Figure 3-3.

3.6.2 Exposure Rate Measurements From Site Characterization

Gamma walkover surveys serve as screening tools to identify areas that exhibit gamma radioactivity that is elevated with respect to background count rates to facilitate further investigation of such areas. These surveys were performed using an NaI gamma scintillation radiation detector, which was interconnected to a data collection (logging) device and a global positioning system (GPS). The detector was maintained about 4 in (10 cm) above the ground surface and collected data each second consisting of the gamma count rate and location. The system provided both an audible response that was



Exposure Rate of 14 µR/hr from Soil at Jefferson Proving Ground

Figure 3-3

Date: 8/15/2013

proportional to the count rate and a meter reading of the applicable count rate. To perform a gamma walkover survey, the surveyor proceeded forward at a speed of about 1.6 ft (0.5 m) per second while moving the detector in a serpentine manner. During the course of the survey, the surveyor investigated any elevated count rates that were identified. Data subsequently were downloaded and printed, typically at the end of each day. Data then were depicted on maps with color-coding that is indicative of the count rate at each location; thus, areas with elevated count rates were easily identified.

The scan minimum detected concentration (MDC) for DU in soil is reported in NUREG-1507, Minimum Detectable Concentrations with Typical Radiation Survey Instruments for Various Contaminants and Field Conditions (NRC 1995), as 56 pCi/g when using a 2- x 2-in NaI detector. DU penetrator fragments as small as 0.37 cubic inches (in^3) (6 cubic centimeters [cm^3]) are easily located on the soil surface during a typical scan using an investigation threshold of 2,000 cpm above background. Similarly, technical evaluation indicates that a DU penetrator fragment as small as 0.61 in^3 (10 cm^3) can be located easily below 2 in (5 cm) of soil during a typical scan (again assuming an investigation threshold of 2,000 cpm above background). The following table extracted from Appendix A of JPG FSP Addendum 7 (SAIC 2008d) provides information regarding the "modeled count rate versus DU fragment size" for DU fragments located on the ground surface and under 2 in (5 cm) of soil:

Table 3-1. Modeled Count Rate Versus DU Fragment Size at a Distance of 25 Centimeters Jefferson Proving Ground, Madison, Indiana

DU Fragment Size (cm^3)[a,b]	Net Count Rate for DU Fragment on Ground Surface (cpm)[a,b]	Net Count Rate with DU Fragment Beneath 5 cm of Soil (cpm)[a,b]
0.31 in^3 (5.0 cm^3)	1,700	1,100
0.37 in^3 (6.0 cm^3)	2,000	1,300
0.43 in^3 (7.0 cm^3)	2,400	1,500
0.49 in^3 (8.0 cm^3)	2,700	1,700
0.55 in^3 (9.0 cm^3)	3,000	1,900
0.61 in^3 (10.0 cm^3)	3,300	2,100

[a] All data rounded to two significant digits
[b] CPM = counts per minute

In summary, although a 0.061-in^3 (1-cm^3) piece of DU located on the surface of the survey area can be detected, the smallest piece that can be detected with confidence during a normal scan survey using conservative assumptions is a 0.37-cubic inch (6-cm^3) fragment. The smallest piece of DU covered with 2 in (5 cm) of soil that can be detected with confidence during a normal scan survey using conservative assumptions is a 0.61-in^3 (10-cm^3) fragment. Given that DU penetrators are much larger than these minimum sizes, a surveyor can reliably detect penetrators or portions thereof during routine surveys irrespective of whether the DU is located on the surface or under 2 in (5 cm) (or more) of soil.

In addition to the modeling reflected above, the Army performed radiological surveys of a full-size, large-caliber, DU anti-armor penetrator with a nominal length of 24 in (61 cm) on the ground surface and at various depths BGS. Table 3-2 reflects the count rates encountered.

Based on the above empirical data and given use of the typical scan investigation threshold of 2,000 cpm above background, subsurface DU penetrators should be able to be located to depths of at least 18 in (45 cm) BGS. In addition, detector response of radiation survey instruments is proportional to the uranium concentration of DU penetrator corrosion products. As such, detectability of corrosion products is a function of the uranium concentration together with the depth of the corrosion layer BGS. Empirical data for this scenario have not been collected to date at JPG because the depths and concentrations of DU vary widely.

Table 3-2. Variation of Penetrator Count Rate With Distance Below Ground Surface Jefferson Proving Ground, Madison, Indiana

Depth	Count Rate (cpm)[a,b]
On ground surface	1.0×10^6
3.6 in (9.1 cm)	3.6×10^5
7.2 in (18 cm)	2.5×10^5
11 in (27 cm)	1.3×10^5
14 in (37 cm)	4.0×10^4
18 in (45 cm)	1.7×10^4

[a] All data rounded to two significant digits.
[b] CPM = counts per minute.

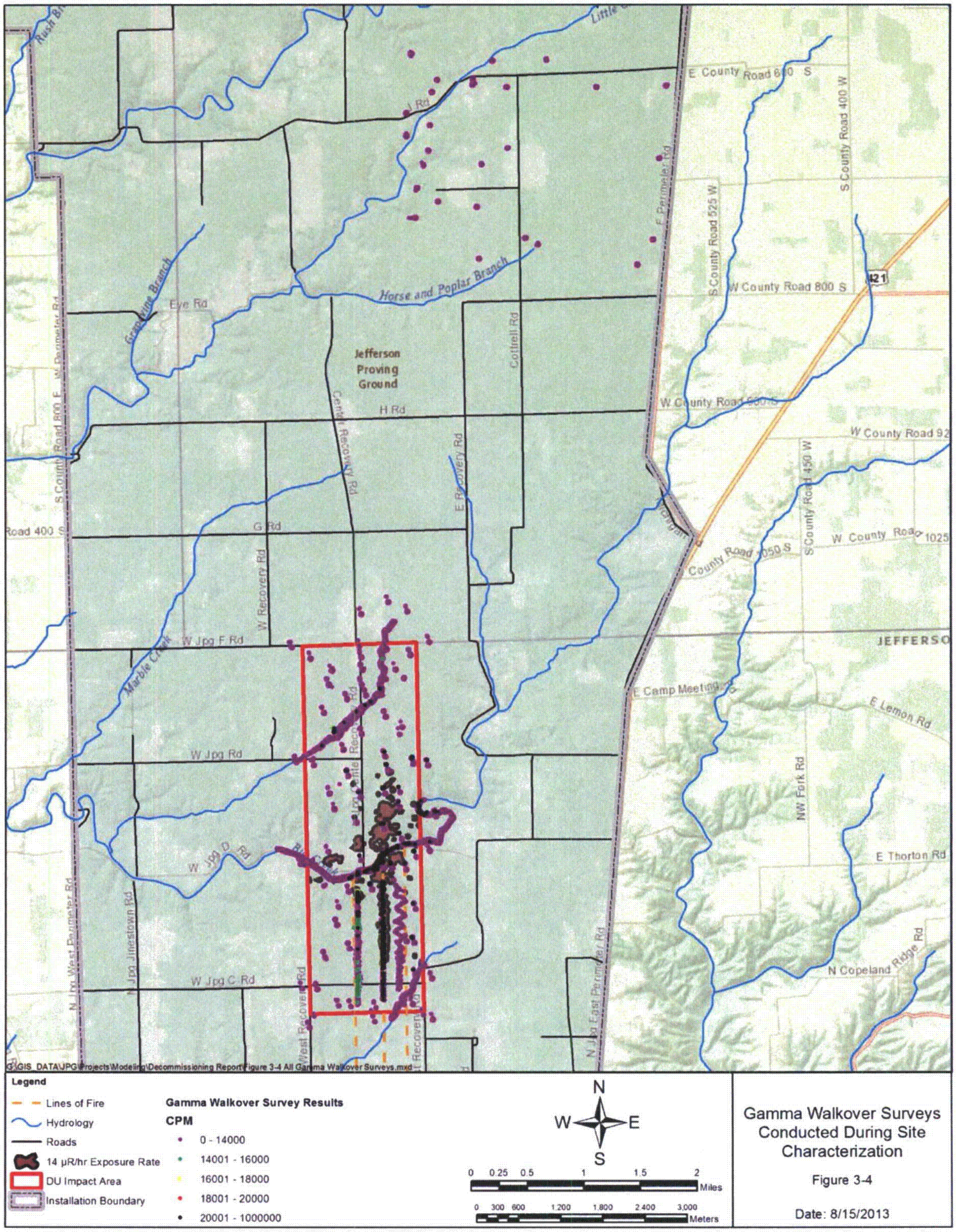
Gamma walkover surveys were conducted to locate areas with elevated residual radiological contamination using surface scans for gross gamma radiation. These surveys were performed for sediment above the water surface in Big Creek, Middle Fork Creek, and North Tributary to evaluate potential contaminant migration in creeks. In addition, gamma walkover surveys were conducted along the presumed lines of fire from the southernmost point of impact (south of C Road) to the downward sloping area just south of Big Creek to delineate the extent of surface contamination (e.g., dense quantities of penetrators). A serpentine search strategy was used to ascertain the lateral extent of the high density areas. Three miles of survey data were collected in creeks in March/April 2008 and 6 mi of survey data were collected along lines of fire in October 2008. In addition, 27 walkover surveys were conducted within a 15-m radius from the center of survey area in background locations. Eighty walkover surveys were conducted within a 15-m radii around soil sampling locations within and around the DU Impact Area. Some were intentionally placed along the presumed lines of fire in areas north of Big Creek.

Figure 3-4 shows the results of these surveys. In particular, Figure 3-4 shows where surveys identified areas with elevated count rates (depicted in black) that confirm the presence of penetrators or significant fragments in Big Creek and North Tributary. However, few, if any penetrators/fragments were identified in Middle Fork Creek.

Approximately 8,500 measurements exceeding background (black dots) were identified within the trench along the 500-Center line of fire (i.e., where approximately 89 percent of the penetrators were fired). Approximately 3,800 measurements exceeding background also were recorded along the J line of fire (i.e., westernmost firing position) near Big Creek. Approximately 7 percent of the penetrators were fired from the J firing position. The area with numerous measurements exceeding background appears to be situated in a depression covering 40 by 175 m. This is believed to be a trench that was previously suspected but never confirmed.

Due to inaccuracies in maps used to plan the survey, gamma walkovers did not actually cover the line of fire associated with the K5 firing position (i.e., easternmost line) from which approximately 4 percent of the total DU penetrators were fired. It is notable, however, that none of the measurements exceeded background.

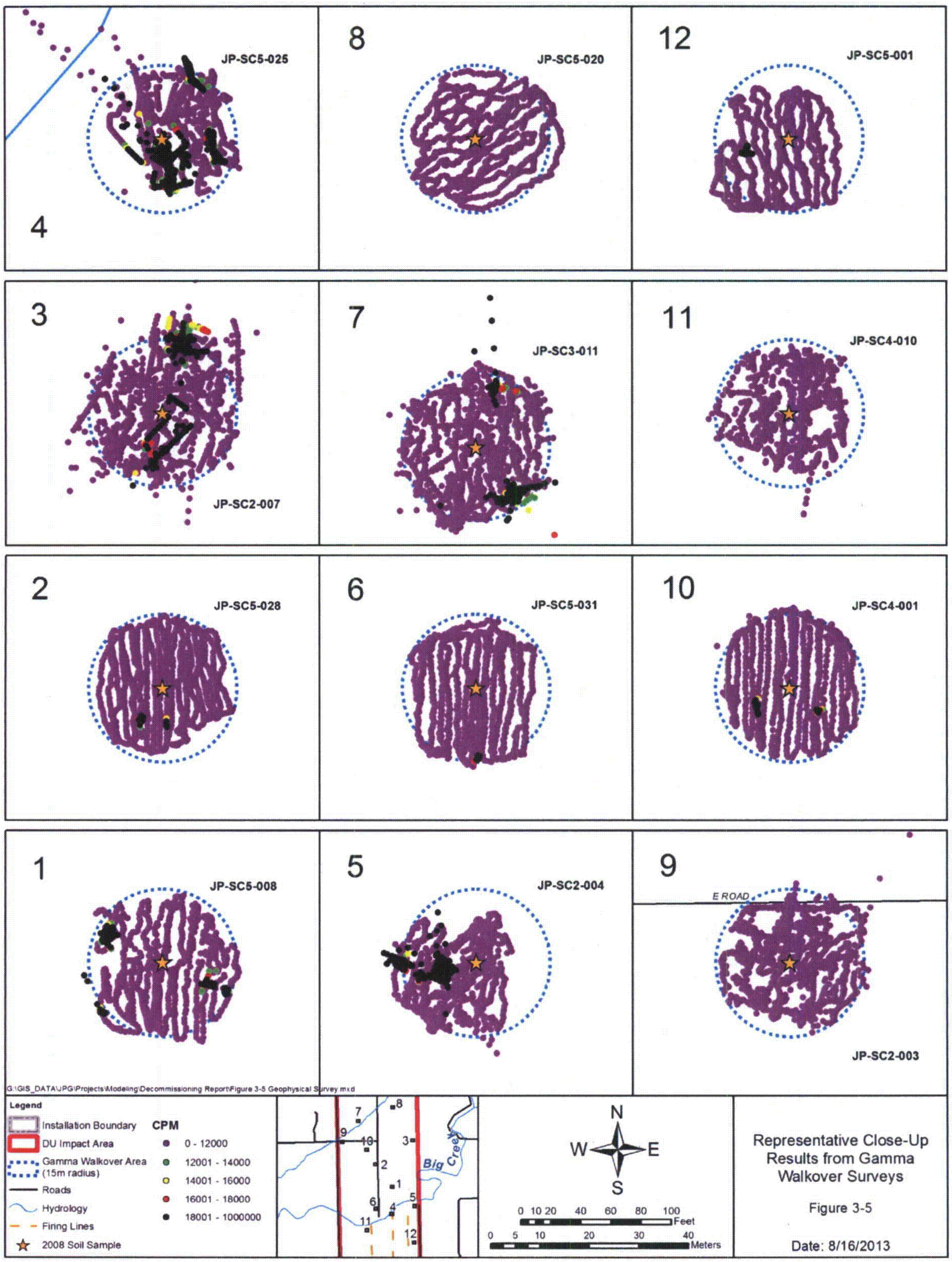
Gamma walkover surveys also were conducted in circular patterns around many of the soil sampling locations. These were collected around background sampling locations to confirm the absence of radiological contamination, although the presence of DU was not considered likely since the background area was approximately 2.5 mi from the DU Impact Area. Figure 3-4 also shows the locations of gamma walkovers conducted in circular patterns to determine possible lateral migration of DU corrosion products. Figure 3-5 shows closeup diagrams with several of the gamma walkovers conducted in circular patterns.



Gamma Walkover Surveys Conducted During Site Characterization

Figure 3-4

Date: 8/15/2013



Representative Close-Up Results from Gamma Walkover Surveys

Figure 3-5

Date: 8/16/2013

3.6.3 Soil Samples From Scoping and Characterization Surveys

Sixty-two soil samples were collected during the scoping survey. Fifty samples were collected from within the DU Impact Area and 12 samples were collected along the 3 trajectories (lines of fire) between the firing line and C Road (Figure 3-2). The soil sampling program was unbiased and based on a 492-ft (150-m) grid system. Samples were collected along the line of fire from the 500 Center firing position, along lines parallel to and 984 ft (300 m) east and west of the 500 Center firing position, and along lines 1,968 ft (600 m) east and west, respectively, of the 500 Center firing position.

The results of this sampling indicated that the highest uranium concentrations were detected south of Big Creek within the DU Impact Area. Total uranium concentrations ranged from <1.3 to 201 pCi/g, with an average concentration of 12.9 pCi/g. Soil samples collected along the trajectories south of the DU Impact Area had concentrations ranging from 1.4 to 1.8 pCi/g total uranium.

Soil samples were analyzed for concentrations of the three major uranium isotopes: U-234, U-235, and U-238. The U-238/U-234 activity ratio (unitless) was reviewed to determine whether the detected uranium is naturally occurring or includes DU. In samples containing natural uranium, the activity ratio of U-238/U-234 is approximately 1 (0.5 to 1.3). The activity ratio for DU is 5.5 to 9 based on a review of isotopic analysis of penetrators collected from the field within the DU Impact Area (SEG 1995c). Therefore, environmental measurements with U-238/U-234 activity ratios greater than two are indicative of DU contamination. The scoping survey soil samples indicated evidence of DU contamination primarily along the central and eastern trajectories within the DU Impact Area.

As part of the characterization survey, background surface and subsurface soil samples were collected from 10 sites in areas not impacted by the DU testing. The background locations were selected to ensure that these locations were representative of the different types of soils in the impact area and consistent with those locations sampled in 1983 as part of the baseline environmental impact survey. Background soil samples were collected from three depths at each location: 0 to 5.9 in (0 to 15 cm), 5.9 to 11.8 in (15 to 30 cm), and 11.8 to 17.7 in (30 to 45 cm) BGS. Total uranium concentrations ranged from 1.33 to 2.76 pCi/g in the background soil samples, as shown in Table 3-3. The U-238/U-234 activity ratio in the background soil samples ranged from 0.5 to 1.3.

Table 3-3. Summary of Soil Sample Results for the Characterization Survey Jefferson Proving Ground, Madison, Indiana

Depth (cm) BGS	Number of Samples	Range in Total Uranium Concentrations (pCi/g)	Average (pCi/g)
Background			
0–15	10	1.52–2.53	1.97
15–30	10	1.33–2.59	1.84
30–45	10	1.33–2.76	1.95
Penetrator Soil Samples			
0–15	20	2.9–12,318	2,881
15–30	20	1.5–547	79.5
30–45	20	1.8–63	12.7
45–60	13	1.4–11.5	4.50
Random Soil Samples			
0–15	20	1.46–4.73	2.60
15–30	20	1.51–6.91	2.40
30–45	20	1.34–4.21	2.00

Source: Compiled from SEG (1996)
To convert from centimeters to inches, divide by 2.54
BGS = below ground surface
cm = centimeter
pCi/g = picoCurie per gram

To correlate measured soil uranium concentrations with measured gamma dose rates, 26 measurements of dose rates for locations in and around a previously identified DU projectile impact trench in the affected area were made. The measured dose rates ranged from 10.0 to 35.6 μR/hr with the resulting data analysis, using linear regression, correlating a 35 pCi/g DU concentration to a measured gamma dose rate of 14.4 μR/hr.

3.6.4 Soil Samples From ERM Program

For 91 discrete samples (inclusive of duplicates) available from 4 surface soil sampling locations (SS-DU-001 to SS-DU-004) during the period from 2004 through October 2012, the average total uranium activity-concentration is 1.5 pCi/g, the standard deviation is 0.3 pCi/g, and the maximum detected activity-concentration is 2.2 ± 0.5 pCi/g. The activity-concentration at each location is well below the action level of 35 pCi/g. Surface soil data are summarized in Table 3-4.

Table 3-4. Summary of JPG Surface Soil Data (December 2004-October 2012) Jefferson Proving Ground, Madison, Indiana

Surface Soil Location	Range of Total Uranium (pCi/g)*	Mean and Standard Deviation of Total Uranium (pCi/g)*
SS-DU-001	1.2 – 2.2	1.7 ± 0.28
SS-DU-002	0.36 – 2.1	1.6 ± 0.33
SS-DU-003	1.0 – 1.7	1.4 ± 0.2
SS-DU-004	0.80 – 2.1	1.4 ± 0.33
Overall (91 data points)	0.36 – 2.2	1.5 ± 0.31

*Data rounded to two significant digits

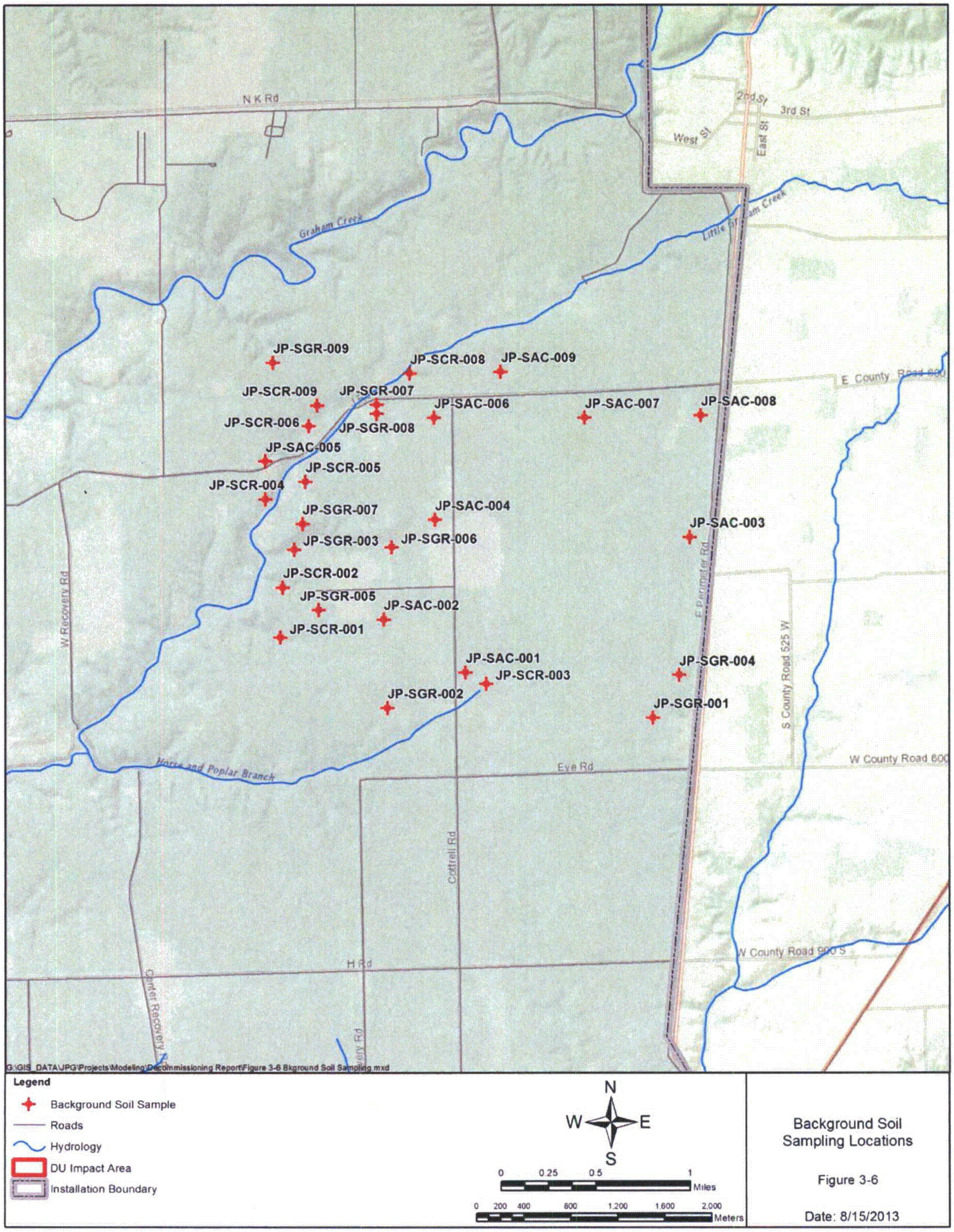
A comprehensive background study performed in the fall of 2008 and spring of 2012 assessed the presence of uranium in a variety of soil types (i.e., Avonburg/Cobbsfork, Cincinnati/Rossmoyne, and Grayford/Ryker) for surface soils (i.e., uppermost 0.5 ft BGS) and for subsurface soils at depths BGS of 0.5 to 1, 1 to 2, and 2 to 4 ft BGS. Nine background surface soil samples were collected for each of the cited soil type groupings. Results reflected means of 1.5 ± 0.1 pCi/g for Avonburg/Cobbsfork, 1.6 ± 0.2 pCi/g for Cincinnati/Rossmoyne, and 1.5 ± 0.2 pCi/g for Grayford/Ryker with an overall mean of 1.5 ± 0.2 pCi/g for all 127 samples. This background data reflects two significant digits and two standard deviation errors.

Comparison of surface soil results listed in Table 3-4 with site background surface soil data supports the conclusion that the uranium present at each of the four surface soil locations is within the range of surface soil background.

3.6.5 Soil Samples From Site Characterization

Soil sampling in October 2008, December 2009, and March 2012 included the collection of 767 soil samples from 152 locations in accordance with requirements in FSP Addenda 7 (SAIC 2008d) and 8 (SAIC 2009). Background sampling (127 samples, Figure 3-6) and sampling under penetrators (107 samples, Figure 3-7) were collected and identified based on their respective soil type groupings: Avonburg/Cobbsfork, Cincinnati/Rossmoyne, and Grayford/Ryker. The remaining 400 samples (Figure 3-8) were collected from various locations in and around the DU Impact Area: Category 1 – outside DU Impact Area perimeter, Category 2 – immediately inside DU Impact Area, Category 3 – midway to DU Impact Area trenches, Category 4 – immediately outside DU Impact Area trenches, Category 5 – other nature and extent samples, and Category 6 – trench locations. Except where sampling with hand augers was limited due to auger refusal (e.g., roots, stones), samples were collected from the following depth intervals:

- For October 2008 sampling, the following sample groups were collected from depths of 0 to 0.5, 0.5 to 1, 1 to 2, and 2 to 4 ft BGS: background samples; samples collected in Categories 1, 2, and 5; and samples collected from under penetrators


N K Rd
2nd St
3rd St
West St
East St
Graham Creek
Little Graham Creek
JP-SGR-009
JP-SCR-008
JP-SAC-009
E County Road 600
JP-SCR-009
JP-SGR-007
JP-SAC-006
JP-SAC-007
JP-SAC-008
JP-SCR-006
JP-SGR-008
JP-SAC-005
JP-SCR-005
JP-SCR-004
JP-SGR-007
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JP-SGR-003
JP-SGR-006
JP-SCR-002
JP-SGR-005
JP-SAC-002
JP-SCR-001
W Recovery Rd
E Perimeter Rd
S County Road 525 W
JP-SAC-001
JP-SCR-003
JP-SGR-004
JP-SGR-002
JP-SGR-001
W County Road 800
Horse and Poplar Branch
Eye Rd
Cottrell Rd
H Rd
W County Road 900 S
Center Recovery
Legend
Background Soil Sample
Roads
Hydrology
DU Impact Area
Installation Boundary
N
W
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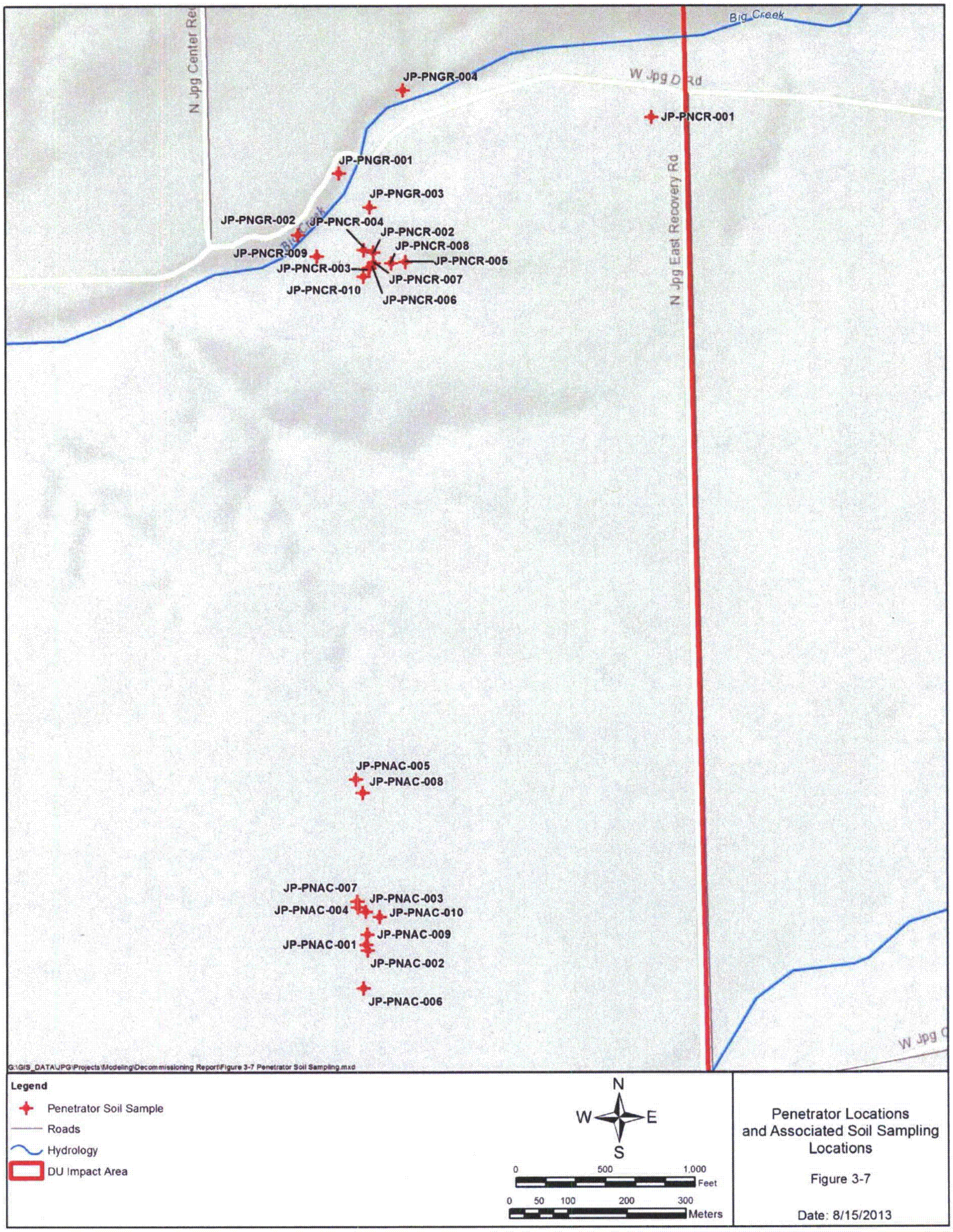
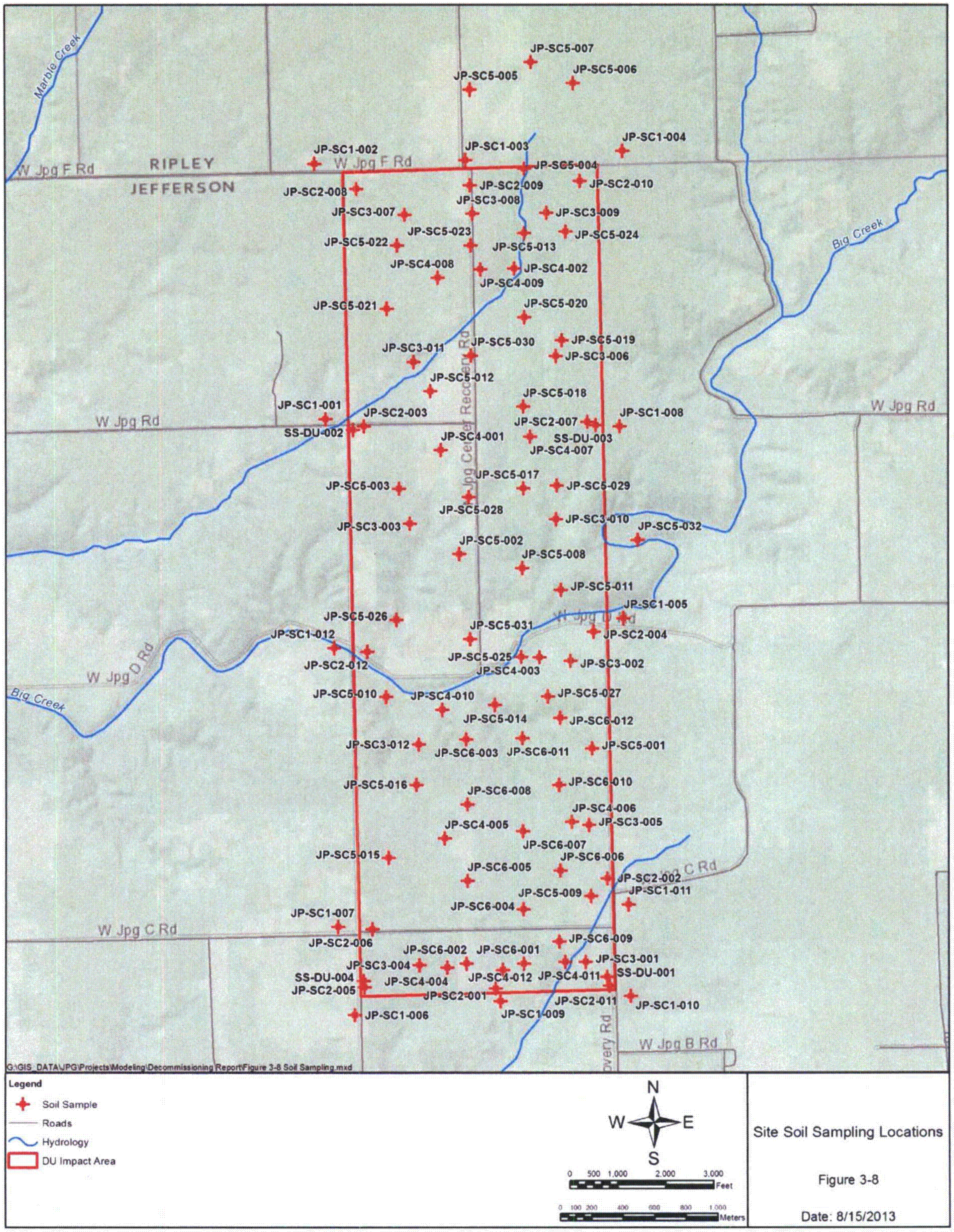
0 0.25 0.5 1 Miles
0 200 400 800 1,200 1,600 2,000 Meters
Background Soil Sampling Locations
Figure 3-6
Date: 8/15/2013



Penetrator Locations and Associated Soil Sampling Locations

Figure 3-7

Date: 8/15/2013



Site Soil Sampling Locations

Figure 3-8

Date: 8/15/2013

- For October 2008 sampling, samples were collected in Categories 3, 4, and 6 from depths of 0 to 0.5, 0.5 to 1, 1 to 2, 2 to 4, and 4 to 6 ft BGS
- For March/April 2012, samples were collected from 0 to 4 ft BGS to address concerns raised by NRC (2011).

Samples were analyzed for total and isotopic uranium and other nonradiological constituents. During the analysis of soil samples collected in the fall of 2008, the Army became aware that alpha spectrometry results for a limited portion of the higher activity samples appeared to be biased high. This conclusion was based on reported results for one alpha spectrometry sample, which exceeded the specific activity of DU as stated in Title 10, Code of Federal Regulations (CFR), Part 20, Appendix B (i.e., 3.6 × 10-7 curies per gram [Ci/g]). This conclusion was reinforced by the reanalysis results from six high-activity samples using gamma spectroscopy and the associated comparison of radioanalytical results for the two methods. The alpha spectrometry results for the highest activity sample were a factor of 50 times higher than the gamma spectroscopy results. In addition, alpha spectrometry results for each of the other five samples were a factor of 3.1 to 7.2 times higher than the gamma spectroscopy results for the same samples. Investigations into the cause suggested that the elevated alpha spectrometry results were associated with poor tracer recoveries and sample dilutions required to accommodate the high uranium concentrations. Based on the high bias that had been encountered with alpha spectrometry, the Army discussed the issue with NRC staff and re-analyzed samples by gamma spectroscopy as follows:

- All samples with total uranium activities greater than 1,000 pCi/g (39 samples) were re-analyzed. The lowest total uranium activity in this range was from JP-PNAC-009/SAIC01 that was collected from 0.5 to 1 ft BGS. The alpha spectrometry result was 1,200 ± 258 pCi/g and the corresponding reanalysis result using gamma spectrometry was 537 ± 48 pCi/g. The highest total uranium activity measured was 720,430 ± 264,000 pCi/g from JP-PNAC-009/ SAIC01 that was collected from 0.5 to 1 ft BGS. The corresponding reanalysis for this sample using gamma spectrometry was 10,149 ± 885 pCi/g.
- Since the issue was related to higher activity samples, results for alpha and gamma spectrometry results were previously expected to converge at 1,000 pCi/g. However, gamma spectrometry re-analysis results remained incongruent around 1,000 pCi/g. For this reason, all samples with total uranium activities greater than 15 pCi/g were re-analyzed, which included 62 additional samples.
- To ensure parity between the alpha and gamma spectrometry results, 5 percent of the remaining samples (35 samples) were re-analyzed and even more would have been re-analyzed except that parity between the results was observed.

Results from alpha and gamma spectrometry analysis are included in Appendix F of the Environmental Report (U.S. Army 2013a). Additional information about sampling and analysis procedures and results is included in Section 6 and Appendix F of the Environmental Report (U.S. Army 2013a). Data from the gamma spectrometry analysis is used for the tables, interpretations, and conclusions presented below.

Sampling results from all soil site characterization sampling were statistically analyzed via ProUCL computer software (USEPA 2007) to evaluate data from background, Categories 1 through 6, glacial till, and soil from under/over penetrators. Results are summarized for sampling in Tables 3-5 and 3-6. Total uranium concentrations ranged from -3.2 ± 2.3 to 40,693 ± 3,580 pCi/g with overall mean concentrations ranging from 0.76 to 6,831 pCi/g. Most soil concentrations (578 results, 76 percent) were low with respect to potential radiological doses (i.e., 35 pCi/g is a common derived concentration guideline level [DCGL]). Total uranium concentrations in 127 background soil samples ranged from 0.15 (0.43 milligram per kilogram (mg/kg), measured with inductively coupled plasma –spectrometry [ICP-MS]) to 3.8 ± 0.81 pCi/g. Total uranium concentrations in 336 soil samples collected away from the trench and

Table 3-5. Summary Statistics for Soil Sampling Across All Depths Jefferson Proving Ground, Madison, Indiana

Sample Group	Number of Samples	Minimum	Maximum	Mean
Background Soil				
Avonburg and Cobbsfork	45	0.16	1.8	1.3
Cincinnati and Rossmoyne	45	0.16	2.1	1.4
Grayford and Ryker	37	0.20	3.8	1.7
Categories 1 Through 6				
1 – Outside DU Impact Area Perimeter	45	1.3	2.1	1.6
2 – Immediately Inside DU Impact Area	48	1.00	2.3	1.6
3 – Midway to DU Impact Area Trenches	58	1.2	19	1.9
4 – Immediately Outside DU Impact Area Trenches	58	1.1	2.1	1.5
5 – Other Nature and Extent Samples	127	0.71	2.6	1.6
6 – Trench Locations	64	-3.2	142	8.5
Glacial Till Soil Samples				
Glacial Till Samples	12	0.16	2.2	0.76
Soil Over/Under Penetrators				
Avonburg and Cobbsfork	46	23	40,693	6,831
Cincinnati and Rossmoyne	42	22	27,253	3,956
Grayford and Ryker	20	-1.5	27,469	3,620

Table 3-6. Summary of Elevated Isotopic Uranium Ratio by Area Jefferson Proving Ground, Madison, Indiana

Sample Group	Number of Samples	Number of Samples with U-238/U-234 Ratios >3.0	Number of Samples with Weight Percent U-235 <0.7 Percent
Samples Outside of Trench/Away From Penetrators (0 to 0.5 ft BGS)	164	1	--
Samples From Trench (0 to 0.5 ft BGS)	7	3	--
Samples From Over/Under Penetrators[a] (0 to 0.75 ft BGS)	34	34	--

BGS = below ground surface
SD = standard deviation
MAD/0.675 = median absolute deviation (MAD)/0.675 is robust estimate of variability
CV = coefficient of variation
[a] Sampling depths for the planned 0 to 0.5 ft BGS interval actually extended from 0 to 0.75 ft BGS for samples collected over/under subsurface penetrators due to the depth to the penetrator. Other depth variations resulted from the presence of subsurface obstructions (e.g., stones, bedrock, roots). Specific sampling intervals included 0 to 0.125, 0 to 0.15, 0 to 0.25, 0 to 0.3, 0 to 0.35, 0 to 0.5, 0.125 to 0.625, 0.15 to 0.5, 0.25 to 0.5, 0.25 to 0.75, 0.35 to 0.5 ft BGS.

penetrators ranged from 0.71 ± 0.18 to 19 ± 5.4 pCi/g. Total uranium concentrations in 12 samples from the glacial till ranged from 0.16 pCi/g (0.45 mg/kg, measured with ICP-MS) to 2.2 ± 0.24 pCi/g. Total uranium concentrations in 63 samples collected from within the trench area (Category 6) ranged from -1.8 ± 2.7 to 142 ± 16 pCi/g. Total uranium concentrations in 107 samples collected from over or under penetrators ranged from 22 ± 4.7 to 40,693 ± 3,580 pCi/g.

With the exception of the surface (0.0 to 0.50 ft) interval of JP-SC3-005, all U-238/U-234 ratios were less ≤ 3 for samples from Category 1 through 5 locations. The U-238/U-234 ratio for the surface interval of JP-SC3-005 was 5.9 ± 2.0. Table 3-6 shows evidence of DU (based on U-238/U-234 ratios exceeding 3.0) in all 34 samples collected under/over penetrators to depths of 0.75 ft BGS. Isotopic ratios for samples collected within the 500 Center trench (Category 6) based on U-238/U-234 ratios also exceeded 3.0 in three of seven samples.

Statistical testing was conducted on the soil data using the standard general linear model (SAS® v 9.2 PROC GLM procedure) to test whether uranium concentrations at the DU Impact Area differed significantly from background levels. The F-test was conducted to evaluate the overall significance in

difference among categories and pairwise t-tests were used to compare individual contrasts between categories. Lower p-values indicate that differences (averages are not equal) are unlikely to be due to chance. With a 5 percent significance level used to reject null hypothesis, tests with p-values <= 0.05 are "significant" and tests with p-values between 0.05 and 0.10 are "marginally significant." In general, concentrations differed by soil type and differences among soil types varied by category. Significant differences were determined among soil types at the background categories and between soil types in Categories 1 and 4. Concentrations were significantly higher at background than in Categories 1 through 5 for Cincinnati/Rossmoyne (log mean [arithmetic mean of data transformed to values corresponding with their respective natural logarithms] =1.70 versus 1.55 pCi/g, p=0.02), and marginally higher for Grayford/Ryker (log mean=1.58 versus 1.45 pCi/g, p=0.08). For Avonburg and Cobbsfork, background mean was lower than onsite, but the difference was not significant (log mean=1.54 versus 1.59 pCi/g, p=0.41). As expected, the mean concentrations at Category 6 (under trenches) and soil under/over penetrators were much higher than either background or the other categories.

3.7 SUBSURFACE SOIL

Residual contamination of subsurface soil has been investigated in the characterization survey and site characterization. The following sections summarize the results of these programs.

3.7.1 Subsurface Soil Samples From Characterization Surveys

Samples of subsurface soil were collected at 10 background, 20 randomly selected, and 20 penetrator locations during the characterization survey (SEG 1996). Sampling locations are summarized in Figure 3-2. In each case, samples were collected at depths of 0 to 15, 15 to 30, and 30 to 45 cm. For 13 of the penetrator locations, an additional sample was collected at a depth of 45 to 60 cm.

For the background sample locations, concentrations of total uranium ranged from 1.33 to 2.76 pCi/g and averaged 1.92 pCi/g. For the depth from 0 to 15 cm, the concentration of total uranium ranged from 1.52 to 2.53 pCi/g and averaged 1.97 pCi/g. For the depth from 15 to 30 cm, the concentration of total uranium ranged from 1.33 to 2.59 pCi/g and averaged 1.84 pCi/g. For the depth from 30 to 45 cm, the concentration of total uranium ranged from 1.33 to 2.76 pCi/g and averaged 1.95 pCi/g. The ratio of concentration of U-238 to U-234 ranged from 0.7 to 1.3. Trends of concentration or ratios of concentrations with location or depth are not evident.

For the randomly selected soil locations, the total uranium concentrations ranged from 1.34 to 6.91 pCi/g, with an average concentration of 2.33 pCi/g. None of the samples was from trenches within the DU Impact Area, and most samples were at background concentrations. The U-238 to U-234 activity ratio in the random soil samples indicated that most of the uranium was naturally occurring.

For penetrator locations, samples were collected at four depths. Concentrations of total uranium ranged from 1 to 12,318 pCi/g. The ratio of concentration of U-238 to U-234 ranged from 1.1 to 8.4. Results of the measurements are summarized in Table 3-7. Concentrations decreased with depth but indicated the presence of contamination and downward movement at all depths.

3.7.2 Subsurface Soil Samples From Site Characterization

In addition to surface soil sampling described in Section 3.6.5, samples were collected from deeper intervals. Section 3.6.5 listed the deeper intervals as part of the description of sampling and analysis procedures, but results presented in Section 3.6.5, including Tables 3-5 and 3-6, were limited to surface soil sampling. This section presents the results for deeper intervals from the same locations described in Section 3.6.5.

In December 2009 and late March 2012 (recollections), twelve soil samples were collected from the deeper glacial till hydrostratigraphic unit with a hydraulic direct-push technology (DPT) Geoprobe®

Table 3-7. Summary of Results of Surface and Subsurface Soil Analysis for Penetrator Locations Jefferson Proving Ground, Madison, Indiana

Depth	Concentration of Total Uranium (pCi/g)		
	Average	Range	
		Minimum	Maximum
0 to 15 cm	2,882	3	12,318
15 to 30 cm	80	2	547
30 to 45 cm	10	2	63
45 to 60 cm	5	1	12

Source: SEG 1996
To convert from centimeters to inches, divide by 2.54
BGS = below ground surface
cm = centimeter
pCi/g = picocurie per gram

6620DT 2 Track with 4.25-in hollow stem auger and sampler within areas cleared for previous drilling inside the DU Impact Area. Sample locations were located adjacent to monitoring 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. The sample locations had minimal impacts from site-related DU due to their depth BGS (6 to 18 feet BGS), the relatively impermeable nature of the till, and the distances from lines of fire. In addition, the sample locations covered the predominant soil type groupings present within the DU Impact Area (i.e., Avonburg/Cobbsfork, Cincinnati/Rossmoyne, and Grayford/Ryker) and provided a relatively widespread geographic distribution.

Table 3-8 shows evidence of DU (based on U-238/U-234 ratios exceeding 3.0) in all 71 samples collected under/over penetrators to depths of 4.5 ft BGS. Isotopic ratios for samples collected within the 500 Center trench (Category 6) based on U-238/U-234 ratios also exceeded 3.0 in 4 of 45 samples. None of the isotopic ratios for samples collected deeper than 4 ft BGS exceeded 3.0 for samples collected within the 500 Center trench. None of the U-238/U-234 ratios for samples collected away from the trench and penetrators exceeded 3.0.

Figures 3-9 through 3-11 show the results for gamma activity scans of soil samples collected under penetrators as a function of depth. The gamma activities measured at ground surface (or immediately underneath subsurface penetrators) ranged from 646 to 88,873 cpm. At 24 in BGS, which is the deepest depth with numerous measurements, the gamma activities ranged from 62 to 607 cpm. Figures 3-9 through 3-11 show 90 to >99 percent reductions which demonstrate a rapid attenuation in gamma activity. A rapid reduction in total uranium activity as a function of depth also is shown in Tables 3-8 and 3-9. For example from Table 3-9, the mean concentration for samples from over/under penetrators falls from 1,926 pCi/g (0.5 to 1.25 ft BGS) to 547 pCi/g (1 to 2.5 ft BGS) to 208 pCi/g (2 to 4.5 ft BGS). Although not shown in Tables 3-5 or 3-6, the mean concentration for samples collected over/under penetrators from 0 to 0.75 ft BGS was 13,729 pCi/g, which demonstrates a precipitous attenuation in total uranium activity with depth. However, the deepest samples, on average, are well above background levels for total uranium with means from 1.3 to 1.7 pCi/g.

In addition to displaying spatial patterns for elevated U-238/U-234 ratios (i.e., under penetrators and within trench), Table 3-8 also indirectly shows depths of DU migration. Consistent with the attenuation of gamma activity demonstrated in Figures 3-9 through 3-11 and reductions in total uranium activities under penetrators from Table 3-9, the number of samples exceeding U-238/U-234 ratios of 3.0 generally diminish with depth from 34 (0 to 0.75 ft BGS) to 26 (0.5 to 1.25 ft BGS) to 27 (1 to 2.5 ft BGS) to 18 (2 to 4.5 ft BGS). Elevated ratios were observed in 18 samples in the 2 to 4.5 ft BGS interval and elevated average concentrations at that same depth (208 pCi/g from 2 to 4.5 ft BGS), suggesting that

Table 3-8. Summary of Elevated Isotopic Uranium Ratio by Area and Depth
Jefferson Proving Ground, Madison, Indiana

Sample Group	Number of Samples	Number of Samples with U-238/U-234 Ratios >3.0	Number of Samples with Weight Percent U-235 <0.7 Percent
Samples Outside of Trench/Away From Penetrators (0.5 to 1 ft BGS)	107	- -	- -
Samples From Trench (0.5 to 1 ft BGS)	10	2	- -
Samples From Over/Under Penetrators[a] (0.5 to 1.25 ft BGS)	26	26	- -
Samples Outside of Trench/Away From Penetrators (1 to 2 ft BGS)	106	- -	- -
Samples From Trench (1 to 2 ft BGS)	12	1	- -
Samples From Over/Under Penetrators[b] (1 to 2.5 ft BGS)	27	27	- -
Samples Outside of Trench/Away From Penetrators (2 to 4 ft BGS)	102	- -	- -
Samples From Trench (2 to 4 ft BGS)	12	1	- -
Samples From Over/Under Penetrators[c] (2 to 4.5 ft BGS)	18	18	- -
Samples Outside of Trench/Away From Penetrators (4 to 6 ft BGS)	20	- -	- -
Samples From Trench (4 to 6 ft BGS)	11	- -	- -
Samples Outside of Trench/Away From Penetrators (0 to 4 ft BGS)	- -	- -	- -
Samples From Over/Under Penetrators[d] (0 to 4 ft BGS)	2	- -	2
Samples Outside of Trench/Away From Penetrators[e] (6 to 18 ft BGS)	6	- -	- -
Total	662	75	2

BGS = below ground surface
SD = standard deviation
MAD/0.675 = median absolute deviation (MAD)/0.675 is robust estimate of variability
CV = coefficient of variation

[a] Sampling depths for the planned 0.5 to 1 ft BGS interval actually extended from 0.5 to 1.25 ft BGS for samples collected over/under subsurface penetrators due to the depth to the penetrator. Other depth variations resulted from the presence of subsurface obstructions (e.g., stones, bedrock, roots). Specific sampling intervals included 0.5 to 1, 0.625 to 1.125, 0.75 to 1.0, and 0.75 to 1.25 ft BGS.

[b] Sampling depths for the planned 1 to 2 ft BGS interval actually extended from 1 to 2.5 ft BGS for samples collected over/under subsurface penetrators due to the depth to the penetrator. Other depth variations resulted from the presence of subsurface obstructions (e.g., stones, bedrock, roots). Specific sampling intervals included 1 to 1.25, 1 to 1.5, 1 to 2, 1.125 to 2.125, 1.25 to 2.25, and 1.5 to 2.5 ft BGS.

[c] Sampling depths for the planned 2 to 4 ft BGS interval actually extended from 2 to 4.5 ft BGS for samples collected over/under subsurface penetrators due to the depth to the penetrator. Other depth variations resulted from the presence of subsurface obstructions (e.g., stones, bedrock, roots). Specific sampling intervals included 2 to 2.5, 1.5 to 2.5, 2 to 4, 2.125 to 4.125, and 2.5 to 4.5 ft BGS.

[d] The presence of subsurface obstructions (e.g., stones, bedrock, roots) prevented the collection of the full 4-foot interval (0 to 4 ft BGS) for some samples. Specific sampling intervals included 0 to 2, 0 to 3, 0 to 3.3, and 0 to 4 ft BGS.

[e] Samples were collected from 6 to 18 ft BGS depending on the zone where glacial till was encountered at the specific location. Specific sampling intervals included 6 to 10, 8 to 14, 10 to 16, and 10 to 18 ft BGS.

Table 3-9. Summary Statistics for Soil Sampling by Area and Depth Jefferson Proving Ground, Madison, Indiana

Sample Group	Number of Samples	Minimum	Maximum	Mean
Background Samples (0.5 to 1 ft BGS)	27	1.3	2.2	1.7
Samples Outside of Trench/Away From Penetrators (0.5 to 1 ft BGS)	80	0.92	2.6	1.6
Samples From Trench (0.5 to 1 ft BGS)	13	-1.8	48	6.2
Samples from Over/Under Penetrators[a] (0.5 to 1.25 ft BGS)	26	86	10,149	1,926
Background Samples (1 to 2 ft BGS)	27	1.3	3.8	1.8
Samples Outside of Trench/Away From Penetrators (1 to 2 ft BGS)	79	1.00	2.1	1.6
Samples From Trench (1 to 2 ft BGS)	12	1.4	25	3.8
Samples From Over/Under Penetrators[b] (1 to 2.5 ft BGS)	26	22	3,137	547
Background Samples (2 to 4 ft BGS)	25	1.0	2.2	1.7
Samples Outside of Trench/Away From Penetrators (2 to 4 ft BGS)	77	0.83	2.4	1.6
Samples From Trench (2 to 4 ft BGS)	12	1.5	5.3	2.2
Samples From Over/Under Penetrators[c] (2 to 4.5 ft BGS)	18	24	670	208
Background Samples (0 to 4 ft BGS)	21	0.16	1.0	0.31
Samples Outside of Trench/Away From Penetrators (4 to 6 ft BGS)	20	1.2	1.8	1.5
Samples From Trench (4 to 6 ft BGS)	12	1.3	3.9	1.9
Samples From Over/Under Penetrators[d] (0 to 4 ft BGS)	3	23	17,100	6,063
Glacial Till Samples[e] (6 to 18 ft BGS)	12	0.16	2.2	0.76

BGS = below ground surface

[a] Sampling depths for the planned 0.5 to 1 ft BGS interval actually extended from 0.5 to 1.25 ft BGS for samples collected over/under subsurface penetrators due to the depth to the penetrator. Other depth variations resulted from the presence of subsurface obstructions (e.g., stones, bedrock, roots). Specific sampling intervals included 0.5 to 1, 0.625 to 1.125, 0.75 to 1.0, and 0.75 to 1.25 ft BGS.

[b] Sampling depths for the planned 1 to 2 ft BGS interval actually extended from 1 to 2.5 ft BGS for samples collected over/under subsurface penetrators due to the depth to the penetrator. Other depth variations resulted from the presence of subsurface obstructions (e.g., stones, bedrock, roots). Specific sampling intervals included 1 to 1.25, 1 to 1.5, 1 to 2, 1.125 to 2.125, 1.25 to 2.25, and 1.5 to 2.5 ft BGS.

[c] Sampling depths for the planned 2 to 4 ft BGS interval actually extended from 2 to 4.5 ft BGS for samples collected over/under subsurface penetrators due to the depth to the penetrator. Other depth variations resulted from the presence of subsurface obstructions (e.g., stones, bedrock, roots). Specific sampling intervals included 2 to 2.5, 1.5 to 2.5, 2 to 4, 2.125 to 4.125, and 2.5 to 4.5 ft BGS.

[d] The presence of subsurface obstructions (e.g., stones, bedrock, roots) prevented the collection of the full 4-foot interval (0 to 4 ft BGS) for some samples. Specific sampling intervals included 0 to 2, 0 to 3, 0 to 3.3, and 0 to 4 ft BGS.

[e] Samples were collected from 6 to 18 ft BGS depending on the zone where glacial till was encountered at the specific location. Specific sampling intervals included 6 to 10, 8 to 14, 10 to 16, and 10 to 18 ft BGS.

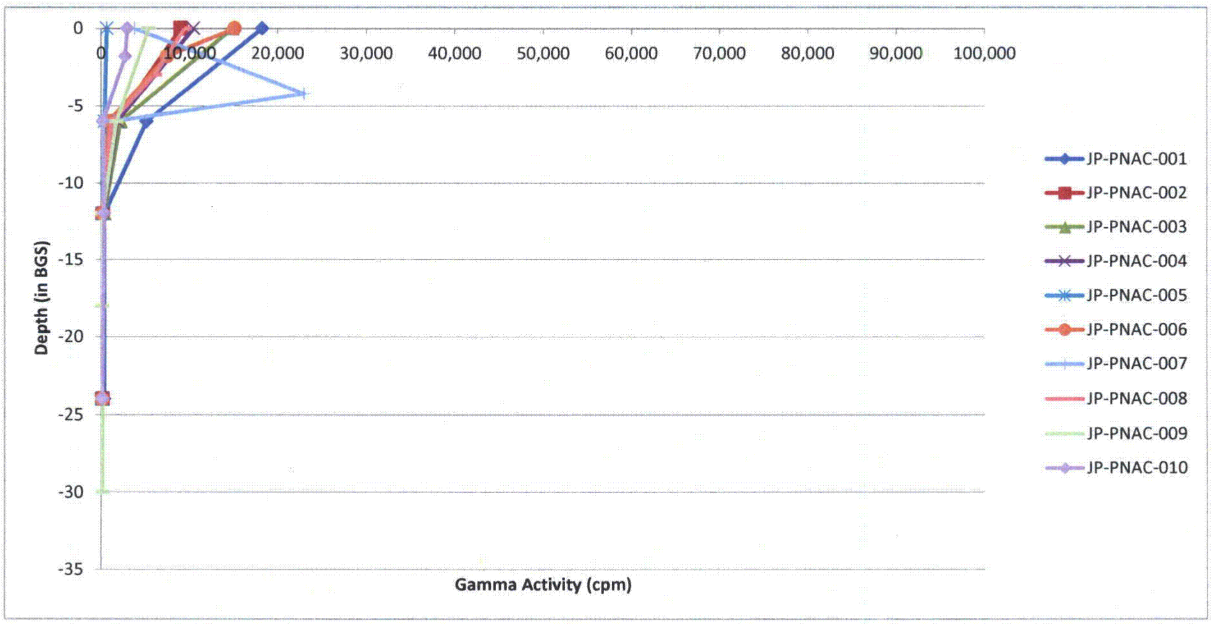


Figure 3-9. Scatterplot for Gamma Activity Measurements Versus Depth for Soil Under Penetrators Collected From Areas with Avonburg/Cobbsfork Soil Types

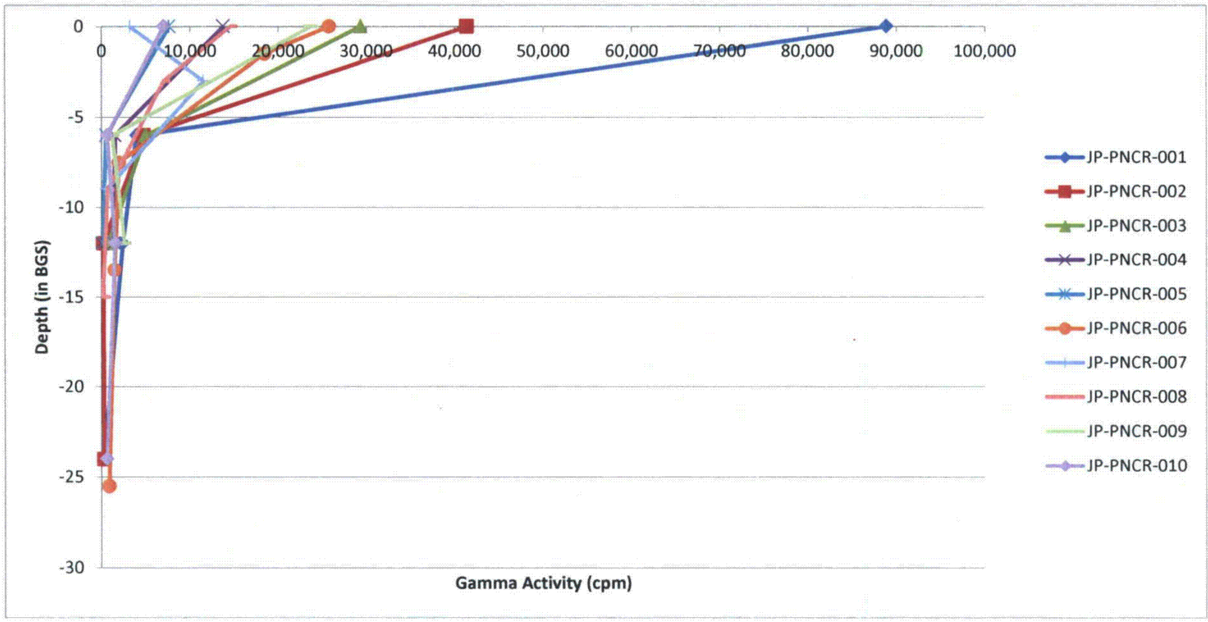


Figure 3-10. Scatterplot for Gamma Activity Measurements Versus Depth for Soil Under Penetrators Collected From Areas with Cincinnati/Rossmoyne Soil Types

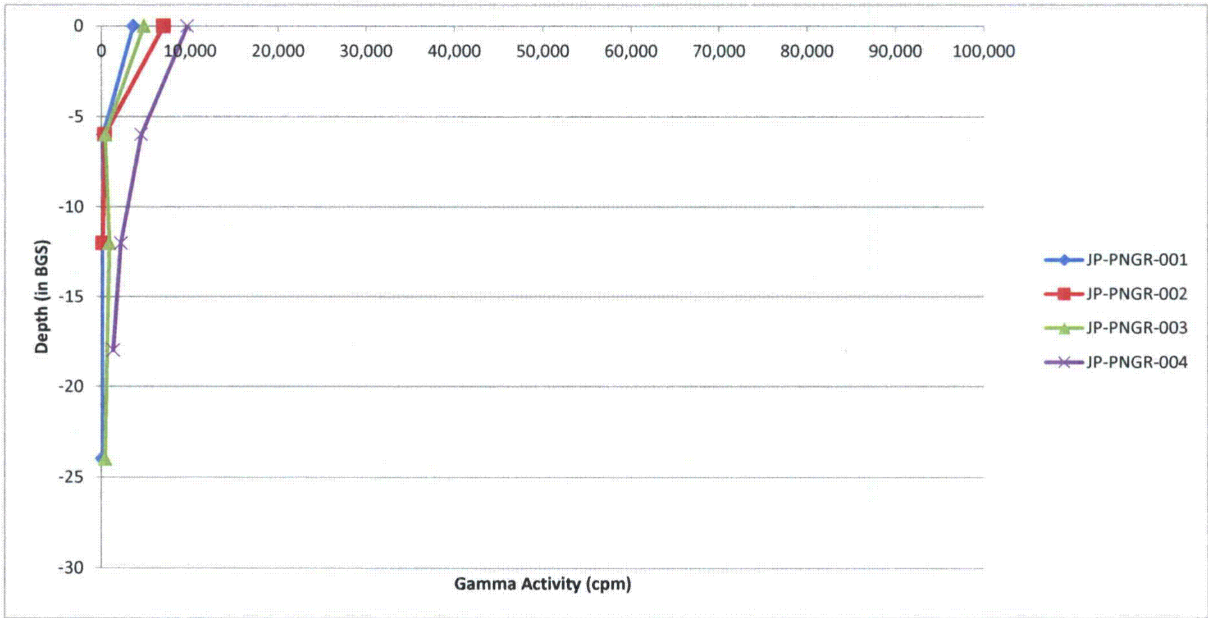


Figure 3-11. Scatterplot for Gamma Activity Measurements Versus Depth for Soil Under Penetrators Collected From Areas with Grayford/Ryker Soil Types

DU has migrated to 4.5 ft BGS and possibly even deeper. Additional discussion regarding migration of DU with depth over time is presented in the groundwater modeling report (Appendix B in Environmental Report [U.S. Army 2013a]) and the K_d study report (Appendix D in Environmental Report [U.S. Army 2013a]).

Statistical testing was conducted on the soil data using the standard general linear model (SAS® v 9.2 PROC GLM procedure). Concentrations did not differ significantly by depth in background or Categories 1 through 5. For soil under/over penetrators, the surface soil mean was much higher than means for lower depths (log mean=9,190 versus 597 versus 137 pCi/g for 0, 1, and 2 ft BGS; $p<0.001$ for all contrasts with surface soil). For samples under trenches, concentrations decreased by depth, although the only significant contrast was for the comparison of 4 ft BGS versus top soil (log means=5.28, 2.63, 2.03, and 1.81 pCi/g for 0, 1, 2, and 4 ft BGS, $p=0.12$, 0.07, and 0.05, respectively compared to surface soil).

3.8 SURFACE WATER AND SEDIMENT

Surface water and sediment samples have been collected as part of the scoping and characterization surveys, ERM program, and site characterization program. Results for each of these programs are presented in the following paragraphs.

3.8.1 Surface Water and Sediment Results From the Scoping Survey

For the scoping survey (SEG 1995a), concentrations in surface water were measured for samples collected at 14 locations. Concentrations of total uranium ranged from 0.21 to 4.11 pCi/L, and reported ratios of the concentrations of U-238 to U-234 were near unity. The data are summarized by location in Table 3-10. Concentrations are at background levels and show no trend with location.

Table 3-10. Average Concentrations of Total Uranium Measured in Surface Water in the Scoping Survey Jefferson Proving Ground, Madison, Indiana

Location	Concentration of Total Uranium (pCi/L)
Big Creek-Upgradient (2 locations)	0.27
Big Creek (4 locations)	1.53
North Tributary of Big Creek (2 locations)	0.75
Middle Fork Creek (4 locations)	0.46
South Tributary of Middle Fork Creek (2 locations)	0.58

Source: SEG 1995a
pCi/L = picoCuries per liter

Thirteen sediment samples were collected during the scoping survey. Four samples were collected from within the DU Impact Area, two samples were collected from Big Creek on the border of and east of the DU Impact Area border, five samples were obtained from the firing line trajectories south of the DU Impact Area, and two samples were collected on the western edge of JPG where Big Creek and Middle Fork Creek exit the property. Samples collected upgradient of (2) and within (4) the DU Impact Area averaged 0.64 and 1.36 pCi/g of total uranium, respectively. Samples collected within the Firing Line Area (5) averaged 1.99 pCi/g of total uranium. Samples collected on the western perimeter averaged 1.46 pCi/g of total uranium. The maximum reported concentration was 3.08 pCi/g of total uranium for a location within the Firing Line Area. All concentrations and isotopic ratios are similar to background conditions.

3.8.2 Surface Water and Sediment Results From the Characterization Survey

Surface water and sediment samples were collected from 10 locations during the characterization survey. Six samples were collected in Big Creek at locations upstream of (1), within (4), and downstream from (1) the DU Impact Area. Four samples were collected in Middle Fork Creek at locations within (3) and downstream from (1) the Firing Line Area.

In the surface water of Big Creek, upstream of the DU Impact Area, the total uranium concentration was measured at 0.62 pCi/L; at locations within the DU Impact Area, the total uranium concentration in surface water ranged from 0.77 to 25.02 pCi/L. At the sample locations on the western boundary of the installation, the total uranium concentration in surface water averaged 0.89 pCi/L. The concentrations of total uranium in surface water samples collected from Middle Fork Creek ranged from 0.63 to 1.80 pCi/L. Concentrations of total uranium in sediment had the same trend as concentrations in surface water. The data are summarized in Table 3-11.

All samples were at, or near, background except for two sampling locations within the DU Impact Area. The surface water samples from the DU Impact Area that had higher total uranium concentrations were collected from static pools of water. The U-238/U-234 activity ratios in the samples from static pools of water were 4.4 and 7.3, indicating the presence of DU contamination.

Table 3-11. Concentrations of Total Uranium in Surface Water and Sediment Measured in the Characterization Survey Jefferson Proving Ground, Madison, Indiana

Location Number	Location	Concentration of Total Uranium	
		Surface Water (pCi/L)	Sediment (pCi/g)
1	Big Creek, east boundary of JPG	0.62	0.78
2	Big Creek, DU Impact Area	25.0	6.20
3	Big Creek, DU Impact Area	2.92	3.83
4	Big Creek, DU Impact Area	0.77	2.18
5	Big Creek, DU Impact Area	1.08	0.75
6	Middle Fork Creek, Firing Line Area	1.04	3.10
7	Middle Fork Creek, Firing Line Area	0.73	2.23
8	Middle Fork Creek, Firing Line Area	1.80	3.46
9	Big Creek, west perimeter of JPG	0.89	0.75
10	Middle Fork Creek, west perimeter of JPG	0.63	1.81

Source: SEG 1996
DU = depleted uranium
JPG = Jefferson Proving Ground
pCi/L = picoCuries per liter
pCi/g = picoCuries per gram

3.8.3 Surface Water Results From ERM Program

For 145 discrete samples (inclusive of duplicates) available from 8 surface water sampling locations (SW-DU-001 to SW-DU-008) collected during the period from December 2004 through October 2012, the average total uranium activity-concentration is 0.88 pCi/L, the standard deviation is 2.4 pCi/L, and the maximum detected activity-concentration is 19 ± 2 pCi/L. The activity-concentrations for each surface water sampling location exhibit average concentrations, which are significantly less than both the U.S. Environmental Protection Agency (USEPA) uranium drinking water standard of 30 microgram per liter (μg/L) and the 150 pCi/L action level for groundwater (i.e., 50 percent of the water effluent concentration limit for uranium prescribed in 10 CFR 20, Appendix B) with the highest individual result (i.e., 19 pCi/L) being about 6 percent of the water effluent concentration limit. Table 3-12 summarizes surface water sampling results.

Table 3-12. Summary of JPG Surface Water Data (December 2004-October 2012) Jefferson Proving Ground, Madison, Indiana

Surface Water Location	Range of Total Uranium (pCi/L)*	Mean and Standard Deviation of Total Uranium (pCi/L)*
SW-DU-001	0.2-1.5	0.42 ± 0.32
SW-DU-002	0.21-0.90	0.48 ± 0.28
SW-DU-003	0.036-3.5	0.53 ± 0.88
SW-DU-004	0.10-16	1.9 ± 4.5
SW-DU-005	0.13-19	2.4 ± 4.7
SW-DU-006	0.04-1.1	0.30 ± 0.03
SW-DU-007	0.09-0.21	0.29 ± 0.21
SW-DU-008	0.12-1.3	0.59 ± 0.36
Overall (145 data points)	0.04-19	0.88 ± 2.4

*Data rounded to two significant digits

U-238/U-234 ratios were reviewed for the period June 2004 to the present (excluding spring 2005 for which information has not currently been located). In addition, the June 2004 report included results only for soil and sediment. Table 3-13 lists the 15 surface water samples that appear to have exhibited U-238/U-234 ratios exceeding 3.

Table 3-13. U-238/U-234 Ratios in Surface Water Data Exceeding 3.0 Jefferson Proving Ground, Madison, Indiana

Sample Collection Date	Surface Water Location	U-238/U/234 Ratio
April 2006	SW-DU-002	3.75
April 2006	SW-DU-008	3.08
October 2006	SW-DU-006	2.65 ± 2.02
October 2007	SW-DU-005	6.3
October 2007	SW-DU-008	2.16 ± 1.0
October 2008	SW-DU-005	7.02 ± 1.38
October 2008	SW-DU-008	3.58 ± 0.18
April 2009	SW-DU-003	2.15 ± 2.71
October 2010	SW-DU-005	7.79 ± 0.08
October 2010	SW-DU-004 / SW-DU-004D	6.36 / 6.63
October 2011	SW-DU-002	3.8 ± 1.8
October 2011	SW-DU-008	3.5 ± 1.7
April 2012	SW-DU-003	3.1 ± 5.3
April 2012	SW-DU-004	2.8 ± 3.9
April 2012	SW-DU-006	1.7 ± 2.0

Surface water samples SW-DU-006, SW-DU-007, and SW-DU-008 are of particular importance given their locations and their potential for offsite releases via the surface water pathway:

- SW-DU-006 is located a short distance south of the DU Impact Area adjacent to Middle Fork Creek
- SW-DU-007 is located south of the DU Impact Area where Middle Fork Creek crosses Morgan Road (i.e., south of but parallel to the western boundary of the DU Impact Area)
- SW-DU-008 is located adjacent to Big Creek where it exits the DU Impact Area.

The maximum surface water concentrations at these locations are 1.1, 0.21, and 1.3 pCi/L for SW-DU-006, SW-DU-007, and SW-DU-008, respectively. Each of these maximum results equates to less than 1 percent of the uranium in water effluent concentration limit prescribed by 10 CFR 20, Appendix B. In addition, it is notable that the 95 percent upper confidence limit on the arithmetic mean (UCL-95) (i.e., 0.88 ± 2.4 pCi/L) equates to about one-third of the USEPA uranium drinking water

standard of 30 µg/L. Additional information about potential trends observed in samples collected from these same locations may be found in the most recent ERM report (U.S. Army 2013c).

3.8.4 Sediment Results From ERM Program

For 151 discrete samples (inclusive of duplicates) available from 8 sediment sampling locations (SD-DU-001 to SD-DU-008) during the period from December 2004 through October 2012, the average total uranium activity-concentration is 0.97 pCi/g, the standard deviation is 0.49 pCi/g, and the maximum detected activity-concentration is 2.4 ± 0.4 pCi/g. The activity-concentrations at each location are well below the 35 pCi/g action level, which has historically served as a common DCGL for uranium in surface soils, although DCGLs for sediments are typically much higher than the value used for surface soils. Table 3-14 summarizes sediment sampling results.

**Table 3-14. Summary of JPG Sediment Data (December 2004-October 2012)
Jefferson Proving Ground, Madison, Indiana**

Sediment Location	Range of Total Uranium (pCi/g)*	Mean and Standard Deviation of Total Uranium (pCi/g)*
SD-DU-001	0.36-1.9	1.2 ± 0.48
SD-DU-002	0.35-1.6	0.91 ± 0.36
SD-DU-003	0.75-2.2	1.5 ± 0.4
SD-DU-004	0.21-2.4	0.57 ± 0.51
SD-DU-005	0.28-0.94	0.59 ± 0.19
SD-DU-006	0.43-1.6	1.0 ± 0.36
SD-DU-007	0.41-1.9	1.2 ± 0.19
SD-DU-008	0.19-1.9	0.87 ± 0.50
Overall (151 data points)	0.19-2.4	0.97 ± 0.49

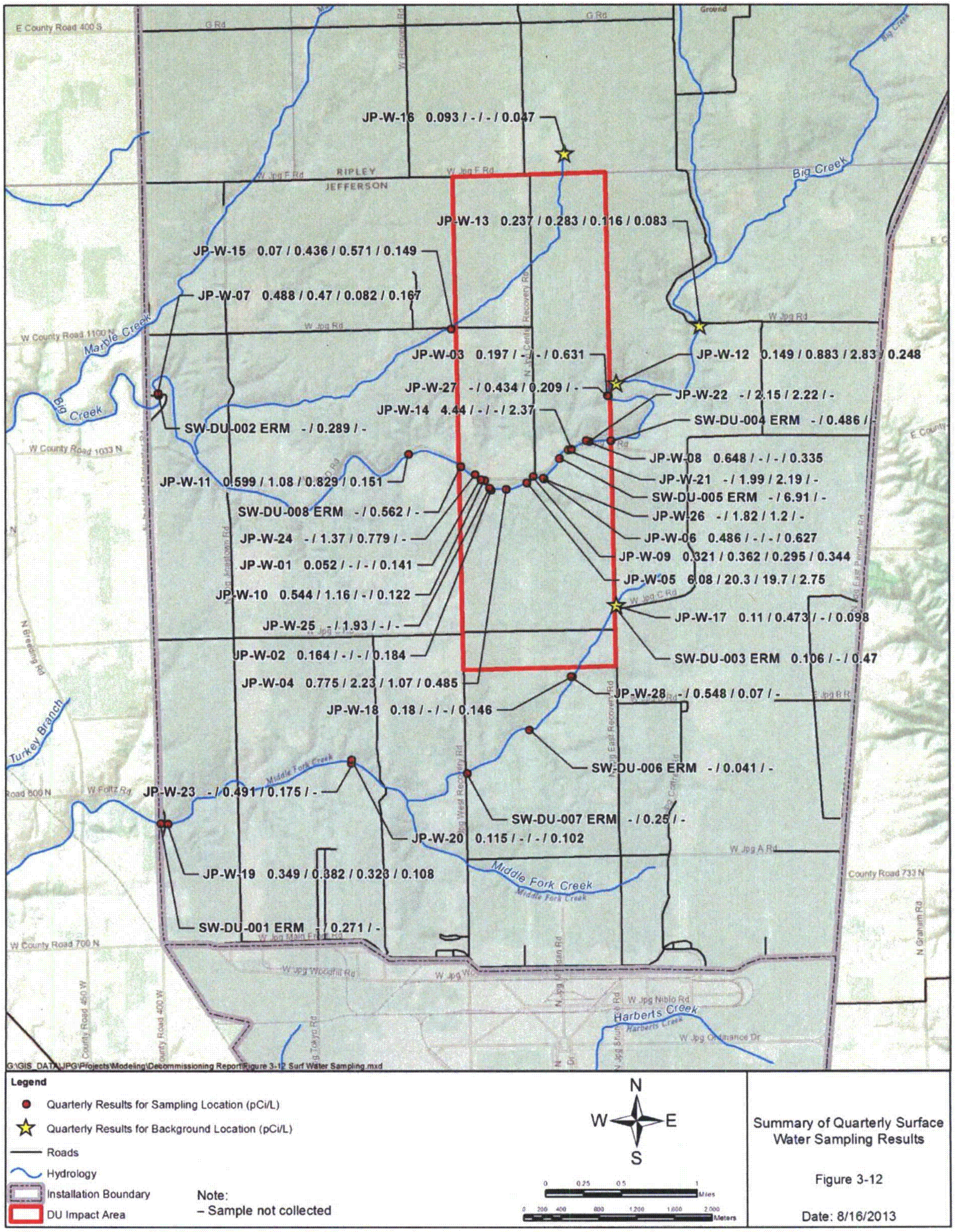
*Data rounded to two significant digits

Comparison of sediment in Table 3-14 with site background surface soil data supports the conclusion that the uranium present at each of the nine sediment sampling locations is within the range of surface soil background. In addition, with respect to sediment, it is notable that the mean and associated standard deviation for each sediment sampling location are within the range of surface soil background and do not reflect a buildup of DU.

3.8.5 Surface Water Results From Site Characterization Program

Filtered and unfiltered surface water samples (plus duplicates) were collected from 20 locations, which were selected based on a stream survey (Section 6.2.6 of the Environmental Report [U.S. Army 2013a]) conducted from February to April 2008 when a hydrologist walked along the streams looking for mixing zones, caves, and seeps along Big Creek, Middle Fork Creek, and the northern tributary of Big Creek. In total Samples were collected upgradient of the DU Impact Area, within the DU Impact Area near and downgradient from areas with the highest suspected sources of DU, and downgradient from the DU Impact Area. Samples from seven locations were relocated since they were dry when sampling occurred and some samples were not collected because water was not available even at backup sampling locations. In total, 59 filtered and 59 unfiltered samples were collected from Big Creek, 19 unfiltered and 16 filtered samples were collected from Middle Fork Creek, and 11 unfiltered and 10 filtered samples were collected from the northern tributary of Big Creek (North Tributary).

Surface water samples were collected quarterly between April 2008 and February 2009 from 20 primary and/or pre-determined alternative locations chosen from data collected during the February to April 2008 stream survey. Samples were analyzed for total and isotopic uranium, alkalinity, anions, cations, aluminum, iron, manganese, silicon, and total organic carbon (TOC). Filtered and unfiltered samples were collected. As shown in Figure 3-12 and Table 3-15, total uranium concentrations ranged from 0.032 ± 0.14 to 22 ± 4.4 pCi/L with an overall mean concentration of 1.2 pCi/L. Some evidence of



Summary of Quarterly Surface Water Sampling Results

Figure 3-12

Date: 8/16/2013

Table 3-15. Summary Statistics for Surface Water Sampling Jefferson Proving Ground, Madison, Indiana

Sample Group	Number of Samples	Minimum	Maximum	Mean
Big Creek Locations (filtered)	59	0.059	22	1.6
Big Creek (filtered)	59	0.059	22	1.6
Big Creek (unfiltered)	59	0.082	20	1.6
Middle Fork Creek (filtered)	16	0.032	0.65	0.30
Middle Fork Creek (unfiltered)	19	0.070	0.55	0.24
Northern Tributary (filtered)	10	0.057	0.56	0.23
Northern Tributary (unfiltered)	11	0.047	0.64	0.26

DU was suspected in 12 samples (based on U-238/U-234 ratios exceeding 2). Most concentrations were low with respect to potential radiological doses when surface water is used as a drinking water source. Results from four samples exceeded USEPA's 30 µg/L (9 pCi/L) Safe Drinking Water Act (SDWA) maximum contaminant level (MCL). Results for the following four samples collected from JP-W-05 exceeded the MCL: July 2008 at 22 ± 4.4 (filtered) and 20 ± 4.1 (unfiltered) pCi/L and October 2008 at 18 ± 3.5 (filtered) and 20 ± 3.8 (unfiltered) pCi/L. Samples collected from location JP-W-05 were collected from a point in the vicinity where overland flow from 500 Center trench intersects with Big Creek. These samples were collected from standing pools of water (i.e., limited or no water flow).

Table 3-16 shows evidence of DU in surface water samples based on elevated U-238/U-234 ratios (i.e., exceeding 3.0) during one or more of the quarterly site characterization sampling events. The table also lists results for all four quarters of sampling to show potential seasonal trends and/or locational trends. Generally, the number of samples with isotopic ratios exceeding 3.0 was highest for the July 2008 sampling event and lowest for the April 2008 sampling event. The majority of the samples with elevated isotopic ratios were collected from Big Creek, particularly in close proximity to the trench associated with the 500 Center line of fire, and fewer elevated ratios were associated with samples collected from Middle Fork Creek and North Tributary.

Statistical testing was conducted on the surface water data using the standard general linear model (SAS® v 9.2 PROC GLM procedure) to test whether uranium concentrations onsite (i.e., DU Impact Area) differed significantly from background levels and whether concentrations differed by season. Lower p-values indicate that differences (averages are not equal) are unlikely to be due to chance. A 5 percent significance level was used to reject null hypothesis (i.e., tests with p-values <= 0.05 are "significant" and tests with p-values between 0.05 and 0.10 are "marginally significant"). In general, surface water results were about twice as high onsite as compared to background (log mean [arithmetic mean of data transformed to values corresponding with their respective natural logarithms] = 0.46 versus 0.23 pCi/L, p=0.05) and concentrations were significantly higher in summer than at other times. The concentrations in July and August 2008 (log mean=0.75 pCi/L) were much greater than the results for April/May 2008 (log mean=0.20 pCi/L, p<0.001) and February 2009 (log mean=0.19 pCi/L, p<0.001). Results for July and August 2008 marginally higher than October 2008 (log mean=0.40 pCi/L, p=0.08). October 2008 was significantly higher than April/May 2008 (p=0.04) and February 2009 (p=0.05).

The point where overland flow from the 500 Center trench intersects with Big Creek was the location with the highest total uranium concentrations and isotopic ratios. Results were generally higher when water flowing through the streams was lowest (e.g., sampling from standing pools of water). Under these low flow conditions, regional agricultural impacts on surface water quality renders surface water even less desirable as a drinking water source (e.g., buildup of bacteria and fertilizer chemicals from farm runoff). Most concentration trends in ERM events over time are not discernible (poor linear correlation – coefficient of determination [R^2] <0.5) because results fluctuate just above detection limits, with the possible exception of a nonstatistical observation that elevated U-238/U-234 ratios generally occurred when water was not flowing in Big Creek and/or Middle Fork Creek.

Table 3-16. Summary of Total Uranium Concentrations and Elevated U-238/U-234 Isotopic Ratios for Surface Water Jefferson Proving Ground, Madison, Indiana

Sample ID	Filtered	Total Uranium (pCi/L)	U-238/U-234 Ratio	Total Uranium (pCi/L)	U-238/U-234 Ratio	Total Uranium (pCi/L)	U-238/U-234 Ratio	Total Uranium (pCi/L)	U-238/U-234 Ratio
Big Creek Samples									
JP-W-01 / JP-W-24[a]	Unfiltered	ND	ND	1.4 ± 0.4	2.7 ± 1.6	0.78 ± 0.26	4.1 ± 2.6	0.14 ± 0.08	2.0 ± 2.5
	Filtered	ND	ND	1.2 ± 0.4	7.1 ± 5.3	1.2 ± 0.3	4.0 ± 2.2	0.20 ± 0.10	1.8 ± 1.9
JP-W-02 / JP-W-25[b]	Unfiltered	ND	ND	1.9 ± 0.5	4.9 ± 2.7	- -[h]	- -[h]	0.18 ± 0.096	1.0 ± 1.1
	Filtered	ND	ND	1.6 ± 0.4	3.7 ± 2.2	- -[h]	- -[h]	0.20 ± 0.099	1.4 ± 1.5
JP-W-03 / JP-W-27[c]	Unfiltered	0.20 ± 0.11	1.8 ± 2.1	0.43 ± 0.18	2.4 ± 2.1	0.21 ± 0.17	1.8 ± 1.6	0.63 ± 0.21	9.3 ± 9.1
	Filtered	0.19 ± 0.11	1.6 ± 1.9	0.37 ± 0.17	ND	0.20 ± 0.16	1.1 ± 1.0	0.74 ± 0.24	5.3 ± 4.4
JP-W-04	Unfiltered	0.78 ± 0.25	1.6 ± 1.1	2.2 ± 0.57	4.2 ± 2.2	1.1 ± 0.28	4.3 ± 2.4	0.49 ± 0.16	3.2 ± 2.5
	Filtered	0.75 ± 0.27	8.0 ± 8.1	1.9 ± 0.49	5.5 ± 3.2	0.97 ± 0.26	5.2 ± 3.2	0.48 ± 0.16	2.4 ± 1.8
JP-W-05	Unfiltered	6.1 ± 1.3	6.5 ± 2.8	20 ± 4.1	7.3 ± 2.6	20 ± 3.8	6.5 ± 2.2	2.8 ± 0.60	5.5 ± 2.4
	Filtered	6.5 ± 1.4	6.3 ± 2.7	22 ± 4.4	6.8 ± 2.4	18 ± 3.5	6.7 ± 2.2	2.9 ± 0.63	5.4 ± 2.5
JP-W-06 / JP-W-26[d]	Unfiltered	0.49 ± 0.20	2.3 ± 1.8	1.8 ± 0.49	3.8 ± 2.1	1.2 ± 0.30	4.5 ± 2.5	0.63 ± 0.18	1.9 ± 1.2
	Filtered	0.32 ± 0.15	1.4 ± 1.3	2.0 ± 0.49	2.9 ± 1.5	1.3 ± 0.33	8.3 ± 5.4	0.58 ± 0.18	1.6 ± 1.1
JP-W-07	Unfiltered	0.49 ± 0.20	4.2 ± 4.0	0.47 ± 0.23	1.4 ± 1.2	0.082 ± 0.14	2.6 ± 2.4	0.17 ± 0.16	0.55 ± 0.58
	Filtered	0.59 ± 0.20	3.5 ± 3.0	0.61 ± 0.22	3.0 ± 2.4	0.090 ± 0.038	4.4 ± 4.6	0.12 ± 0.097	3.0 ± 4.9
JP-W-08 / JP-W-22[e]	Unfiltered	0.65 ± 0.20	1.4 ± 0.93	2.2 ± 0.54	5.4 ± 3.0	2.2 ± 0.51	6.9 ± 3.4	0.33 ± 0.18	2.2 ± 2.5
	Filtered	0.47 ± 0.18	1.4 ± 1.1	1.9 ± 0.49	7.0 ± 4.5	1.9 ± 0.44	5.9 ± 3.0	0.42 ± 0.17	1.6 ± 1.3
JP-W-09	Unfiltered	0.32 ± 0.15	2.6 ± 2.7	0.36 ± 0.21	1.3 ± 1.1	0.30 ± 0.12	1.2 ± 0.99	0.34 ± 0.15	1.7 ± 1.4
	Filtered	ND	ND	ND	ND	0.30 ± 0.12	2.1 ± 1.8	0.41 ± 0.17	2.5 ± 2.3
JP-W-10	Unfiltered	ND	ND	1.2 ± 0.34	2.7 ± 1.6	- -[h]	- -[h]	0.12 ± 0.15	0.79 ± 0.95
	Filtered	0.56 ± 0.22	9.9 ± 12	1.1 ± 0.32	3.1 ± 2.0	- -[h]	- -[h]	0.059 ± 0.14	4.9 ± 11
JP-W-11	Unfiltered	0.60 ± 0.20	2.4 ± 1.9	1.1 ± 0.32	4.7 ± 3.2	0.83 ± 0.28	7.3 ± 5.4	0.15 ± 0.17	3.3 ± 5.5
	Filtered	0.71 ± 0.24	2.5 ± 1.8	1.1 ± 0.32	3.3 ± 2.1	1.3 ± 0.32	5.6 ± 3.2	0.33 ± 0.21	0.54 ± 0.53
JP-W-12	Unfiltered	0.15 ± 0.09	0.83 ± 1.0	0.88 ± 0.29	3.2 ± 2.3	2.8 ± 0.62	6.1 ± 2.7	0.25 ± 0.19	0.54 ± 0.58
	Filtered	0.21 ± 0.12	1.0 ± 1.2	0.82 ± 0.30	6.0 ± 5.0	2.9 ± 0.62	5.0 ± 2.2	0.14 ± 0.16	0.71 ± 0.85
JP-W-14 / JP-W-21[f]	Unfiltered	4.4 ± 1.0	7.2 ± 3.6	2.0 ± 0.54	7.1 ± 4.6	2.2 ± 0.50	5.0 ± 2.4	2.4 ± 0.55	5.4 ± 2.7
	Filtered	4.8 ± 1.1	8.4 ± 4.0	2.2 ± 0.58	5.0 ± 2.8	2.7 ± 0.60	4.6 ± 2.1	2.4 ± 0.55	7.2 ± 3.8
Middle Fork Samples									
JP-W-17	Unfiltered	ND	ND	0.047 ± 0.19	0.86 ± 0.71	- -[i]	- -[i]	0.098 ± 0.17	6.5 ± 54
	Filtered	ND	ND	0.046 ± 0.23	1.3 ± 1.1	- -[i]	- -[i]	0.053 ± 0.14	0.29 ± 0.81
JP-W-20 / JP-W-23[g]	Unfiltered	0.12 ± 0.083	0.53 ± 0.79	0.49 ± 0.19	0.48 ± 0.39	0.18 ± 0.16	1.1 ± 1.1	0.10 ± 0.17	1.8 ± 4.0
	Filtered	ND	ND	0.60 ± 0.25	1.2 ± 0.86	0.19 ± 0.094	1.0 ± 1.0	0.18 ± 0.15	4.0 ± 9.2

Table 3-16. Summary of Total Uranium Concentrations and Elevated U-238/U-234 Isotopic Ratios for Surface Water Jefferson Proving Ground, Madison, Indiana (Continued)

Sample ID	Filtered	Total Uranium (pCi/L)	U-238/U-234 Ratio	Total Uranium (pCi/L)	U-238/U-234 Ratio	Total Uranium (pCi/L)	U-238/U-234 Ratio	Total Uranium (pCi/L)	U-238/U-234 Ratio
North Tributary Samples									
JP-W-15	Unfiltered	ND	ND	0.44 ± 0.23	0.93 ± 0.77	0.57 ± 0.18	1.3 ± 0.81	0.15 ± 0.089	0.83 ± 1.0
	Filtered	ND	ND	0.50 ± 0.24	0.61 ± 0.51	0.56 ± 0.17	0.89 ± 0.56	0.11 ± 0.086	0.83 ± 1.4

[a] Due to lack of water available for sampling at location JP-W-01 during July and October 2008 sampling events, the actual sampling location was relocated and the site ID was changed to JP-W-24.
[b] Due to lack of water available for sampling at location JP-W-02 during July and October 2008 sampling events, the actual sampling location was relocated and the site ID was changed to JP-W-25.
[c] Due to lack of water available for sampling at location JP-W-03 during July and October 2008 sampling events, the actual sampling location was relocated and the site ID was changed to JP-W-27.
[d] Due to lack of water available for sampling at location JP-W-06 during July and October 2008 sampling events, the actual sampling location was relocated and the site ID was changed to JP-W-26.
[e] Due to lack of water available for sampling at location JP-W-08 during July and October 2008 sampling events, the actual sampling location was relocated and the site ID was changed to JP-W-23.
[f] Due to lack of water available for sampling at location JP-W-14 during July and October 2008 sampling events, the actual sampling location was relocated and the site ID was changed to JP-W-21.
[g] Due to lack of water available for sampling at location JP-W-20 during July and October 2008 sampling events, the actual sampling location was relocated and the site ID was changed to JP-W-23.
[h] Sample not collected from mouth of cave because no water was available. Water was not available as a representative backup location.
[i] Sample not collected from Middle Fork Creek because no water was available within 100 yards of planned location and area was covered with waist-height vegetation.

3.8.6 Sediment Results From Site Characterization Program

Sediment samples (plus duplicates) were collected from 20 locations, which were selected based on a February 2008 stream survey when a hydrologist looked for areas with deposition of finer-grained sediments based on channel widths, water depths/directions, changes in slope, and flow velocities along Big Creek, Middle Fork Creek, and the North Tributary.

Sediment samples were collected quarterly between April 2008 and February 2009 from 20 primary locations chosen from data collected during the February to April 2008 stream survey. Samples were analyzed for total and isotopic uranium. Samples were collected from the same locations regardless of whether or not they were dry when sampling occurred.

Sediment sampling results from all locations were statistically analyzed via ProUCL computer software (USEPA 2007). Most samples indicate total uranium concentrations were detected at less than 2 pCi/g. Table 3-17 and Figure 3-13 show that total uranium concentrations ranged from 0.25 ± 0.13 to 7.4 ± 1.6 pCi/g (0.70 to 21 mg/kg) for Big Creek sediment samples, 0.51 ± 0.20 to 2.0 ± 0.55 pCi/g (1.4 to 5.6 mg/kg) for Middle Fork Creek sediment samples, and 0.96 ± 0.16 to 1.7 ± 0.38 pCi/g (0.97 to 4.7 mg/kg) for North Tributary sediment samples, with overall mean concentrations of 1.3, 1.2, and 1.3 pCi/g (3.6, 3.4, and 3.6 mg/kg) for Big Creek, Middle Fork Creek, and North Tributary, respectively. All concentrations are low with respect to potential radiological dose (35 pCi/g). The highest concentrations were observed where runoff is expected to enter Big Creek from the 500 Center trench.

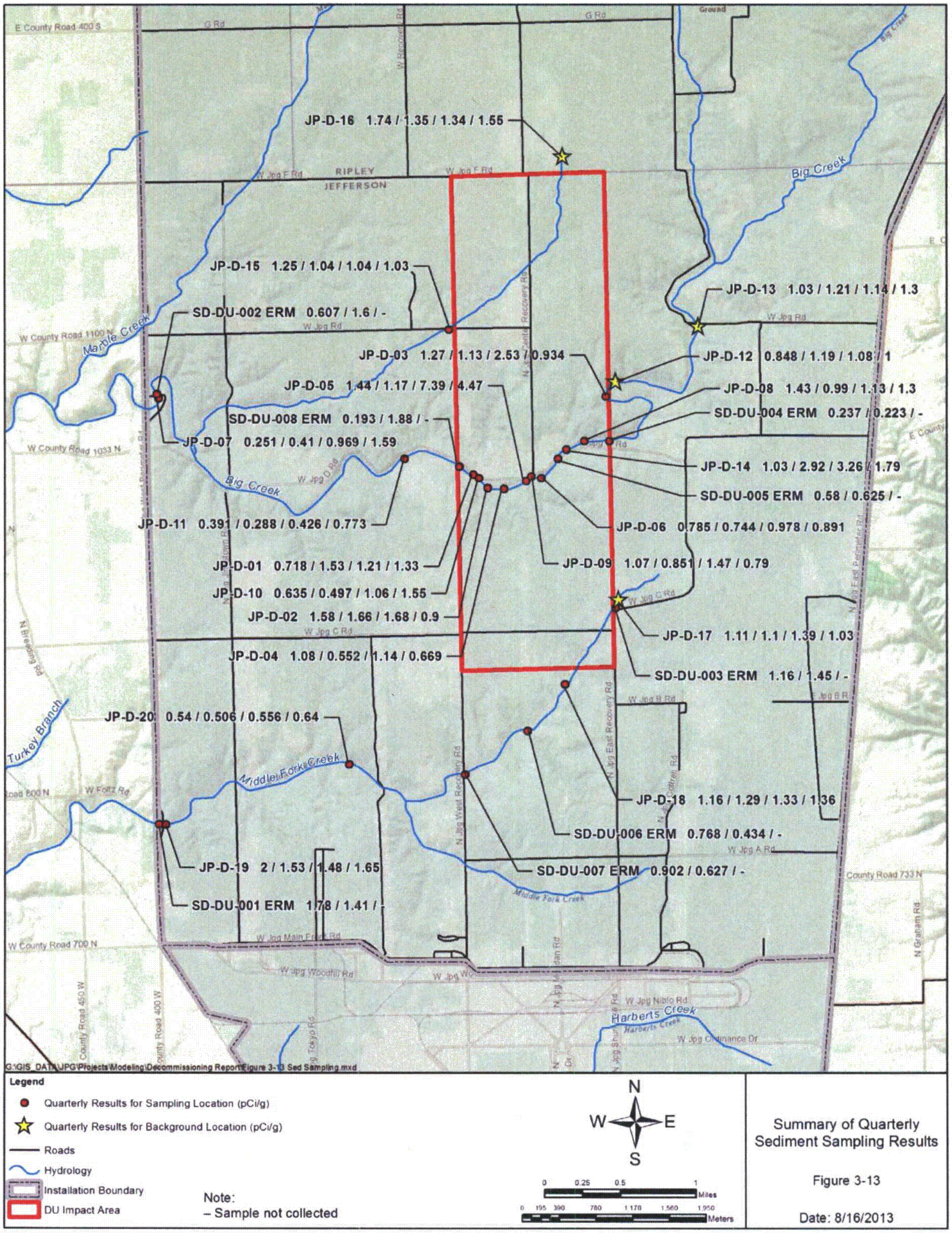
Evidence of DU was observed in eight sediment samples collected from five locations based on elevated U-238/U-234 ratios (i.e., exceeding 3.0) during one or more of the quarterly site characterization sampling events. Isotopic ratios (U-238/U-234) exceeded 3.0 in the following samples: JP-D-05 (4.7 ± 2.9 in April 2008, 4.4 ± 2.9 in July 2008, 5.1 ± 1.7 in October 2008, and 4.5 ± 1.5 in February 2009) and JP-D-14 (4.2 ± 2.7 in April 2008, 5.2 ± 2.5 in July 2008, 5.2 ± 1.8 in October 2008, and 1.7 ± 0.6 in February 2009). All sediment samples with elevated isotopic ratios were collected from Big Creek in close proximity to the trench associated with the 500 Center line of fire.

Table 3-17. Summary Statistics for Sediment Sampling Jefferson Proving Ground, Madison, Indiana

Sample Group	Number of Samples	Minimum	Maximum	Mean
Sediment Groupings by Water Body				
Big Creek Sediment	56	0.25	7.4	1.3
Middle Fork Creek Sediment	16	0.51	2.0	1.2
North Tributary Sediment	8	0.96	1.7	1.3
Sediment Groupings for Upgradient and Site/Downgradient Sampling Locations				
Site/Downgradient Sediment	64	0.25	7.4	1.3
Upgradient Sediment	16	0.85	1.7	1.2

[a] Big Creek sediment samples include JP-D-1 through JP-D-14, North Tributary Samples include JP-D-15 and JP-D-16, and JP-D-17 through JP-D-20. Statistics represent results for samples collected in April 2008, July 2008, October 2008, and February 2009.

[b] Upgradient sediment samples include JP-D-12 and JP-D-13 (Big Creek), JP-D-16 (Northern Tributary), and JP-D-17 (Middle Fork Creek).



JP-D-16 1.74 / 1.35 / 1.34 / 1.55
JP-D-15 1.25 / 1.04 / 1.04 / 1.03
SD-DU-002 ERM 0.607 / 1.6 / -
JP-D-03 1.27 / 1.13 / 2.53 / 0.934
JP-D-05 1.44 / 1.17 / 7.39 / 4.47
SD-DU-008 ERM 0.193 / 1.88 / -
JP-D-07 0.251 / 0.41 / 0.969 / 1.59
JP-D-11 0.391 / 0.288 / 0.426 / 0.773
JP-D-01 0.718 / 1.53 / 1.21 / 1.33
JP-D-10 0.635 / 0.497 / 1.06 / 1.55
JP-D-02 1.58 / 1.66 / 1.68 / 0.9
JP-D-04 1.08 / 0.552 / 1.14 / 0.669
JP-D-20 0.54 / 0.506 / 0.556 / 0.64
JP-D-19 2 / 1.53 / 1.48 / 1.65
SD-DU-001 ERM 1.78 / 1.41 / -
JP-D-13 1.03 / 1.21 / 1.14 / 1.3
JP-D-12 0.848 / 1.19 / 1.08 / 1
JP-D-08 1.43 / 0.99 / 1.13 / 1.3
SD-DU-004 ERM 0.237 / 0.223 / -
JP-D-14 1.03 / 2.92 / 3.26 / 1.79
SD-DU-005 ERM 0.58 / 0.625 / -
JP-D-06 0.785 / 0.744 / 0.978 / 0.891
JP-D-09 1.07 / 0.851 / 1.47 / 0.79
JP-D-17 1.11 / 1.1 / 1.39 / 1.03
SD-DU-003 ERM 1.16 / 1.45 / -
JP-D-18 1.16 / 1.29 / 1.33 / 1.36
SD-DU-006 ERM 0.768 / 0.434 / -
SD-DU-007 ERM 0.902 / 0.627 / -
Big Creek
Marble Creek
Middle Fork Creek
Turkey Branch
Harberts Creek
RIPLEY
JEFFERSON
Legend
Quarterly Results for Sampling Location (pCi/g)
Quarterly Results for Background Location (pCi/g)
Roads
Hydrology
Installation Boundary
DU Impact Area
Note:
- Sample not collected
N
W
E
S
0 0.25 0.5 1 Miles
0 195 390 780 1,170 1,560 1,950 Meters
Summary of Quarterly Sediment Sampling Results
Figure 3-13
Date: 8/16/2013

No concentration trends are discernible from ERM data collected over time as evidenced by poor linear correlation (R^2 <0.5) in run charts plotting concentrations over time. Most results show total uranium concentrations having fluctuated slightly above detection limits over time.

Statistical testing was conducted on the sediment data using the standard general linear model (SAS® v 9.2 PROC GLM procedure) to test whether uranium concentrations at the site differed significantly from background levels and whether concentrations differed by season. Site concentrations were lower than background at a statistically significant level ($p < 0.05$) and no concentration trends were observed between quarterly sampling events.

3.9 GROUNDWATER

Several monitoring wells were completed around the DU firing range between 1984 and 1994. These wells were drilled to various depths that ranged to more than 40 feet from the surface (SEC Donohue, Inc. 1992). The groundwater data from these wells showed some variation in the concentrations of uranium in wells between 1984 and 1994, with the largest variation being attributed to issues involving analytical laboratories (Ebinger and Hansen 1996a,b). Overall, the data indicated that there was not significant movement of DU to the groundwater from the DU Impact Area between 1984 and 1994. This conclusion was further supported by the isotopic composition of uranium in the groundwater samples (Ebinger and Hansen 1996a,b).

3.9.1 Groundwater Results From Scoping and Characterization Surveys

Concentrations of uranium isotopes in groundwater have been measured at 11 wells in the scoping and characterization surveys and in the ERM program. The scoping and characterization survey samples were collected in 1994 and 1995 from these same wells. A summary of the results of these measurements is presented in Table 3-18. The total uranium concentration in groundwater samples collected in the surveys ranges from 0.33 to 5.09 pCi/L at background levels at the site. The U-238/U-234 activity ratio in groundwater samples indicates that the uranium is naturally occurring.

3.9.2 Groundwater Results From ERM Program

For 202 discrete samples (inclusive of duplicates) available from 11 monitoring wells (MW-DU-001 to MW-DU-011) during the period from December 2004 through October 2012, the average total uranium activity-concentration is 1.4 pCi/L, the standard deviation is 1.2 pCi/L, and the

Table 3-18. Summary of Concentrations of Uranium in Groundwater Samples From the Scoping and Characterization Surveys Jefferson Proving Ground, Madison, Indiana

Sample Location	Concentration of Total Uranium (pCi/L)	
	Scoping Survey	Characterization Survey
MW-01	0.43	0.33
MW-02	1.25	1.20
MW-03	0.76	1.67
MW-04	2.40	3.34
MW-05	0.46	3.74
MW-06	3.61	5.09
MW-07	1.99	0.80
MW-08	1.23	1.10
MW-09	2.26	1.50
MW-10	3.38	1.34
MW-11	<1.28	2.04

Source: SEG 1995a and 1996
MW = monitoring well
pCi/L = picocuries per liter

maximum detected activity-concentration is 5.7 ± 0.6 pCi/L. The activity-concentrations for each well are clearly significantly less than both the USEPA drinking water standard for uranium of 30 μg/L and the 150 pCi/L action level for groundwater (i.e., 50 percent of the water effluent concentration limit for uranium prescribed in 10 CFR 20, Appendix B). Table 3-19 summarizes groundwater sampling results by groundwater monitoring well.

Table 3-19. Summary of JPG Groundwater Data (December 2004-October 2012)
Jefferson Proving Ground, Madison, Indiana

Monitoring Well Location	Range of Total Uranium (pCi/L)*	Mean and Standard Deviation of Total Uranium (pCi/L)*
MW-DU-001	0.3-1.3	0.54 ± 0.28
MW-DU-002	0.59-4.5	1.8 ± 1.0
MW-DU-003	0.52-1.7	1.0 ± 0.3
MW-DU-004	0.19-3.1	1.3 ± 0.9
MW-DU-005	0.11-0.81	0.43 ± 0.19
MW-DU-006	1.6-5.7	3.8 ± 1.1
MW-DU-007	0.81-2.7	2.0 ± 0.4
MW-DU-008	0.23-0.92	0.54 ± 0.17
MW-DU-009	0.9-1.9	1.3 ± 0.3
MW-DU-010	2.0-3.2	2.7 ± 0.3
MW-DU-011	0.0-0.62	0.26 ± 0.17
Overall (202 data points)	0.11-5.7	1.4 ± 1.2

*Data rounded to two significant digits

U-238/U-234 ratios were reviewed for the period June 2004 to the present excluding spring 2005 for which information has not currently been located. In addition, the June 2004 report included results only for soil and sediment. The only groundwater sample that appears to have exhibited a U-238/U-234 ratio exceeding 3 was the sample collected from MW-DU-001 in October 2008. The ratio was 5.99 ± 0.75. This ratio was not seen in subsequent sampling and, as shown in Table 3-19, the total uranium concentrations from this well have been comparatively low with mean total uranium concentrations ranging from 0.3 to 1.3 pCi/L. Additional information about potential trends observed in samples collected from this and other groundwater wells is provided in the most recent ERM report (U.S. Army 2013c).

3.9.3 Groundwater Results From Site Characterization Program

Groundwater sampling was conducted during four consecutive quarters (i.e., April 2008, June 2008, October 2008, and January 2009) with one event (October 2008) occurring during the expected low point in the hydrologic year and another event (April 2008) occurring near the expected high point in the hydrologic year. Samples were collected from the 19 existing groundwater monitoring wells in addition to the 23 newly installed wells listed in Table 3-20 and shown in Figure 3-14. Eight of the existing wells were installed in August 2002 during the Army's Range Study (U.S. Army 2003c). Eleven of the existing wells were installed in December 1983 and September 1988 and have been sampled as part of the semi-annual ERM program since being installed. All of the existing wells listed in Table 3-20 were re-developed and locations were re-surveyed in accordance with the procedures for developing and surveying new wells, as described in FSP Addendum 4 (SAIC 2007b).

Samples were collected from 42 groundwater monitoring wells, including 11 ERM wells, 5 wells installed in the soil overburden, 9 wells installed in shallow/weathered bedrock, 9 wells installed in deep bedrock, and 8 Range Study wells. Table 3-20 lists the wells according to their respective hydrostratigraphic unit (overburden, shallow bedrock, or deep bedrock) and purpose (ERM, site characterization, or Range Study).

In addition to analyzing samples for total and isotopic uranium (U-234, U-235, and U-238), samples also were analyzed for alkalinity, anions (nitrate, chloride, and sulfate), cations (calcium,

Table 3-20. Summary of Wells by Hydrostratigraphic Unit
Jefferson Proving Ground, Madison, Indiana

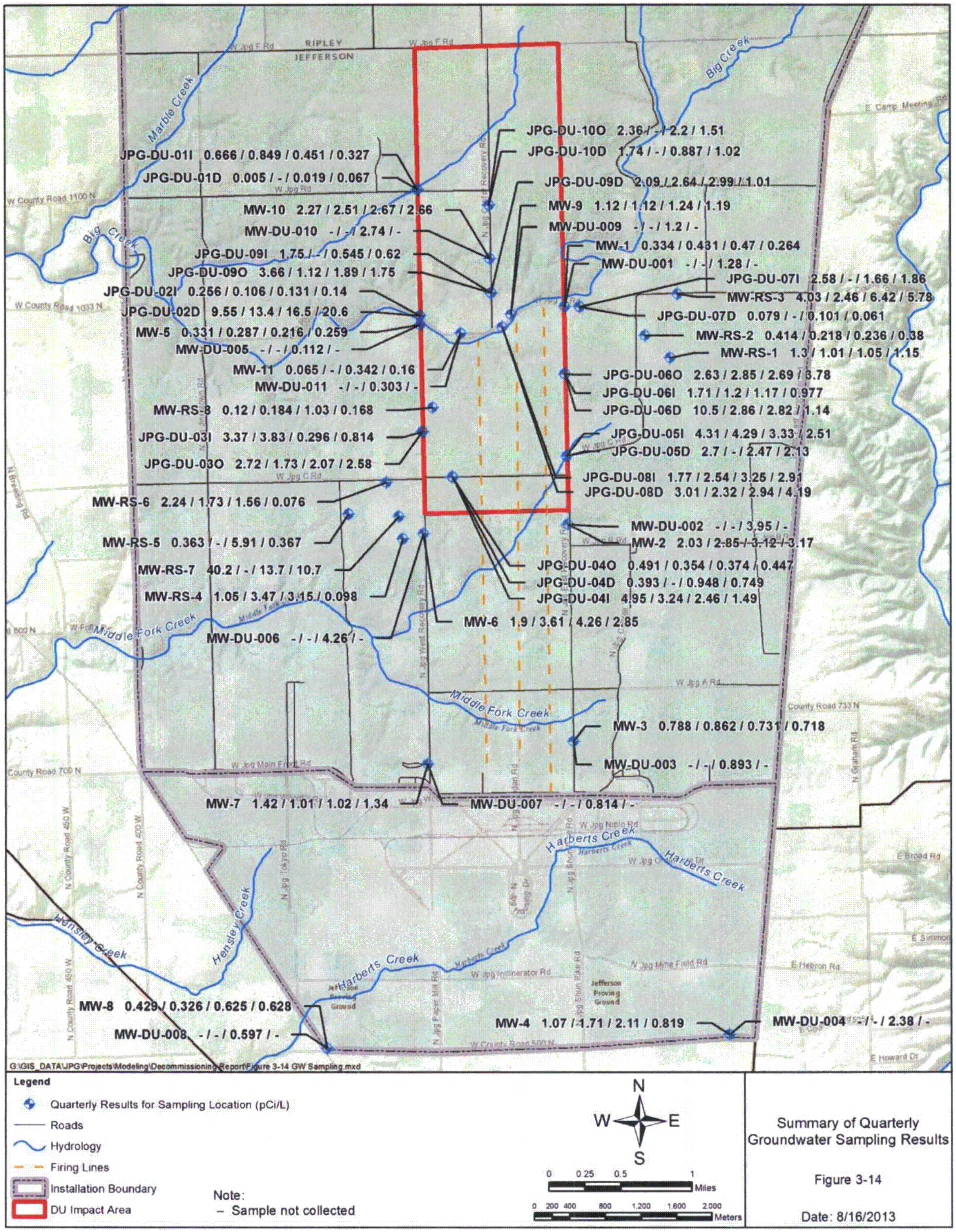
Overburden		Shallow Bedrock		Deep Bedrock	
Background Wells					
MW-RS1		JPG-DU-07I	MW-7	JPG-DU-07D	
MW-RS3		MW-3	MW-8		
		MW-4	MW-RS2		
Site Wells					
JPG-DU-03O	MW-RS4	JPG-DU-01I	JPG-DU-09I	JPG-DU-01D	
JPG-DU-04O	MW-RS5	JPG-DU-02I	JPG-DU-10I	JPG-DU-02D	
JPG-DU-06O	MW-RS6	JPG-DU-03I	MW-1	JPG-DU-04D	
JPG-DU-09O	MW-RS7	JPG-DU-04I	MW-2	JPG-DU-05D	
JPG-DU-10O	MW-RS8	JPG-DU-05I	MW-5	JPG-DU-06D	
MW-6		JPG-DU-06I	MW-9	JPG-DU-08D	
MW-10		JPG-DU-08I	MW-11	JPG-DU-09D	

Nomenclature for 42 groundwater monitoring wells:

- 11 ERM wells = MW-x or MW-DU-xxx
- 5 site characterization wells installed in overburden: JPG-DU-xxO
- 9 site characterization wells installed in shallow bedrock (intermediate wells): JPG-DU-xxI
- 9 site characterization wells installed in deep bedrock: JPG-DU-xxD
- 8 Range Study wells: MW-RS-x

3 Hydrostratigraphic Units:

- 14 overburden wells include 2 background and 12 site wells
- 20 shallow bedrock wells include 6 background and 14 site wells
- 8 deep bedrock wells include 1 background and 7 site wells



JPG-DU-10O 2.36 / - / 2.2 / 1.51
JPG-DU-10D 1.74 / - / 0.887 / 1.02
JPG-DU-01I 0.666 / 0.849 / 0.451 / 0.327
JPG-DU-01D 0.005 / - / 0.019 / 0.067
JPG-DU-09D 2.09 / 2.64 / 2.99 / 1.01
MW-10 2.27 / 2.51 / 2.67 / 2.66
MW-9 1.12 / 1.12 / 1.24 / 1.19
MW-DU-010 - / - / 2.74 / -
MW-DU-009 - / - / 1.2 / -
JPG-DU-09I 1.75 / - / 0.545 / 0.62
MW-1 0.334 / 0.481 / 0.47 / 0.264
JPG-DU-09O 3.66 / 1.12 / 1.89 / 1.75
MW-DU-001 - / - / 1.28 / -
JPG-DU-07I 2.58 / - / 1.66 / 1.86
JPG-DU-02I 0.256 / 0.106 / 0.131 / 0.14
MW-RS-3 4.03 / 2.46 / 6.42 / 5.78
JPG-DU-02D 9.55 / 13.4 / 16.5 / 20.6
JPG-DU-07D 0.079 / - / 0.101 / 0.061
MW-5 0.331 / 0.287 / 0.216 / 0.259
MW-RS-2 0.414 / 0.218 / 0.236 / 0.38
MW-DU-005 - / - / 0.112 / -
MW-RS-1 1.3 / 1.01 / 1.05 / 1.15
MW-11 0.065 / - / 0.342 / 0.16
JPG-DU-06O 2.63 / 2.85 / 2.69 / 3.78
MW-DU-011 - / - / 0.303 / -
JPG-DU-06I 1.71 / 1.2 / 1.17 / 0.977
MW-RS-8 0.12 / 0.184 / 1.03 / 0.168
JPG-DU-06D 10.5 / 2.86 / 2.82 / 1.14
JPG-DU-05I 4.31 / 4.29 / 3.33 / 2.51
JPG-DU-03I 3.37 / 3.83 / 0.296 / 0.814
JPG-DU-05D 2.7 / - / 2.47 / 2.13
JPG-DU-03O 2.72 / 1.73 / 2.07 / 2.58
JPG-DU-08I 1.77 / 2.54 / 3.25 / 2.91
JPG-DU-08D 3.01 / 2.32 / 2.94 / 4.19
MW-RS-6 2.24 / 1.73 / 1.56 / 0.076
MW-DU-002 - / - / 3.95 / -
MW-RS-5 0.363 / - / 5.91 / 0.367
MW-2 2.03 / 2.85 / 3.12 / 3.17
MW-RS-7 40.2 / - / 13.7 / 10.7
JPG-DU-04O 0.491 / 0.354 / 0.374 / 0.447
JPG-DU-04D 0.393 / - / 0.948 / 0.749
MW-RS-4 1.05 / 3.47 / 3.15 / 0.098
JPG-DU-04I 4.95 / 3.24 / 2.46 / 1.49
MW-6 1.9 / 3.61 / 4.26 / 2.85
MW-DU-006 - / - / 4.26 / -
MW-3 0.788 / 0.862 / 0.731 / 0.718
MW-DU-003 - / - / 0.893 / -
MW-7 1.42 / 1.01 / 1.02 / 1.34
MW-DU-007 - / - / 0.814 / -
MW-8 0.429 / 0.326 / 0.625 / 0.628
MW-DU-008 - / - / 0.597 / -
MW-4 1.07 / 1.71 / 2.11 / 0.819
MW-DU-004 - / - / 2.38 / -
RIPLEY
JEFFERSON
Marble Creek
Big Creek
Middle Fork Creek
Harberts Creek
Hensley Creek
Jefferson Proving Ground
G:\GIS_DATA\JPG\Projects\Modeling\Decommissioning Report\Figure 3-14 GW Sampling.mxd
Legend
Quarterly Results for Sampling Location (pCi/L)
Roads
Hydrology
Firing Lines
Installation Boundary
DU Impact Area
Note:
- Sample not collected
N
W
E
S
0 0.25 0.5 1 Miles
0 200 400 800 1,200 1,600 2,000 Meters
Summary of Quarterly Groundwater Sampling Results
Figure 3-14
Date: 8/16/2013

potassium, magnesium, and sodium), and dissolved concentrations of aluminum, iron, manganese, silicon, and TOC. Procedures related to sample collection, handling, and analysis are discussed in FSP Addendum 5 (SAIC 2008b).

Sampling results from all groundwater wells were statistically analyzed via ProUCL computer software (USEPA 2007) to evaluate data by the hydrostratigraphic units listed in Table 3-21. Total uranium concentrations for groundwater samples varied depending on the hydrostratigraphic unit (i.e., overburden, shallow bedrock, deep bedrock) and whether the samples were filtered or not and whether samples were collected from site or background wells. The following bullets summarize the results presented in Figure 3-14 and Table 3-21.

Table 3-21. Summary Statistics for Groundwater Sampling Jefferson Proving Ground, Madison, Indiana

Sample Group	Number of Samples	Minimum	Maximum	Mean
Background Groundwater				
Overburden Wells (filtered)	10	0.98	4.8	2.2
Overburden Wells (unfiltered)	10	0.81	6.4	2.5
Shallow Bedrock Wells (filtered)	35	0.18	2.2	0.79
Shallow Bedrock Wells (unfiltered)	36	0.14	2.6	0.88
Deep Bedrock Wells (filtered)	1	0.11	0.11	0.11
Deep Bedrock Wells (unfiltered)	3	0.060	0.10	0.080
Site Groundwater				
Shallow Bedrock Wells (filtered)	54	0.085	4.7	1.4
Shallow Bedrock Wells (unfiltered)	56	0.065	5.0	1.4
Overburden Wells (filtered)	59	0.027	47	2.9
Overburden Wells (unfiltered)	60	0.076	40	2.6
Deep Bedrock Wells (filtered)	27	0.042	17	3.0
Deep Bedrock Wells (unfiltered)	31	0.066	21	3.9

- Ten samples collected from overburden wells in background/upgradient locations were analyzed for total and isotopic uranium and 10 additional samples were collected, filtered in the field, and analyzed for total and isotopic uranium. Total uranium concentrations in unfiltered samples ranged from 0.81 ± 0.21 to 6.4 ± 1.1 pCi/L (2.2 to 18 μg/L) and from 0.98 ± 0.25 to 4.8 ± 0.88 pCi/L (2.7 to 13 μg/L) in filtered samples with mean concentrations of 2.5 (unfiltered) and 2.2 (filtered) pCi/L (6.9 and 6.1 μg/L, respectively).
- Sixty samples collected from overburden wells within and downgradient from the site were analyzed for total and isotopic uranium and 59 additional samples were collected, filtered in the field, and analyzed for total and isotopic uranium. Total uranium concentrations in unfiltered samples ranged from 0.076 ± 0.15 to 40 ± 6.6 pCi/L (0.21 to 112 μg/L) and from 0.027 ± 0.14 to 47 ± 7.7 pCi/L (0.075 to 131 μg/L) in filtered samples with mean concentrations of 2.6 (unfiltered) and 2.9 (filtered) pCi/L (7.2 and 8.1 μg/L, respectively).
- Thirty-six samples collected from shallow bedrock wells in background/upgradient locations were analyzed for total and isotopic uranium and 35 additional samples were collected, filtered in the field, and analyzed for total and isotopic uranium. Total uranium concentrations in unfiltered samples ranged from 0.14 ± 0.16 to 2.6 ± 0.58 pCi/L (0.39 to 7.2 μg/L) and from 0.18 ± 0.13 to 2.2 ± 0.49 pCi/L (0.5 to 6.0 μg/L) in filtered samples with mean concentrations of 0.88 (unfiltered) and 0.79 (filtered) pCi/L (2.4 and 2.2 μg/L, respectively).
- Fifty-six samples collected from shallow bedrock wells within and downgradient from the site were analyzed for total and isotopic uranium and 54 additional samples were collected, filtered in the field, and analyzed for total and isotopic uranium. Total uranium concentrations in unfiltered samples ranged from 0.065 ± 0.065 to 5.0 ± 0.98 pCi/L (0.18 to 14 μg/L) and from

0.085 ± 0.071 to 4.7 ± 0.92 pCi/L (0.24 to 13 μg/L) in filtered samples with mean concentrations of 1.4 (unfiltered and filtered) pCi/L (3.9 μg/L).

- Three samples collected from deep bedrock wells in background/upgradient locations were analyzed for total and isotopic uranium and one additional sample was collected, filtered in the field, and analyzed for total and isotopic uranium. Total uranium concentrations in unfiltered samples ranged from 0.060 ± 0.058 to 0.10 ± 0.065 pCi/L (0.17 to 0.28 μg/L) with a mean concentration of 0.080 pCi/L (0.22 μg/L). Total uranium was detected in the single filtered sample at 0.11 pCi/L (0.31 μg/L).
- Thirty-one samples collected from deep bedrock wells within and downgradient from the site were analyzed for total and isotopic uranium and 27 additional samples were collected, filtered in the field, and analyzed for total and isotopic uranium. Total uranium concentrations in unfiltered samples ranged from 0.066 ± 0.059 to 21 ± 3.5 pCi/L (0.18 to 57 μg/L) from 0.042 ± 0.17 to 17 ± 2.8 pCi/L (0.12 to 47 μg/L) in filtered samples with mean concentrations of 3.9 (unfiltered) and 3.0 (filtered) pCi/L (10.8 and 8.3 μg/L, respectively).

During the October 2008 sampling event, only one U-238/U-234 ratio in groundwater environmental monitoring sample MW-DU-001 exhibited a U-238/U-234 ratio exceeding 3.0 with a ratio of 6.0 ± 3.5. Therefore, groundwater results did not generally reflect the presence of DU. Results for total uranium are summarized for samples collected during all four quarters of sampling in Figure 3-14 and Table 3-21. Detailed sampling results, including results for individual uranium isotopes and results for individual samples on data presentation tables, frequency distributions, sampling forms, logbooks, and water quality criteria during sampling (e.g., pH, turbidity), are included in Appendix F.

3.10 VEGETATION AND BIOLOGICAL RESOURCES

Sampling data for vegetation and biological specimens collected during the scoping and characterization surveys are summarized in Sections 3.10.1 and 3.10.2, respectively. Section 3.10.3 discusses the results of deer sampling that occurred as part of the site characterization.

3.10.1 Vegetation Samples

During the scoping survey, 20 vegetation samples were collected. Fourteen samples were obtained from within the DU Impact Area and six samples were obtained along the firing line trajectories (lines of fire). The total uranium concentration in vegetation samples was less than 0.7 pCi/g in all samples. Two lichen samples from the south-central portion of the DU Impact Area had U-238/U-234 activity ratios of 2.3 and 2.6, which indicate DU contamination.

During the characterization survey, 10 vegetation samples of lichens, leaves, or grasses were collected from the affected area trenches. Samples were collected from the three penetrator fragment areas shown in Figure 3-2. Five vegetation samples were collected from Area 1, four samples from Area 2, and one sample from Area 3, and were analyzed for total uranium. Samples were washed with deionized water prior to analysis, and the wash water was analyzed separately from the vegetation sample to determine the amount of uranium on the surface of, and in, the sample. The total uranium concentration in vegetation samples ranged from 0.75 to 3,447 pCi/g, with an average concentration of 627.5 pCi/g. The total uranium concentration in the root wash samples ranged from 46.1 to 14,258 pCi/g, with an average concentration of 2,869 pCi/g. The U-238/U-234 activity ratio ranged from 6.1 to 8.4, indicating the presence of DU contamination.

As part of the ERM program, analyses of eight lichen samples and seven leaf samples have been reported. Concentrations of total uranium were generally less than 2 pCi/g but were at 91 pCi/g for one sample (lichen). The results indicate that uranium can concentrate in vegetation but that this has not occurred on a widespread basis.

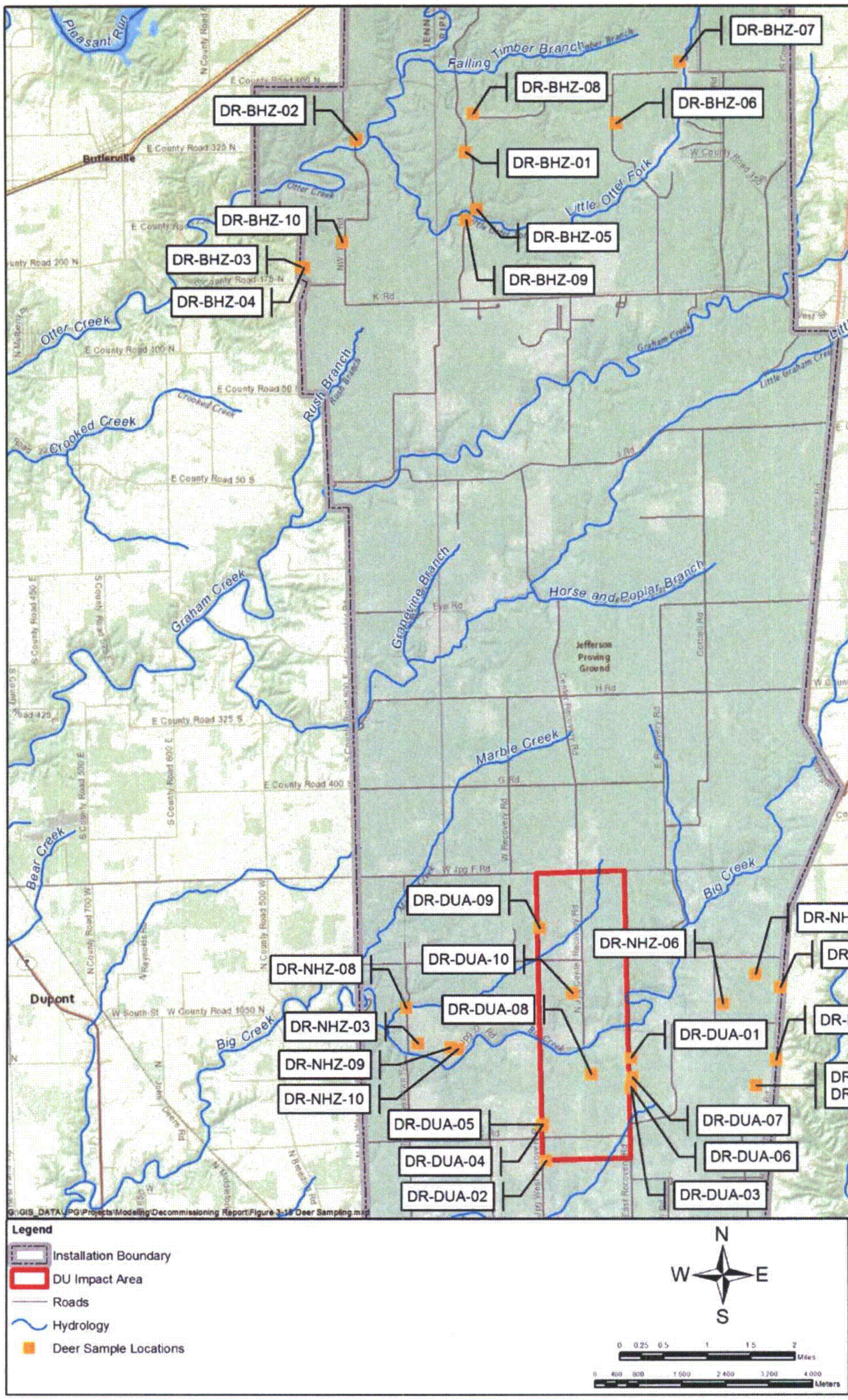
3.10.2 Biological Samples

During the characterization survey, a total of eight biological samples were collected from deer, freshwater clams, fish, and a soft-shelled turtle. For three deer samples, concentrations of total uranium ranged from 0.09 to 0.42 pCi/g. For two samples of freshwater clams, concentrations of total uranium were 0.33 and 0.77 pCi/g. Concentrations of total uranium in fish and turtle were below 0.25 pCi/g. The U-238/U-234 activity ratios ranged from 0.4 to 1.2 and do not indicate the presence of DU contamination.

Data on concentrations of uranium in deer are reported for the ERM program for the years 1984, 1987, 1992, and 1993. Concentrations of total uranium are low (less than 0.4 pCi/g) and do not indicate an impact from DU.

3.10.3 Results of Deer Sampling for Site Characterization

Given that extensive hunting has taken place on JPG in areas outside DU and UXO exclusion zones, that deer routinely use the habitat and cross the DU Impact Area, and the potential for ingestion and uptake of uranium by deer present on the installation, the Army implemented a comprehensive program to evaluate the uptake of uranium by deer present on the installation. The evaluation consisted of the collection and laboratory analysis of 132 tissue samples from 30 deer present on the installation with sample collection (Figure 3-15) taking place during the winter of 2005/2006 (SAIC 2006a). DU was not detected in any tissue sample during laboratory analysis. As such, the conclusion is drawn that uptake of uranium as a result of the intake of deer meat by hunters does not represent a potentially significant exposure pathway at JPG. This was substantiated through NRC testimony at the Administrative Hearing of 22 October 2007, which indicated that if all of the beef in a person's diet were replaced by deer meat with the highest reading obtained from these 30 samples for a year, the increased exposure would be less than 1 mrem (Ridge 2007).



Deer Sampling Locations

Figure 3-15

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4. DOSE MODELING

Residual radiological contamination at Jefferson Proving Ground (JPG) is in the form of depleted uranium (DU) penetrators and their degradation products concentrated in a heterogeneous manner in and around three lines of fire oriented in north-south directions approximately 1.5 miles (mi) north of the firing line. An estimated 1.5 million rounds of high-explosive unexploded ordnance (UXO) rounds and an estimated 3 to 5 million rounds with live detonators, primers, or fuzes are co-located with the residual DU contamination in the area north of the firing line. The UXO poses an immediate risk to life in addition to the lesser, long-term stochastic risk posed by the residual radiological contamination, which is approximately only 60 percent as radioactive as naturally occurring uranium.

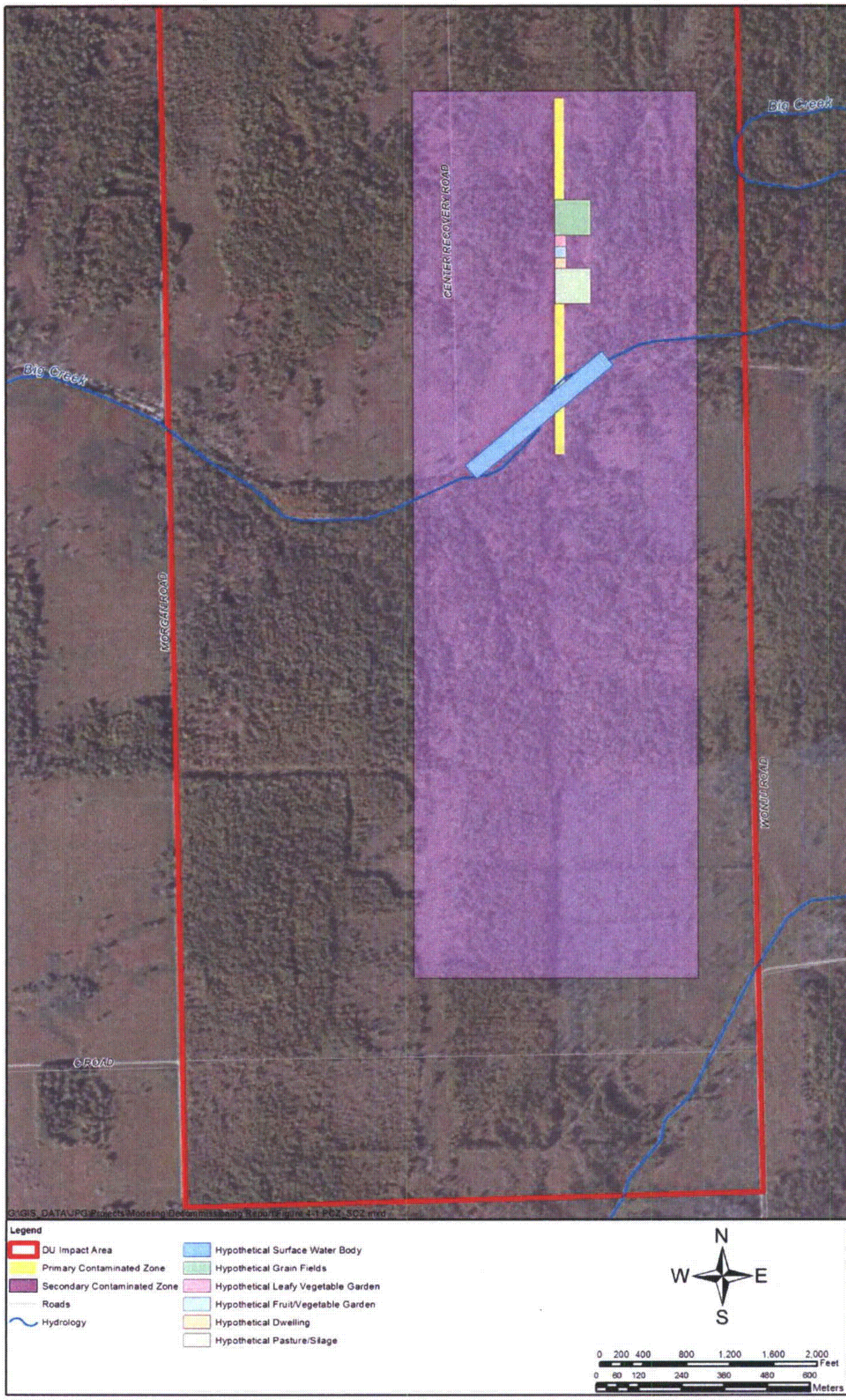
The operating history and radiological status of the facility are discussed in greater detail in Sections 1 and 2, respectively, of this Decommissioning Plan. As described in Sections 1 and 6 of this Decommissioning Plan, the Proposed Action is license termination under restricted conditions. The objective of this section is to describe the residual dose analysis that provides reasonable assurance that the dose criteria of Title 10, Code of Federal Regulations (CFR), Part 20, Sections 1403(b) and 1403(e) (10 CFR 20.1403[b] and [e]) will not be exceeded. The dose analysis demonstrates that if institutional controls remain in effect, the total effective dose equivalent (TEDE) to the average member of the critical group (AMCG) will not exceed 0.25 milliSieverts per year (mSv/y) (25 millirems per year [mrem/y]), and if institutional controls are not in effect, the TEDE to the AMCG will not exceed 1.0 mSv/y (100 mrem/y).

The dose analysis follows the first approach defined in Section 5 of U.S. Nuclear Regulatory Commission Regulation (NUREG)-1757 Volume 2, Revision 1, Consolidated Decommissioning Guidance (NRC 2006a). Specifically, the analysis uses projections of the final concentrations of residual contamination to demonstrate compliance with the dose criteria. Given the proposed approach of license termination, values for derived concentration guideline levels (DCGLs) are not calculated. Compliance with the as low as reasonably achievable (ALARA), financial assurance, and public participation requirements of 10 CFR 20.1403 are presented in Sections 4.3, 12, and 13.5, respectively. The balance of this section, including Sections 4.1 through 4.3, summarizes the technical approach, conceptual site model (CSM), source term, transport pathways, receptors, exposure scenarios, analysis techniques, results of the dose analysis, and results of the ALARA. Appendix C includes the details of the residual dose analysis and Appendix E includes additional supporting details for the ALARA analysis.

4.1 RESTRICTED RELEASE USING SITE-SPECIFIC INFORMATION

DU is the radionuclide of interest at JPG. DU is uranium from which some fraction of the uranium-235 (U-235) isotope has been removed and used as a component in the manufacturing of munitions that penetrate armor plating. The possession and test firing of DU penetrators were conducted under a license issued by the U.S. Nuclear Regulatory Commission (NRC) (Materials License SUB-1435). The test firing of DU projectiles occurred between 1983 and 1994 in the DU Impact Area, which is located in the south-central area north of the firing line of JPG. No hard target testing was conducted at JPG. Only accuracy testing through soft cloth targets spaced at 1,000-meter (m) intervals from the three DU test firing positions. Although the rounds may have fragmented upon impact, these tests were designed to be nondestructive; therefore, no aerosolization occurred because the Army was not testing armor penetration.

DU is present in the DU Impact Area primarily as solid DU penetrators and associated DU corrosion/oxidation products as the DU has started to corrode in the environment. The residual DU is commonly covered by soil due to previous DU penetrator recovery activities, which focused primarily on retrieving surface DU penetrators and penetrator fragments in the former DU lines of fire. The source term, as shown in Figure 4-1, was separated into two areas: a primary contamination zone (PCZ) and a



DU Impact Area Primary and Secondary Contaminated Zones

Figure 4-1

Date: 8/15/2013

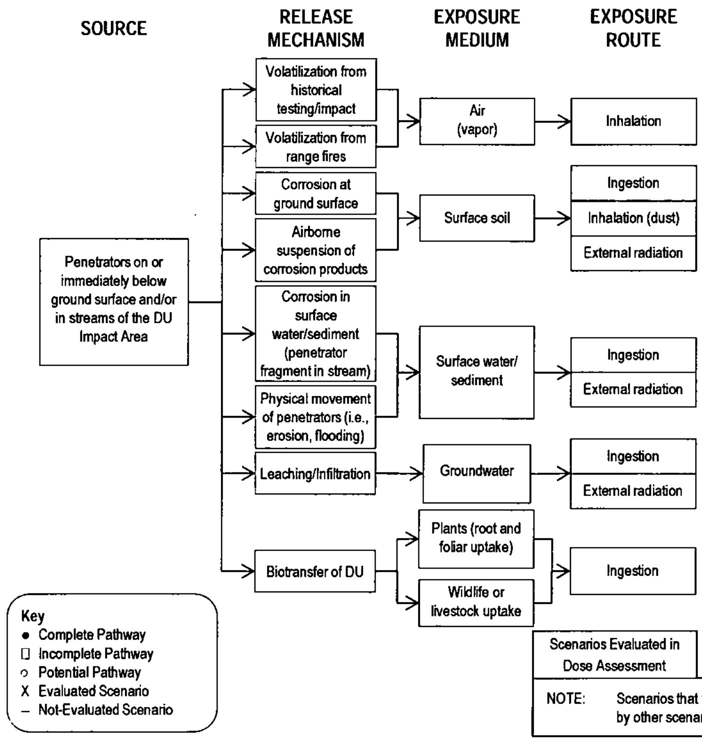
secondary contamination zone (SCZ). The PCZ and associated geometry is set to represent the area of highest DU penetrator concentration as established by the DU penetrator distribution study. The SCZ is set to conservatively represent the remaining area from the DU penetrator distribution study but with a reduced area. For the dose assessment, the SCZ was reduced in size from approximately 4,000 ac to 494 ac but contained the same mass of DU in order to conservatively establish a greater source term for the SCZ. The area of the smaller yet conservative SCZ is based on a width between the J line of fire trench and the K5 line of fire trench. The length of the SCZ, 2,500 m, is based on the results of the radiological survey (SEG 1995a; 1996). This width and length ensure the SCZ area contains the majority of the areas where increased DU soil concentrations are suspected based upon the radiological survey (SEG 1995a; 1996). The source terms for DU are calculated based upon the density of DU penetrators per specific area from the DU penetrator distribution study and the depth to which penetrator corrosion products could migrate through the soil column in the average amount of time it takes for a penetrator to fully corrode and for the corrosion products to dissolve such that they are available for exposure to human receptors. This approach was used because all dose pathways with the exception of external gamma require the source term to be mobile in the environment for the pathway to be complete. Calculation of source term concentrations is presented in Appendix C, Section 3.4.

The CSM shown in Figure 4-2 includes direct exposure to external radiation from DU as well as internal exposure from DU as a result of environmental migration and transport in soil, water, and air. The CSM also includes intake of livestock, wildlife, fish, and plants that have been exposed to the DU. The complete exposure pathways are dependent upon the specific scenarios. The scenarios, including the critical group, associated with potential DU exposure are discussed briefly later in this section and provided in detail in Appendix C, Sections 3.6 and 3.7.

Residual Radiation (RESRAD)-OFFSITE Version 2.6 (Yu et al. 2010) and the probabilistic approach were used to calculate the TEDE to the average member of the critical group for the bounding scenarios (i.e., scenarios with institutional controls in place and in the event of loss of institutional controls). The RESRAD-OFFSITE code is an extension of the original RESRAD code, which was designed for evaluation of radiological doses to an onsite receptor from exposure to residual radioactive materials in soil (Yu et al. 1993, 2001). RESRAD-OFFSITE can model both onsite and offsite receptors and includes additional capabilities such as the three-dimensional dispersion groundwater flow and radionuclide transport model, the Gaussian plume model for atmospheric dispersion, and the deposition model used to estimate the accumulation of radionuclides in offsite locations and in foods. The input parameters used in the RESRAD-OFFSITE model were selected using the following hierarchy:

- Empirical site-specific data (e.g., from the Final Phase 2 Remedial Investigation (RI) (MWH 2002) and Well Location Selection Report [SAIC 2007a])
- Literature values based on site-specific conditions (e.g., density and porosity for silt loam [loess] from NUREG/CR-6697 [ANL 2000] and Carsel and Parrish [1988])
- Calculated values from data presented in NUREG/CR-6697 (ANL 2000) and NUREG/CR-6937 (Yu et al. 2007)
- Most likely or expected values from NUREG/CR-6697 (ANL 2000) and NUREG/CR-6937 (Yu et al. 2007)
- Literature values and professional judgment (e.g., sportsman's onsite occupancy).

The approach adopted herein models the transport of DU at JPG relying on site-specific data to the maximum extent possible. In addition, some simplifying assumptions were made in order to make the modeling adequately conservative. These major assumptions included assuming all DU is currently available for transport, assuming an adequate water supply is available onsite even though shallow groundwater yields are too low to sustain water needs on a yearly basis, assuming a surface water pond



HUMAN RECEPTORS

Exposure Medium	Exposure Route	Exposure Scenarios with Institutional Controls in Place												Exposure Scenarios with Loss of Institutional Controls							
		Onsite Recreationist	Onsite Hunter	Onsite Fisherman	Offsite Resident Farmer	Offsite Boundary Recreationist	Offsite Boundary Recreationist (Hunter)	Offsite Boundary Recreationist (Fisherman)	Offsite Part-Time Resident	Offsite Part- Time Resident, Mod. 1	Offsite Industrial Worker	City Resident	Downwind Resident Farmer	Resident Farmer, Without Irrigation[a]	Resident Farmer, With Irrigation[a b]	Onsite Hunter	Onsite Fisherman	Domestic[a]	Part-Time Domestic[a]	Onsite Industrial Worker	Onsite Sportsman/ Recreationalist
Air (vapor)	Inhalation	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□
Surface soil	Ingestion	●	●	□	●	□	●	●	□	□	□	□	●	●	●	●	●	●	●	●	●
Surface soil	Inhalation (dust)	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Surface soil	External radiation	●	●	●	●	●	●	●	●	●	●	□	●	●	●	●	●	●	●	●	●
Surface water/ sediment	Ingestion	□	□	□	●	●	○	○	●	●	●	●	□	□	□	●	●	○	□	□	●
Surface water/ sediment	External radiation	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Groundwater	Ingestion	□	□	□	□	□	□	□	□	□	□	□	□	●	●	□	□	●	□	□	□
Groundwater	External radiation	□	□	□	□	□	□	□	□	□	□	□	□	●	●	□	□	●	□	□	□
Plants (root and foliar uptake) / Wildlife or livestock uptake	Ingestion	□	●	○	●	●	●	●	□	●	□	□	●	●	●	●	●	●	●	□	●
Scenarios Evaluated in Dose Assessment		–	–	–	X	–	–	–	–	–	–	–	–	–	X	–	–	–	–	X	X

NOTE: Scenarios that were not evaluated in the Dose Assessment, including those with potential pathways, were bounded by other scenarios that were evaluated (reference dose assessment section).

Figure 4-2. CSM for Residual Dose Analysis

was created by damming part of Big Creek to increase surface water yields, and assuming that land use scenarios involve frequencies for receptor activities well above current levels.

A quantitative sensitivity analysis was conducted on RESRAD-OFFSITE Priority 1 parameters (NUREG/CR-6697, Attachment B). Generally speaking, parameters ranked as Priority 1 have a greater potential of affecting radiation doses, tend to vary more from site to site, and can be characterized more easily because their data can be found in readily available literature. Sensitivity analyses on many of the parameters indicate that changing the thickness of the contaminated zone resulted in changes of 15 percent or more in the predicted doses, whereas variations in other parameters did not result in significant changes in the predicted doses.

Uncertainty analysis is a means by which the distribution of output values is estimated (i.e., the degree of error in estimated values is established). Uncertainty analysis uses distributions of parameter values for each parameter in the analysis. A value for each parameter is selected at random from the distribution, the dose is calculated for that set of parameter values, and then the process is reiterated. Uncertainty analysis using all of the parameters in the RESRAD-OFFSITE model for each scenario is a large task that is extremely inefficient given that the contributions of all of the parameters would be included for each estimated dose for each scenario.

Although the thickness of the contaminated zone was the only sensitive parameter identified in the sensitivity analysis, several other parameters were related to contaminated zone thickness as they were used to calculate initial soil concentrations (i.e., thickness of the unsaturated zone, hydraulic conductivity, and distribution coefficients). Therefore, the parameters selected for probabilistic distributions included: thickness of the contaminated zone; thickness of the unsaturated zone; distribution coefficients (K_ds) in the contaminated zone and unsaturated zones; concentrations of uranium-234 (U-234), U-235, and uranium-238 (U-238); and hydraulic conductivity of the contaminated zone and unsaturated zones. The parameter values and probabilistic distributions selected for each scenario are listed in Appendix C, Table 3-5.

A detailed uncertainty analysis is provided in Appendix C, Section 3.9. The RESRAD-OFFSITE input and output files associated with the dose assessments are provided electronically in a compact disk (CD) attached to the inside of the front cover of this document.

Thirteen exposure scenarios with institutional controls in place were evaluated with respect to requiring quantitative evaluation in RESRAD-OFFSITE. Many other potential exposure scenarios were effectively addressed by other exposure scenarios, and thus, were evaluated qualitatively through "bounding" scenarios. For example, the onsite hunter scenario with institutional controls was effectively addressed by the sportsman/recreationalist with loss of institutional controls because the sportsman/recreationalist evaluated all of the same pathways as the hunter and spent more time onsite closer to the contaminated area. Therefore, RESRAD-OFFSITE simulations were not completed for the onsite sportsman/recreationalist with institutional control in place. Results for these less controlling scenarios are reported below and in Appendix C for bounding scenarios for which RESRAD-OFFSITE simulations were completed. Bounding scenarios with and without institutional controls were covered by three loss of controls scenarios (i.e., subsistence farmer, industrial worker, and sportsman/recreationalist) and a single scenario with institutional controls in place (i.e., offsite subsistence farmer).

The main difference in the scenarios considered if institutional controls fail, besides the probable exposure to UXO, is the proximity to the DU Impact Area where farming, residential development, or recreational use can take place. The farming scenarios described below assume that a resident farmer lives all year in a house built on the DU Impact Area in the PCZ and supports a family on produce and livestock onsite residing in the PCZ. Part-time residential scenarios assume that residents live part of the year in houses built on the DU Impact Area and grow vegetables during the summer (4 months) for consumption at home. Recreational uses of the lands are similar to those listed in Appendix C (Table 3-1)

except that the DU Impact Area is accessible. In addition, as a conservative approach, although highly implausible, a scenario was established for an industrial worker (i.e., U.S. Fish and Wildlife Service [FWS]/Indiana Air National Guard [INANG] worker) who spends an entire work year (2,000 hours) outdoors on the DU Impact Area in the PCZ and a scenario was established for a sportsman/recreationalist (i.e., hunter/fisherman/recreationalist) who spends 103 days per year (i.e., the amount of time annually the Big Oaks National Wildlife Refuge [NWR] is open to the public) in the DU Impact Area in the PCZ. The pathways for the INANG/FWS worker include external radiation, inhalation, and incidental soil ingestion. The pathways for the sportsman/member of the public include external radiation, inhalation, incidental soil and water ingestion, meat ingestion, and fish ingestion. These two scenarios were established because they bound many of the other scenarios (inclusive of exposures with institutional controls in place and in the event of loss of institutional controls). Results for scenarios covered by loss of controls are presented in Table 4-1. The dose estimate for the offsite subsistence farmer scenario (i.e., with institutional controls in place) is presented in Table 4-2.

**Table 4-1. Doses for Scenarios With Institutional Controls in Effect
Jefferson Proving Ground, Madison, Indiana**

Receptor	Location[a]	TEDE[b] (mrem/y)	Method
Residential Farmer	Offsite	2.0	RESRAD-OFFSITE
Industrial Worker (FWS Worker)	Onsite without controls	5.9	RESRAD-OFFSITE
Sportsman/Recreationalist	Onsite without controls	3.3	RESRAD-OFFSITE

[a] Doses for onsite industrial workers and sportsman/recreationalist, although developed based on TEDEs for receptors without institutional controls being in place, comply with NRC's unrestricted release dose limit of 25 mrem/y prescribed in 10 CFR 20.1402 as well as dose criteria in 10 CFR 20.1403 that applies both with and without institutional controls being in place. In these situations where the TEDEs would clearly be less in the restricted scenario compared to the unrestricted scenario, the actual TEDEs were not calculated.
[b] Doses for RESRAD-OFFSITE simulations are peak-of-the-mean estimates from probabilistic calculations.

**Table 4-2. Pathway Analysis for Offsite Resident Farmer With Institutional Controls
Jefferson Proving Ground, Madison, Indiana**

Pathway	TEDE[a]	Percent of TEDE	Relevant Assumptions
Water Ingestion[b]	1.22	62.0	• Due to limited water availability in groundwater and surface water, Big Creek is assumed to be dammed such that it provides needed volumes of water for drinking water, crop irrigation, and livestock consumption. Water is used directly from the creek without prior treatment. • Probabilistic RESRAD assessments assume that initial source term is immediately available for transport whereas many of the DU penetrators have not fully corroded. Thus, DU is not currently available for migration.
Ingestion of Vegetation[b]	0.51	26.2	
Milk Ingestion[b]	0.18	9.1	
Other Pathways	0.06	2.7	
Total	**2.0**	**100**	

[a] Peak of the mean dose over the period from the first year to year 1,000
[b] Water release
The peak dose occurs in the first year for each scenario.

The only modeled peak dose for offsite receptors is 2.0 mrem/y and represents the TEDE for the offsite subsistence farmer controls. The peak dose to the offsite residential farmer is from drinking water and ingesting plants (Table 4-2) and is observed in the early years. Because the sportsman/recreationalist and industrial worker (i.e., FWS/INANG worker) scenarios with loss of controls were less than 25 mrem/y, one reasonably concludes that the same scenarios with institutional controls in place (i.e., FWS/INANG worker or sportsman/recreationalist located outside the contaminated area) also would meet the 25 mrem/y (i.e., the unrestricted release criterion) because they have less exposure to the contaminated zone. In these situations where the TEDEs would clearly be less in the restricted scenario compared to the unrestricted scenario, the actual TEDEs were not calculated. The industrial worker represents the critical group with institutional controls in place. For example, as the TEDE for this

receptor equates to only 5.9 mrem/y in the event of loss of institutional controls, the TEDE with controls in place would be much lower than this value. The TEDEs for these receptors are primarily the result of external exposure (Tables 4-3 and 4-4).

Table 4-3. Pathway Analysis for FWS/INANG Worker With and Without Institutional Controls Jefferson Proving Ground, Madison, Indiana

Pathway	TEDE [a]	Percent of TEDE	Relevant Assumptions
Ground/External Exposure [b]	5.39	91.7	• Probabilistic RESRAD assessments assume that initial source term is immediately available for transport whereas many of the DU penetrators have not fully corroded. Thus, DU is not currently available for migration. • Although institutional controls minimize time onsite, dose assessment assumes worker is onsite for 1,036 hours per year (i.e., the total time that the Big Oaks NWR is open) and that worker is constantly present at location with highest exposure rate. As institutional controls severely limit time spent in the DU Impact Area by FWS/INANG industrial workers, actual TEDE with institutional controls in place would be a small percentage of doses specified herein. This is particularly true given the inability to access most areas due to the presence of UXO.
Soil Ingestion [b]	0.38	6.4	
Inhalation	0.11	1.9	
Other Pathways	0.07	Negligible	
Total	**5.9**	**100**	

[a] Peak of the mean dose over the period from the first year to year 1,000
[b] Direct and air
The peak dose occurs in the first year for each scenario.

Table 4-4. Pathway Analysis for Sportsman With and Without Institutional Controls Jefferson Proving Ground, Madison, Indiana

Pathway	TEDE [a]	Percent of TEDE	Relevant Assumptions
Ground/External Exposure [b]	2.77	83.5	• Probabilistic RESRAD assessments assume that initial source term is immediately available for transport whereas many of the DU penetrators have not fully corroded. Thus, some DU is not currently available for migration. • Assumes individual is present onsite for 103 days per year and that hunting and fishing and all other activities occur in the primary contamination zone. • Under conditions such that institutional controls are in place, sportsmen are prohibited from entering the DU Impact Area and adjacent areas that contain UXO. As such, actual TEDEs with institutional controls in place would be a small percentage of the doses specified herein.
Soil Ingestion [b]	0.22	6.8	
Meat Ingestion	0.19	5.8	
Other Pathways	0.13	3.9	
Total	**3.3**	100	

[a] Peak of the mean dose over the period from the first year to year 1,000
[b] Direct and air
The peak dose occurs in the first year for each scenario.

4.2 UNRESTRICTED RELEASE USING SITE-SPECIFIC INFORMATION

As stated above, RESRAD-OFFSITE Version 2.6 (Yu et al. 2010) and the probabilistic approach also were used to calculate the TEDE to the average member of the critical group for the scenarios without institutional controls. Loss of institutional controls implies the failure of physical and administrative access control to the JPG lands north of the former firing line. Site characteristics are such that the land could be farmed, developed, or used as habitat for wildlife or to support outdoor activities similar to those permitted at JPG, as discussed above. However, even though institutional controls are assumed to fail, removal of UXO scattered throughout the JPG lands is not assumed. Thus, potential risks involved with using the JPG lands must include both the potential exposure to residual DU as well as potential for injury and death from UXO-related encounters. Because of the presence of an estimated 1.5 million rounds of high-explosive UXO and an estimated 3 to 5 million rounds with live detonators, primers, and fuzes at JPG and given the cost and technical considerations involved with UXO removal, intrusive activities, such as farming or development for residential homes or industry, although plausible, are not likely future land uses. However, farming and development are evaluated as potential DU exposure pathways and are included in the tested scenarios.

Eight exposure scenarios with loss of institutional controls were evaluated with respect to requiring quantitative evaluation in RESRAD-OFFSITE. Many exposure scenarios were addressed by other exposure scenarios, such as the bounding scenarios presented in Section 4.1 (e.g., onsite hunter scenario with institutional controls was addressed by the sportsman/recreationalist with loss of institutional controls). The dose estimates for the three scenarios involving the loss of institutional controls (i.e., subsistence farmer, industrial worker, and sportsman/recreationalist) are presented in Table 4-5. As shown in Table 4-5, all scenarios had dose estimates that were significantly less than 100 mrem/y, the restricted release criterion of 10 CFR 20.1403(e).

Table 4-5. Doses for Scenarios Without Institutional Controls in Effect
Jefferson Proving Ground, Madison, Indiana

Receptor	Location	Dose (mrem/y)*	Method
Sportsman/Recreationalist	Onsite	3.3	RESRAD-OFFSITE
Industrial Worker (FWS Worker)	Onsite	5.9	RESRAD-OFFSITE
Residential Farmer	Onsite	26.3	RESRAD-OFFSITE

*Doses for RESRAD-OFFSITE simulations are peak-of-the-mean estimates from probabilistic calculations.

The same factors described in Section 4.1 for the analysis of residual dose for scenarios with institutional controls were used for the scenarios evaluated in the event of loss of institutional controls. Exceptions are limited to behavioral differences (represented by different exposure parameters) that are expected to result from the lack of physical and administrative access control to the DU Impact Area. Scenarios selected for analysis when institutional controls fail are listed in Appendix C, Table 3-3. The scenarios were selected for inclusion in the RESRAD-OFFSITE analysis because they represent potential exposures to humans under scenarios not included when institutional controls are in place. These scenarios consisted of the resident farmer with irrigated crops, FWS/INANG worker, and sportsman/recreationalist member of the public.

The largest modeled peak dose is 26.3 mrem/y and represents the TEDE for the onsite residential farmer, the critical group in the event of loss of institutional controls. The TEDE for this receptor is primarily the result of external exposure and plant ingestion (Table 4-6) at the beginning of the analysis

Table 4-6. Pathway Analysis for Onsite Resident Farmer With Loss of Institutional Controls
Jefferson Proving Ground, Madison, Indiana

Pathway	TEDE [a]	Percent of TEDE	Relevant Assumptions
Ground/External Exposure [b]	13.3	50.5	• Sensitivity analysis reflected that thickness of the contaminated zone was a sensitive parameter. Probabilistic modeling computed TEDEs based on 0.3 and 1-m thicknesses of contaminated zone. • Probabilistic RESRAD assessments assume that initial source term is immediately available for transport whereas many of the DU penetrators have not fully corroded. Thus, DU is not currently available for migration. • Residence and subsistence farm are assumed to be present in an area with large quantities of UXO and in the areas with the highest DU concentrations. • Construction of residence and farm occurs in the forested DU Impact Area rather than available open areas with less or no DU contamination. • Assumes groundwater well located on DU Impact area used as drinking water source, crop irrigation, and livestock consumption. Water used without prior treatment and irrespective of insufficient yield and limited quality due to the presence of sodium, sulfate, and dissolved solids.
Ingestion of Vegetation [b]	10.2	38.9	
Soil Ingestion [b]	1.36	5.2	
Other Pathways	1.45	5.5	
Total	**26.3**	**100**	

[a] Peak of the mean dose over the period from the first year to year 1,000
[b] Direct and Air
TEDE decreases nonlinearly over time from 26.3 mrem/y in year zero to 1.4 mrem/y at year 1,000 with a concurrent change in relevant pathways and their associated doses. The peak dose occurs in the first year for each scenario.

period (i.e., first hundred years). The residential farmer with loss of controls is the only scenario where the estimated dose exceeded 25 mrem/y (i.e., the unrestricted release criterion from 10 CFR 20.1403[b]).

4.3 ALARA ANALYSIS

This section presents the ALARA analysis performed in accordance with requirements in NUREG 1757 (NRC 2006a) to support the Army's request to terminate NRC Materials License SUB-1435 under restricted conditions in accordance with 10 CFR 20.1403. No additional ALARA analysis is planned to support the license termination because the proposed license termination will not involve additional site characterization or removal of DU contamination.

As discussed in Section 2.2, additional DU remediation within a portion of the DU Impact Area was considered but eliminated from the detailed analysis of alternatives. Further remediation in a portion of the DU Impact Area to meet the unrestricted release requirements specified in 10 CFR 20.1402 would not allow for unrestricted use of the DU Impact Area due to the remaining UXO hazards in areas surrounding the hotspot remediation. As an enduring entity of the Federal Government, the continued Army ownership of the JPG property north of the firing line bolsters the continuation of land use restrictions and security measures for the DU Impact Area and other areas of the former installation surrounding the DU Impact Area. These land use restrictions and security measures fulfill the requirement for durable and legally enforceable institutional controls. These access restrictions will remain in place regardless of the radiological status of the DU Impact Area to mitigate potential explosive safety hazards associated with UXO.

In addition, semiannual DU penetrator retrieval efforts between 1984 and 1995 were focused on easily retrievable penetrators and fragments in high-probability areas (i.e., on or near the surface within the line of fire for the 500 Center firing position); therefore, remediation of the easily retrievable DU penetrators and fragments in high-probability areas has already been conducted. Engineer Pamphlet (EP) 75-1-2 (USACE 2004) describes the process that would likely be used if DU remediation were undertaken. Remediation of the remaining DU penetrators, fragments, and corrosion products would require extensive UXO clearance activities with engineering controls to minimize the blast effects and additional spread of DU contamination (e.g., atmospherically entrained DU from explosions occurring during UXO destruction, enhanced runoff after vegetation destruction). The uneven spatial distribution of penetrators, fragments, and corrosion products both laterally and vertically and the requirement for sequential UXO/DU remediation with engineering controls would present substantial additional challenges. The presence of federally threatened or endangered species such as the Indiana bat, which prefers stream corridors and forested areas on the Big Oaks NWR for summer foraging, roosting, and rearing young, also could complicate remediation efforts. The elements of the remediation are discussed in further detail below.

To demonstrate that this approach is consistent with the ALARA principle, the cost-benefit analysis presented below was performed. This analysis consists of identifying and quantifying, to the extent practical, the benefits and costs that would be associated with further decontamination of a portion of the DU Impact Area. Because of uncertainty regarding the exact depths and locations of UXO and DU requiring removal and decontamination and the evolution of remediation technologies for UXO and DU, there are uncertainties about the costs of further remediation; thus, the costs are summarized in a comparative manner. As indicated in Section 4.3.3, this uncertainty does not limit the Army's ability to develop conclusions based on this ALARA analysis.

This ALARA analysis was performed in accordance with Appendix N of NUREG-1757, Volume 2, Revision 1 (NRC 2006a). Sections 4.3.1 and 4.3.2 present the calculation of the benefits and costs for the ALARA analysis, respectively. The ALARA analysis for the residual radioactivity and its conclusions are summarized in Section 4.3.3. The need for additional analyses (if any) is addressed in Section 4.3.4.

4.3.1 Calculation of Benefits

Several benefits were identified as being associated with further decontamination of a portion of the DU Impact Area to levels consistent with unrestricted release conditions. The benefits were identified using the potential benefits identified in Table N.1 of the NRC's Consolidated Decommissioning Guidance (NUREG-1757) (NRC 2006a). The benefits identified for the JPG include collective dose averted, regulatory costs avoided, changes in land values, esthetics, and reduction in public opposition. Sections 4.3.1.1 through 4.3.1.5 provide additional detail on each of these possible benefits.

4.3.1.1 Collective Dose Averted

The dose modeling is described in Sections 4.1 and 4.2 with the TEDEs for each receptor group summarized in Tables 4-1 and 4-2. The TEDE for the critical group, the onsite resident farmer, was determined to be 0.263 mSv/y (26.3 mrem/y) under loss of institutional controls. This dose is essentially indistinguishable from the 0.25 mSv/y (25 mrem/y) dose standard prescribed in 10 CFR 20.1402 for unrestricted release. However, the costs for the collective dose averted are considered further in the residual radioactivity calculations in Section 4.3.3.

4.3.1.2 Regulatory Costs Avoided

Regulatory costs associated with an alternative of license termination under unrestricted conditions would include licensing fees until the existing radioactive license was terminated, at which time there would be no licensing fees. There would be costs associated with license termination under restricted conditions (e.g., licensing fees, inspection fees) until the license is terminated followed by financial assurance costs associated with the monitoring and maintenance trust and for unknown future liabilities. However, the regulatory costs are expected to decrease over time and to be minimal and, therefore, were not included in the estimate.

The Army expects to incur approximately $268,000 annually for implementing institutional control costs at JPG, as detailed in Appendix F. These costs include road maintenance, perimeter mowing, perimeter fence inspection, fence repair, and fence-sign monitoring and replacement. Please note that these are the costs if the Army needs to carry out the functions of the Memorandum of Agreement (MOA) in the event that both INANG and FWS decide to terminate their respective agreements in the MOA. If one or both agencies remain, the costs to the Army would decrease but the overall costs would remain the same.

4.3.1.3 Changes in Land Values

Farmland in the area of JPG has a market value of $3,000 to $5,000 per acre based on classified advertisements and Internet real estate postings from the following websites: Craigslist, Landwatch, and Trulia in March 2013. The DU Impact Area is located in the south-central portion of the JPG area north of the firing line and contains, and is surrounded by, areas containing large quantities of UXO.

The DU Impact Area also is adjacent to the Jefferson Range operated by INANG for the U.S. Air Force (USAF) in accordance with the MOA between the Army, FWS, and USAF (U.S. Army 2000a). The range activities involve training munitions (i.e., inert munitions with spotting charges) and laser energy. The 983-ac (4.0-square kilometers [km^2]) operational range is located several miles north of the DU Impact Area, but the safety fans for a 50-ac (0.2-km^2) Precision-Guided Munitions (PGM) range, which is located just north of F Road (i.e., the northern boundary of the DU Impact Area), extends over a portion of the DU Impact Area. The Army also has no plans to reduce or eliminate the UXO contamination in the DU Impact Area. Therefore, the Army would not be able to release the DU Impact Area for other uses even if it were further decontaminated with respect to residual DU. Any benefit associated with increased land values would be minimal.

4.3.1.4 Esthetics

The DU Impact Area is in the south-central portion of the JPG area north of the firing line and covered by woods and grassy areas. The Big Oaks NWR was created to exploit expansive existing woodland with the potential for allowing or managing remaining open areas to revert to a closed canopy forest and associated understory, which is highly unusual in the Midwest. This approach affords an ideal opportunity for restoration management of biodiversity at the community level to benefit, among other species, interior forest nesting and neotropical migrant birds. There are no DU-contaminated structures that would have to be removed or decontaminated to meet the requirements for license termination without restrictions. In the short-term, remediation would impact the esthetic value of the DU Impact Area negatively as the remediation would require the removal of vegetation, including large trees and undergrowth, and excavation of soil to an unknown depth, which could result in the destruction of flora and displacement of fauna. Over time and with appropriate mitigation measures, the area could be restored to its present state. No additional esthetic value is estimated to accrue for license termination without restrictions.

4.3.1.5 Reduced Public Opposition

The Army sought public input in accordance with requirements specified in 10 CFR 20.1403(d) for the Army's intent to terminate Materials License SUB-1435 pursuant to restricted release provisions of 10 CFR 20.1403. The Army held meetings on 28, 29, and 30 October 2008 in Madison, Versailles, and North Vernon, respectively, and repeated the meetings on 23, 24, and 25 June 2009 in North Vernon, Versailles, and Madison, respectively. A total of five local citizens attended the October 2008 meetings (three in Madison, none in Versailles, and two in North Vernon). A total of 33 local citizens attended the June 2009 meetings (4 in North Vernon, 11 in Versailles, and 18 in Madison). Prior to the meetings, the Army published notices in the *Madison Courier*, *North Vernon Plain Dealer*, *Versailles Republican*, *Indianapolis Star*, *Louisville Courier Journal*, and *Cincinnati Enquirer*. Some members of the public expressed concerns regarding the termination of the JPG license with restrictions while other members supported the Army's plan for restricted release license termination. Additional details about public input are provided in Section 13.5. Transcripts from these meetings are included in Appendix G.

The conclusion regarding public support for restricted release license termination also is based on a review of the Restoration Advisory Board (RAB) meeting minutes and review of related documentation prepared by local activist groups such as Save the Valley (STV) (STV 2001). However, it should be noted that local meetings held in the 1990s with JPG personnel and residents of the Madison, Indiana area indicated that potential users of the Big Oaks NWR supported its creation and continued maintenance. The interest expressed by the local stakeholders shows concern that the environment remain as it is (U.S. Army 1999).

The benefit associated with reduced public opposition as a result of license termination for unrestricted use (i.e., destruction of NWR habitat for further remediation to unrestricted use levels) is difficult to quantify but is considered negligible relative to other benefits quantified in this analysis and is not quantified.

4.3.2 Calculation of Costs

Several categories of costs were identified for further decontamination of all or a portion of the DU Impact Area to unrestricted release conditions. These cost categories also were identified using the potential costs identified in NUREG-1757, Volume 2, Appendix N (NRC 2006a). The costs applicable for JPG are: UXO and DU remediation costs, occupational and public radiological exposure during the remediation, occupational nonradiological risk to onsite personnel during the remediation, nonradiological transportation risks, and environmental degradation. These cost elements are presented in Sections 4.3.2.1 through 4.3.2.5.

Because of the uncertainties in exact depths and locations of the DU penetrators, fragments, and residual soil contamination and the unique nature of a UXO-DU remediation project, there are substantial uncertainties associated with some of the cost estimates. For this reason, a range of cost estimates is provided to reflect the uncertainty in estimating these costs.

4.3.2.1 UXO and DU Remediation Costs

As discussed in Section 2.2 and in the sections above, the severe explosive hazards pose a significant complication when planning further DU remediation in the DU Impact Area. It is believed that approximately 1.5 million rounds potentially remain as high-explosive UXO rounds and 3 to 5 million rounds with live detonators, primers, or fuzes remain within the installation north of the firing line due to Army munitions testing between 1941 and 1994 (U.S. Army 1995a). Specifically within the DU Impact Area, a "very high" density of UXO (i.e., 85 UXO/acre) is suspected to be present (U.S. Army 1995a).

Due to the severe explosive safety hazard potentially posed by the UXO, UXO and DU remediation of the DU Impact Area would need to occur sequentially. This protocol includes UXO identification and removal from surface soils; removal of surface DU penetrators, fragments, and corrosion products from surface soils; UXO clearance to the prescribed maximum depth (e.g., of 4 feet [1.2 m below ground surface (BGS)]); and the identification and removal of DU to the established standards subsequent to UXO removal.

Table 4-7 summarizes the general range of values for each of the identified high cost parameters associated with UXO and DU remediation within a portion of the DU Impact Area. Presented costs do not account for remedial design, including pilot study of the remedial technology, work plan development, mobilization and demobilization of equipment, infrastructure construction (e.g., utilities, access roads), vegetation removal, site restoration, and costs associated with groundwater or surface water containment and/or treatment.

Table 4-7. Key Parameters Impacting DU Impact Area Remediation Costs Jefferson Proving Ground, Madison, Indiana

Parameter	Unit	Estimated Values	Source
Area Requiring UXO Detection, Removal, and Disposition	Acres	5-500	Estimate based on existing characterization information
Unit Cost for UXO Detection, Removal, and Disposition	$/acre	27,210-150,660	Estimate based on RACER 11.1 cost modeling (cost per acre is lower if more acres are remediated)
Area Requiring Soil Survey for DU (acre)	Acres	1.7-500	Estimate based on existing characterization information
DU Contamination Depth	Feet	4	Estimate based on existing characterization information
Unit Cost for Physical Treatment of Soil	$/ft³	3.5	Estimate based on RS Means references (RS Means 2011) and historical vendor quotes from similar projects
Volume Percent of Soil Determined to Be Contaminated with DU	percent	5-30	Estimate based on similar remedial actions Dependent of soil type to be treated
Unit Cost for Contaminated Soil Transportation and Disposal LLRW LLRW Mixed	 $/ft³ $/ft³	 18 37	Estimate based on a quote from a commercial disposal facility
Total			
Low-end scenario (5 ac cleared of UXO and 1.7 ac remediated of DU to a depth of 4 feet)			$2,500,000*
High-end scenario (500 ac cleared of UXO and remediated of DU to a depth of 4 feet BGS)			$11,000,000,000*

* The costs presented above are focused on identified high cost parameters for UXO and DU remediation in the DU Impact Area. The costs do not include remedial design, work plan development, mobilization and demobilization of equipment, infrastructure construction, vegetation removal, site restoration, and costs associated with groundwater or surface water containment and/or treatment.

In order to achieve the 25 mrem/y criterion, approximately 5 percent of the source term would need to be removed. For the low-end scenario, it was assumed that 1.7 ac (0.007 km^2) of the most contaminated area (within the PCZ) of the DU Impact Area would need to be remediated to a depth of 4 ft. A greater surface area of 2.3 ac (0.009 km^2) would be distributed to account for the excavation sloping. Area(s) surrounding the DU remediation area would be required for maneuvering of heavy equipment, staging contaminated and clean fill soil and must be cleared of UXO before DU decontamination could occur. For the low-end scenario, it was assumed that a minimum of 5 ac (0.020 km^2) of UXO clearance would be required. However, the number and overall sizes of these areas could significantly increase if any of the DU remediation design component(s) require more area (e.g., surface water treatment systems). The high-end scenario assumed that 500 ac (2 km^2) would undergo UXO clearance and DU would be remediated to a depth of 4 feet BGS.

The estimated costs for surface and subsurface clearance of UXO were developed by modeling multiple scenarios using Remedial Action Cost Engineering and Requirements (RACER™) version 11.1 (AECOM 2012) cost estimation software. The unit costs ($/acre) are approximately $150,660/acre ($37.23/m^2) for UXO surface and subsurface clearance of 5 ac (0.02 km^2) to a depth of 4 feet (1.2 m) BGS. The unit costs ($/acre) are approximately $27,210/acre ($6.72/m^2) for a UXO surface and subsurface clearance of 500 ac (2 km^2) to a depth of 4 feet (1.2 m) BGS. The scenarios assumed a flat topography with heavy shrubs and trees. None of the scenarios modeled accounted for additional care that may be required to conduct UXO clearance work in areas contaminated with DU (e.g., additional engineering controls to minimize spread of contamination during in-place destruction of UXO, decontamination of safe-to-move UXO before movement to other parts of project site where destruction and disposal can safely take place, potential remote/robotic operations needed due to safety concerns for dense quantities of UXO). The removal of the vegetation following the surface clearance also was not included.

A waste volume reduction process using a physical treatment technology could be employed onsite to reduce the volume of waste necessary for offsite disposal. Excavated DU penetrators and fragments and DU-contaminated soil may undergo physical treatment by screening and soil sorting, including radiological scan and in situ measurements. All excavated soil would be screened and segregated based on its radioactivity level; soil below cleanup criteria could be used as backfill. The effectiveness of soil sorting and radiological scanning is heavily influenced by the soil types to be treated. For cost estimating purposes, it is assumed that volume reduction rates of 70 to 95 percent could be obtained by implementing soil sorting. The costs are assumed to be typical for segregating DU penetrators and fragments from DU-contaminated soil and are estimated at approximately $3.50/cubic foot ($ft^3$) ($123.60/cubic meter [m^3]). The derived unit costs neglect remedial design, mobilization, and demobilization costs but include the use of erosion/sediment controls and dust suppression during excavation of soils using conventional construction equipment following the UXO subsurface clearance. The costs for the excavation of soils could increase significantly if the explosive hazards warrant the need for remotely operated and/or armored excavation equipment or if a higher degree of mitigation measures is required.

The unit transportation and disposal costs also are variable and are dependent on the quantity for disposal and the distance the waste is to be transported. Approximate transportation and disposal costs at commercial sites for the disposal of low-level radioactive waste (LLRW), such as DU, are presented in Table 4-8. The estimates presented do not include remedial design or waste characterization. The transportation and disposal costs are reported to be $18/$ft^3$ to $37/$ft^3$ ($617/$m^3$ to $1,294/$m^3$) for LLRW and low-level mixed waste (LLMW), which is waste that contains both LLRW and hazardous waste pursuant to U.S. Environmental Protection Agency (USEPA) regulations, respectively. The estimated costs do not include the design or construction of infrastructure required to stage, load, and transport the waste offsite (e.g., transfer facility, railroad spur, and/or access roads).

Table 4-8. Estimated Remediation Costs for the Key Parameters Jefferson Proving Ground, Madison, Indiana

Remediation Activity	Estimate ($)
UXO Detection, Removal, and Disposition	753,300-13,605,000
Physical Treatment of DU-Contaminated Soil	1,202,200-3,038,000,000
Contaminated Soil Transportation and Disposal	519,650-7,879,053,000
Total (Rounded to two significant figures)	2,500,000-11,000,000,000

Currently, there are four NRC-licensed commercial LLRW disposal facilities: Hanford, Washington; Barnwell, South Carolina; Energy Solutions' Clive Facility, Clive, Utah; and Waste Control Specialists' (WCS) disposal site in Andrews, Texas. The two commercial disposal facilities licensed for LLRW and available for the disposal of JPG DU are in Clive, Utah and Andrews, Texas. As the Clive, Utah facility is licensed to receive Class A[1] wastes and the WCS facility is authorized to receive Class A, B[2], and C[3] wastes, barring constraints on receipt of DU, either of these facilities should be able to receive JPG DU. The Hanford, Washington facility currently accepts only waste from the 11 states in the Northwest and Rocky Mountain compacts and the Barnwell, South Carolina facility is restricted to accepting wastes only from the three states of the Atlantic compact (American Nuclear Society 2009). Limitations on the quantity of uranium to be disposed of may impact the ability of one or more disposal sites to receive JPG DU. Table 4-8 summarizes the total cost estimate by remediation activity given the variation in major parameters presented in Table 4-7.

The costs presented in Tables 4-7 and 4-8 show the potential for considerable variation in the total remediation cost estimate depending on the area and depth of soil that must be remediated and the unit remediation and disposal costs. The total cost is dominated by the cost of identifying, processing, and disposing of UXO and DU-contaminated soil.

4.3.2.2 Occupational and Public Radiological Exposure

The cost of the remediation worker dose, $Cost_{wdose}$, was evaluated using the following formula, Equation N-7 from NUREG-1757, Volume 2, Appendix N (NRC 2006a):

$$Cost_{WDose} = \$2,000 * D_R * T$$

Where:

D_R = The TEDE rate to remediation workers in units of rems/h

T = The time worked (site labor to remediate the area in units of persons-hour).

Occupational exposures during DU remediation activities will be minimal with the implementation of appropriate health and safety protocols. In Table N.2 of NUREG-1757, Volume 2, Appendix N (NRC 2006a), the acceptable parameter value of 1.62 person-hour/m^3 is provided for use in ALARA analyses for excavation, monitoring, packaging, and handling of soil. Multiplying this factor with the range of excavation volumes of approximately 647 m^3 (1.7 ac) to 9,807,031 m^3 (500 ac) of soil, a range from 1,595

[1] Class A waste is waste that is usually segregated from other waste classes at the disposal site. The physical form and characteristics of Class A waste must meet the minimum requirements set forth in 10 CFR 61.56(a). If Class A waste also meets the stability requirements set forth in 10 CFR 61.56(b), it is not necessary to segregate the waste for disposal (10 CFR 61.55[a][2][i]).

[2] Class B waste is waste that must meet more rigorous requirements on waste form to ensure stability after disposal. The physical form and characteristics of Class B waste must meet both the minimum and stability requirements set forth in 10 CFR 61.56 (10 CFR 61.55[a][2][ii]).

[3] Class C waste is waste that not only must meet more rigorous requirements on waste form to ensure stability but also requires additional measures at the disposal facility to protect against inadvertent intrusion. The physical form and characteristics of Class C waste must meet both the minimum and stability requirements set forth in 10 CFR Section 61.56 (10 CFR 61.55[a][2][iii]).

to 15,887,390 persons-hour for the time worked (T) is obtained. If similar labor requirements are required for UXO detection and removal, the total labor hours could exceed 133,000 person-hours, as shown in Appendix F.

Assuming an occupational exposure rate on the order of 15 μR/hr (some of the higher direct exposure rates measured during the characterization survey in the mid-1990s [SEG 1996]), the cost of the remediation worker dose ($Cost_{WDose}$) is equivalent to approximately $27 to $410,000.

The cost of the public dose during remediation is expected to be negligible due to the use of erosion/sediment controls, dust suppression, and personal protective equipment (PPE). In addition, the monetary cost of the dose to workers and the public is negligible relative to the total cost of remediation; thus, it was not calculated.

4.3.2.3 Nonradiological Workplace Accidents

The cost of the nonradiological workplace accidents ($Cost_{ACC}$) was evaluated using the following formula, Equation N-5 from NUREG-1757, Volume 2, Appendix N (NRC 2006a):

$$Cost_{ACC} = \$3{,}000{,}000 * F_{W*} T_A$$

Where:

$3,000,000	=	NRC's recommendation on the monetary value of a fatality equivalent to $2,000 per person rem
F_W	=	The workplace fatality rate in fatalities per hour worked (4.2×10^{-8} fatalities per worker hour)
T_A	=	The worker time required for remediation in units of worker-hours.

In Table N.2 of NUREG-1757, Volume 2, Appendix N (NRC 2006a), the acceptable parameter value of 1.62 person-hour/m^3 is suggested for use in ALARA analyses for excavation, monitoring, packaging, and handling of soil. Multiplying this factor with the range of excavation volumes of soil approximately 647 m^3 to 9,807,031 m^3, a range from 1,048 to 15,887,390 persons-hour for the worker time (T_A) is obtained. The costs calculated for the nonradiological workplace accidents ($Cost_{ACC}$) range from $130 to $2,000,000; however, it should be noted that this equation was not developed with explosive safety hazards in mind. The estimated cost of nonradiological workplace accidents could be substantially higher when incorporating the explosive safety hazard into workplace fatality rate.

4.3.2.4 Nonradiological Transportation Risk

The cost of transportation risks from fatalities ($Cost_{TF}$) incurred during transportation was evaluated using Equation N-6 from NUREG-1757, Appendix N (NRC 2006a):

$$Cost_{TF} = \$3{,}000{,}000 * \frac{V_A}{V_{Ship}} * F_T * D_T$$

Where:

$3,000,000	=	NRC's recommendation on monetary value of a fatality equivalent to $2,000 person rem
V_A	=	The volume of material in units of cubic meters (m^3)
F_T	=	The fatality rate per vehicle-kilometer (km) traveled in units of fatalities per vehicle-km (6.3×10^{-7} fatalities/rail car-km was calculated based on the

Federal Railroad Administration, Office of Safety Analysis, "Accident/Incident Overview, January February, 2013," total fatal accidents/incidents)

D_T = The distance traveled in km

V_{Ship} = The volume of vehicle shipment in cubic meters (m^3).

Transportation of DU-contaminated soil using the railway system from JPG to the potential disposal site in Clive, Utah could pose risks to the public. The number of shipments depends on the remediation criteria, volume of contaminated soil excavated, and mass of penetrators/fragments recovered. The volume of waste to be transported (V_A) ranges from approximately 647 to 9,807,031 m^3, which accounts for the volumes associated with the low-end and the high-end scenarios, respectively. The projected travel distance from JPG to the disposal facility (D_T) is approximately 1,750 mi (2,816.35 km). With a conservative rail car capacity of 55 m^3 and an estimate of 20 rail cars per shipment, the volume of vehicle shipment (V_{Ship}) is 1,100 m^3. An estimate of the nonradiological transportation risk ($Cost_{TF}$) was developed and the monetary value ranges from $3,100 to $47 million.

4.3.2.5 Environmental Degradation

Environmental degradation would result if UXO and DU detection and removal were implemented. The environmental degradation would be the result of tree and brush removal, soil disturbance in the DU Impact Area and the banks of Big Creek, and soil erosion. In the short-term, the habitat would be destroyed and the terrain modified as a result of remediation. With appropriate mitigative measures (e.g., soil erosion controls, site restoration) and allowance of time, the site would be restored, thereby likely resulting in no permanent environmental degradation costs. Therefore, no irreversible and irretrievable loss in environmental resources in the long-term is expected.

UXO and DU detection and removal also would require formal consultation with FWS to determine potential impacts and associated mitigation measures for federally threatened and endangered species such as the Indiana bat. Typical mitigation for this species includes limiting remediation during the roosting season. The total ALARA cost for the major elements of remediation of the DU Impact Area to meet requirements for unrestricted use are presented in Table 4-9. As noted in the discussion above, the ALARA costs are dominated by the direct costs for detection, removal, and disposition of the UXO and the DU-contaminated soil and penetrators/fragments.

Table 4-9. Summary of Major Cost Elements of License Termination for Unrestricted Use Jefferson Proving Ground, Madison, Indiana

Remediation Activity	Estimate ($)
UXO and DU Remediation Cost[a]	2,500,000-11,000,000,000
Occupational and Public Radiological Exposure	27-410,000
Occupational Nonradiological Risk	130-2,000,000
Nonradiological Transportation Risk	3,100-47,000,000
Environmental Degradation	0[b]
Total[c]	2,500,000-11,000,000,000

[a] Cost breakdown is presented in Table 4-2.
[b] No environmental degradation costs are anticipated over the long-term.
[c] Total cost is rounded to two significant figures.

4.3.3 ALARA Analysis of Residual Radioactivity

The purpose of this analysis is to 1) demonstrate that the residual radioactivity that will remain in place under the Proposed Action are ALARA, and 2) demonstrate initial eligibility for restricted use license termination. The intent of the calculation below is to illustrate that additional remediation should

not be performed to further reduce the TEDE to the average member of the critical group below applicable current levels as defined in Tables 4-1 and 4-2 for restricted release and that further reductions in the residual radioactivity would be prohibitively expensive as defined in Table N.4 of NUREG 1757, Volume 2 (NRC 2006a).

The ALARA concentration of residual radioactivity (Conc) is that for which the benefit associated with additional remediation equals the cost of the remedial effort. Equation N-8 from Appendix N, NUREG-1757, Volume 2 (NRC 2006a), can be applied as a ratio of soil concentrations to $DCGL_W$:

$$\frac{Conc}{DCGL_W} = \frac{Cost_T}{\$2{,}000 * P_D * 0.025 * F * A} * \frac{r + \lambda}{1 - e^{-(r+\lambda)N}}$$

Where:

Conc	=	The average concentration of residual radioactivity in the area being evaluated (picoCuries per gram [pCi/g])
$DCGL_W$	=	DCGL equivalent to the average concentration of residual radioactivity per unit volume (pCi/g)
$Cost_T$	=	The total estimated cost (minimum value of $2,500,000)
r	=	Monetary discount rate (0.03 for soil given in Table N.2, Appendix N, NUREG 1757 [NRC 2006a])
λ	=	Radiological decay constant for the radionuclide (1.55×10^{-10}/year) assumed to be predominantly U-238
P_D	=	Population density (0.0004 persons/m^2 given in Table N.2, Appendix N, NUREG 1757 [NRC 2006a])
F	=	Fraction of the residual radioactivity removed by the remediation action (0.07 – assuming the 5% of the source term could be removed during the remediation to achieve the 25 mrems/year criterion)
A	=	Area being evaluated (minimum impacted area 500 ac [2,023,413 m^2])
N	=	The number of years over which the collective dose will be evaluated (1,000 year for soil).

The ratio is in effect a cost-benefit ratio; therefore, a ratio greater than 1 indicates that the costs associated with additional remediation exceed the benefit to be realized by the remediation. In order to demonstrate that further reduction of the residual radioactivity is prohibitively expensive, the following equation substitutes a value of $20,000 per person-rem in place of the $2,000 per person-rem in the above equation as discussed in Section N.4, Appendix N, NUREG 1757 (NRC 2006a).

$$\frac{Conc}{DCGL_W} = \frac{\$2{,}500{,}000}{\$20{,}000 * 0.0004 * 0.025 * 0.05 * 2{,}023{,}413} * \frac{0.03 + 1.55\,E - 10}{1 - e^{-(0.03+1.55E-10)*1{,}000}}$$

$$\frac{Conc}{DCGL_W} = 3.66$$

Because the ratio of 3.7 is greater than 1, the conclusion is that the soil DCGL is ALARA and further action to reduce the residual radioactivity is considered prohibitively expensive.

The above calculation is considered to be a conservative estimate, based on the use of the low-range estimates for UXO and DU remediation in Table 4-5. If 100 percent of the residual radioactivity (i.e., 162,040 pounds [lb] [73,500 kilograms {kg}] of DU source term) were removed from the 500 ac (2 km^2) in the DU Impact Area, a ratio of 816 is determined using the conservative total cost estimate of $11,000,000,000 in Table 4-7.

4.3.4 Method for Showing Compliance With ALARA at the Time of License Termination

The Proposed Action for license termination will not generate any additional information to refine the ALARA analysis presented in this section. Furthermore, it has been demonstrated that further reduction of the residual radioactivity using even the most conservative UXO and DU remediation scenario are prohibitively expensive. Based on these considerations, no additional analysis is planned in support of license termination.

4.3.5 UXO and DU Remediation Cost Uncertainty Discussion

There is uncertainty about the cost of remediation of UXO and DU within a portion of the DU Impact Area. This uncertainty is the result of several factors, the major factors of which include the following:

- Remaining site characterization uncertainties are the variability in depth of transport of the corrosion products under the penetrators and the spatial distributions of the penetrators outside the lines of fire.
- The remaining DU penetrators, fragments, and associated corrosion products are not uniformly distributed across the DU Impact Area. The DU remediation area and volume estimates are conservative and assume a uniform distribution as was required for the residual dose modeling (Yu et al. 2007). In reality, DU remediation within the DU Impact Area would focus on hot spot removal from large numbers of locations across the site.
- Large area(s) surrounding the DU remediation areas would be required for staging contaminated and clean fill soil and must be cleared of UXO before DU decontamination could occur. The number and overall sizes of these areas could significantly increase if the DU remediation requires more localized removals that are spatially distributed across the site.
- The effectiveness of soil sorting and radiological scanning is heavily influenced by the soil types to be treated. For cost estimating purposes, it is assumed that volume reduction rates of 70 to 95 percent could be obtained by implementing soil sorting. Lower volume reduction rates have resulted for the clay and silt soil types present in the DU Impact Area. A pilot study would be required to determine the predicted volume reduction rates for the DU Impact Area.
- The unit cost ($/acre) for UXO detection, removal, and disposition is uncertain because of the types, depths, and quantities of UXO remaining within the distinct areas requiring DU remediation. In addition, the specific means of disposal of the UXO (e.g., in-place destruction, consolidated shots, use of armored and/or remotely controlled equipment) could add significantly to the cost considering the immense quantities of UXO present in the DU Impact Area.
- The unit costs for transportation and disposal of contaminated soil could vary significantly depending on the quantities to be disposed of and the location of the disposal facility.

5. PLANNED DECOMMISSIONING ACTIVITIES

Because license termination under restricted conditions is anticipated, no decommissioning tasks (i.e., depleted uranium [DU] remediation activities) are envisioned. Therefore, no related tasks will be implemented. The Army will continue to maintain institutional control of the area north of the firing line, which includes the DU Impact Area. Institutional controls that already have been implemented by the Army include physical access restrictions (e.g., pad locked metal swing gates, warning signs, the perimeter chain-link fence) to prevent unauthorized entry into areas north of the firing line. Institutional controls also include legal (e.g., Army retains ownership of all of the Jefferson Proving Ground [JPG] property north of the firing line) and administrative (e.g., hunting prohibitions) controls over the DU Impact Area. The specific institutional controls to be implemented by the Army include (U.S. Army 2000a):

- The Army, as an agency of the Federal Government, is an enduring entity. The Army will retain title to the DU Impact Area property and the surrounding area "in caretaker status until transfer by encumbered title is feasible." "The Army will not transfer fee title or other property interests in the Firing Range without consulting with the FWS and Air Force. If in the future the Firing Range is determined suitable for transfer, the Army shall, to the extent legally authorized, provide the FWS and Air Force the right of first refusal on their respective property interests before conveying any poperty interests. If the Air Force no longer requires use of the Bombing Range and the property is no longer needed for other military purposes, the Army will offer the FWS a real estate permit for the Bombing Range subject to the same terms of this agreement or any other mutually agreeable terms" (U.S. Army 2000a).
- Access to the approximately 50,950 acres (ac) (206 square kilometers [km^2]) north of the firing line is and will continue to be restricted by a fence, topped with barbed wire, around the entire area and warning signs will continue to be posted along the fence line and at vehicle access points. No demolition, excavation, digging, drilling, or other disturbance of the soil, ground, or groundwater, or use of soil, ground, or groundwater for any purpose will be permitted without written approval of the Army. Public access will only be allowed in selected areas that do not have higher concentrations of unexploded ordnance (UXO). These select areas primarily are along the inside of the perimeter fence and on the northern portion of JPG. When public access is allowed, the visitors will receive an annual safety briefing on the hazards and will be required to sign a statement acknowledging the hazard and agreeing to hold the Army harmless.
- In 1995, the Army retroceded exclusive jurisdiction over JPG to the State of Indiana (U.S. Army 1995b). Under the Public Access Plan for the Big Oaks National Wildlife Refuge (NWR) (FWS 2012), the U.S. Fish and Wildlife Service (FWS), in consultation with the Indiana Air National Guard (INANG) for the U.S. Air Force (USAF), developed and coordinated law enforcement strategies to enforce refuge and bombing range trespasses and other public use violations.
- Additional access controls are applied to signs around the perimeter stating, "No Trespassing." Key access for entering the area north of the firing line is limited to personnel formally authorized by the Army. Quarterly lock and key inventories are conducted.
- The Army may authorize permits for other U.S. Government agencies to use the land, but such permits will require compliance with all of the controls listed above and maintenance requirements listed in the Memorandum of Agreement (MOA) (U.S. Army 2000a) and associated permits. At the present time, the Army has an agreement with FWS for management of the Big Oaks NWR (50,950 ac; 206 km^2) and with USAF for use of portions (1,038 ac; 4 km^2) of JPG north of the firing line as bombing ranges and responsibility for the Old Timbers' Lodge and surrounding 5 ac (0.020 km^2) (U.S. Army 2000a). Although "the Army will

maintain and secure the property while in caretaker status" (U.S. Army 1995b), and will take appropriate corrective action in the event of noncompliance with requirements of the MOA and/or permits, consistent with U.S. Nuclear Regulatory Commission (NRC) guidance, formal 5-year reviews will not be required.

- Records of all Public Access Public Permits will be tracked by permit number. An annual database will be maintained that records the individual permit information (e.g., name, address, date of safety briefing, etc.) for the areas north of the firing line and will be maintained by the Federal authority (the Army or an Army-permitted Federal authority) granting access to the area. The Army also will maintain a record of its review of the effectiveness of the institutional controls (U.S. Army 2000a).

These institutional controls are planned to remain in place for the foreseeable future because of the presence of, and hazards associated with UXO.

6. CURRENT PROJECT MANAGEMENT AND ORGANIZATION

This section identifies the project management and task organization within the Army that is responsible for license termination of U.S. Nuclear Regulatory Commission (NRC) Materials License SUB-1435 (Sections 6.1 and 6.2) for Jefferson Proving Ground (JPG). In addition, the key positions within this organizational structure and their respective qualifications are described in Section 6.3. The responsibilities for the Army's License Radiation Safety Officer (LRSO) are defined in Section 6.4. Related training and contractor support are identified in Sections 6.5 and 6.6, respectively.

6.1 DECOMMISSIONING MANAGEMENT ORGANIZATION

The key organizations currently supporting the license termination process consist of the U.S. Army Installation Management Command (IMCOM); U.S. Army Corps of Engineers (USACE), Louisville District; U.S. Army Public Health Command (PHC), formerly the U.S. Army Center for Health Promotion and Preventive Medicine (USACHPPM); Los Alamos National Laboratory (LANL); and stakeholders. Each of these organizations is described in Sections 6.1.1 through 6.1.4, respectively. The reporting hierarchy is addressed in Section 6.1.5.

6.1.1 Army Installation Management Command

IMCOM's mission is to "synchronize, integrate, and deliver installation services and sustain facilities in support of Senior Commanders in order to enable a ready and resilient Army" (see http://www.imcom.army.mil/). To accomplish this mission, IMCOM is organized so that individual installation garrisons report to IMCOM Headquarters in San Antonio, Texas. The IMCOM Commander also serves as the Assistant Chief of Staff for Installation Management (ACSIM), providing "policy formulation, strategy development, enterprise integration, program analysis and integration, requirements and resource determination, and best business practices for services, programs, and installation support to Soldiers, Families, and Civilians of an expeditionary Army in a time of persistent conflict."

Installation support functions for JPG are provided by U.S. Army Garrison, Rock Island Arsenal (USAG-RIA) with radiation safety support for NRC Materials License SUB-1435 currently being provided to USAG-RIA by the IMCOM Radiation Safety Staff Officer (RSSO). USAG-RIA is responsible for completion of the license termination process; identification and management of resources to complete the process; and implementation of corrective action, as appropriate and necessary. It also specifically includes coordination of the license termination process with NRC Headquarters; NRC Region III; and other Federal and state agencies, such as the U.S. Environmental Protection Agency (USEPA) Region 5, U.S. Fish and Wildlife Service (FWS), U.S. Air Force (USAF), Indiana Air National Guard (INANG), and Indiana Department of Environmental Management (IDEM). IMCOM also coordinates with PHC on health physics and radiological health issues, including radiochemical analysis.

IMCOM regards safety as being the responsibility of all participants in the license termination process. Concerns and corrective actions regarding the license termination process at JPG are resolved through IMCOM.

6.1.2 U.S. Army Corps of Engineers, Louisville District

The U.S. Army Corps of Engineers (USACE), Louisville District's mission is to provide engineering services to its civil and military customers within the times, budgets, and guidelines established by the Corps. The USACE environmental program, in turn, is dedicated to building a strong, sustainable environment for future generations. To accomplish these missions at JPG, the Louisville District provides support to USAG-RIA using both organic assets and contracted resources to execute a comprehensive program to ensure that residual site conditions are protective of human health and the environment. Efforts contracted and managed by the USACE, Louisville District in support of JPG

include architect/engineering support provided by Science Applications International Corporation (SAIC) and independent technical review assistance provided by staff from LANL.

6.1.3 Army Public Health Command

PHC (formerly USACHPPM) is a major subordinate element of the Army Medical Command. Its mission is to "promote health and prevent disease, injury, and disability of Soldiers and military retirees, their Families, and Department of the Army civilian employees; and assure effective execution of full spectrum veterinary service for Army and Department of Defense Veterinary missions" (see http://phc.amedd.army.mil/organization/Pages/default.aspx). The Army Institute of Public Health, a major element of PHC, provides a full suite of public health services and mission capabilities through a number of technical "Portfolios" and "Programs." Included in the Occupational Health Portfolio is the Health Physics Program (HPP), which has supported the JPG license termination process, including preparation of earlier versions of the Decommissioning Plan and conducting the monitoring and sampling program for the Depleted Uranium (DU) Impact Area at JPG. In addition to HPP support, PHC's Laboratory Sciences Portfolio has provided radiochemistry laboratory and related technical support to the HPP as well as directly to the JPG decommissioning project.

6.1.4 Los Alamos National Laboratory

LANL is a U.S. Department of Energy (DOE) laboratory, operated by the Los Alamos National Security, LLC for DOE's National Nuclear Security Administration (NNSA). "LANL's mission is to develop and apply science and technology to ensure the safety, security, and reliability to the U.S. nuclear deterrent; reduce global threats; and solve other emerging national security and energy challenges" (see http://www.lanl.gov/mission/index.php). LANL's Earth and Environmental Sciences Division has conducted initial studies, dose assessments, and modeling to support JPG decommissioning as well as technical review support for the Decommissioning Plan and Environmental Report.

6.1.5 Stakeholders

In accordance with NRC requirements found in 10 Code of Federal Regulations (CFR) Section 20, Part 1043(d), the Army conducted a public availability session for the public to provide input into potential institutional controls that may be used when JPG NRC Materials License SUB-1435 is terminated. Meetings were held at the Madison-Jefferson County Public Library, 420 East Main Street, Madison, Indiana at 7:00 p.m. on 28 October 2008 and 25 June 2009. Meetings also were held at the South Ripley Elementary School, Versailles, Indiana at 7:00 p.m. on 29 October 2008 and 24 June 2009 and at Jennings County Library, North Vernon, Indiana at 7:00 p.m. on 30 October 2008 and 23 June 2009. A total of five local citizens attended the October 2008 meetings (three in Madison, none in Versailles, and two in North Vernon). A total of 33 local citizens attended the June 2009 meetings (4 in North Vernon, 11 in Versailles, and 18 in Madison). Prior to the meetings, the Army published notices in the *Madison Courier*, *North Vernon Plain Dealer*, *Versailles Republican*, *Indianapolis Star*, *Louisville Courier Journal*, and *Cincinnati Enquirer*. Additional details about these meetings are provided in Section 13.4.

One of the more active organizations participating in the license termination process is Save the Valley (STV), a nonprofit volunteer organization for the protection of air, water, and land in the Valley of the Ohio River between Lawrenceburg, Indiana, and Louisville, Kentucky. STV represents environmental and public interests before regulatory agencies, and at all levels of the court system, and has been involved in the JPG decision making process.

6.1.6 Lines of Authority

As the NRC licensee, IMCOM's USAG-RIA has responsibility for oversight, development, and execution of the license termination process and the authority to assign and manage resources within its

command to this project. As Figure 6-1 indicates, USAG-RIA reports to IMCOM. Notably, the IMCOM commander also serves as the Army's ACSIM. LANL and contractors provide support through the USACE, Louisville District to USAG-RIA while the APHC reports directly to USAG-RIA staff when their technical support is required.

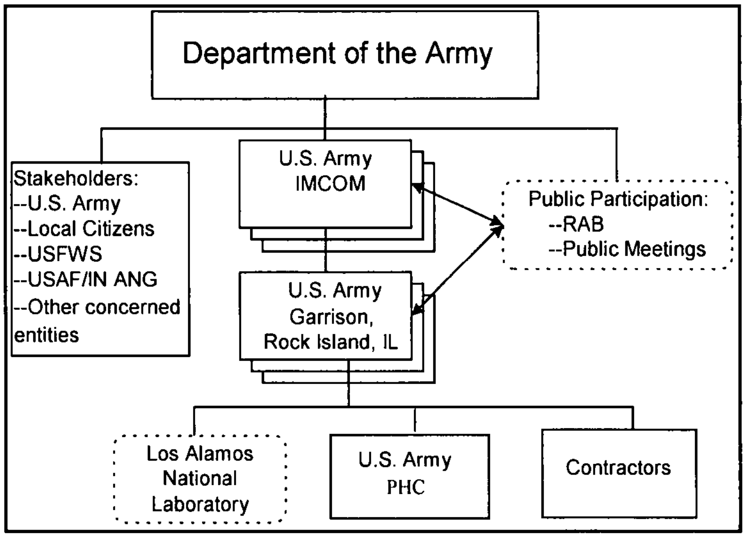


Figure 6-1. Current Chain-of-Command for the License Termination Process at Jefferson Proving Ground Within the U.S. Department of the Army

6.2 DECOMMISSIONING TASK MANAGEMENT

As the NRC licensee, USAG-RIA is responsible for managing the development of the Decommissioning Plan and Environmental Report for termination of NRC Materials License SUB-1435. USAG-RIA is supported in their license termination efforts by others, including the ACSIM-Base Realignment and Closure (BRAC) and USACE, Louisville District. USACE, Louisville District assistance includes support provided by both LANL and SAIC.

Because license termination under restricted conditions is anticipated, decommissioning tasks are limited to ensuring continued implementation and effectiveness of institutional controls and periodic reviews and updates of the Memorandum of Agreement (MOA) and associated permits involving the Army, USAF, and FWS. As remediation of residual DU is not proposed, related decommissioning tasks will not be implemented.

6.3 DECOMMISSIONING MANAGEMENT POSITIONS AND QUALIFICATIONS

The roles and responsibilities of key organizations and key positions within these organizations that support the license termination process are described briefly in this section. Table 6-1 lists the key organizations, positions, and contact information.

6.3.1 IMCOM

Key positions within the Army's IMCOM include the USAG-RIA Garrison Commander and the LRSO for NRC Materials License SUB-1435. The LRSO coordinates and addresses radiation safety issues. This individual also reviews monitoring data; conducts annual reviews and/or audits of site activities or related policies; and recommends corrective actions, as required, to the USAG-RIA Garrison Commander.

Table 6-1. Current Key Organizations, Positions, and Contact Information for the License Termination Process Jefferson Proving Ground, Madison, Indiana

Organization	Position	Contact Information
HQDA (ACSIM)	BRAC Program Manager	Dr. Thomas A. Lineer (703) 545-2487 Thomas.A.Lineer.civ@mail.mil
HQDA (ASO)	Army Radiation Safety Officer	Mr. Gregory Komp (703) 601-2405 Gregory.R.Komp.civ@mail.mil
IMCOM	Radiation Safety Staff Officer/JPG License Radiation Safety Officer	Dr. Robert N. Cherry (210) 466-0368 Robert.N.Cherry.civ@mail.mil
USAG-RIA	Garrison Commander	COL Elmer Speights, Jr. (706) 545-7751 Elmer.Speights3.mil@mail.mil
HQDA (ACSIM)	BRAC Environmental Coordinator	Mr. John J. Germano (812) 256-7314 John.J.Germano.civ@mail.mil
PHC	Health Physics Program Manager	COL John P. Cuellar (410) 436-3502 John.P.Cuellar.mil@mail.mil
LANL Earth and Environmental Sciences Division	Principal Investigator	Dr. Jeffrey M. Heikoop (505) 667-8128 JHeikoop@lanl.gov

BRAC = Base Realignment and Closure
HQDA (ACSIM) = Headquarters, Department of the Army, Assistant Chief of Staff for Installation Management
HQDA (ASO) = Headquarters, Department of the Army, Army Safety Office
IMCOM = Installation Management Command
LANL = Los Alamos National Laboratory
PHC = Public Health Command
USAG-RIA = U.S. Army Garrison, Rock Island Arsenal

The USAG-RIA Garrison Commander manages environmental restoration activities at the installation and is responsible for identifying BRAC closure requirements and implementing related measures to ensure the site closeout process is achieved.

6.3.2 PHC

The Program Manager of the HPP is the overall lead for PHC's support to IMCOM. This individual previously was responsible for project planning, control, monitoring, and completion of all technical deliverables. In addition, PHCs Laboratory Sciences Portfolio has provided radiochemistry laboratory support to the HPP as well as directly to the JPG decommissioning project.

6.3.3 LANL

Principal investigators from LANL's Earth and Environmental Sciences Division have provided support in leading and conducting modeling and dose assessments in support of license termination.

6.3.4 USAF

USAF is operating through INANG an approximately 50-acre (ac) (0.20-square kilometer [km^2]) Precision-Guided Munitions (PGM) Range, a 983-ac (4.0 km^2) conventional air-to-ground bombing and strafing range, and the Old Timbers Lodge and surrounding 5 ac (0.020 km^2) in accordance with the MOA (U.S. Army 2000a). Under the provisions of this agreement, USAF is responsible for infrastructure maintenance requirements and must adhere to certain restrictions on its activities relative to the DU Impact Area. Section V of the MOA details current "Air Force Responsibilities," which are subject to

modification or termination pursuant to Section VIII of the MOA. Consistent with "Enclosure 5 – FWS/Air Force Infrastructure Maintenance Responsibilities," USAF responsibilities currently include:

- Maintenance of all roads, road shoulders, and low water crossing, as well as associated bridges and culverts as specifically identified in the MOA
- Patrolling and inspecting the perimeter fence on a weekly basis and making designated repairs and maintaining the perimeter fence and related infrastructure, including warning signs
- Mowing or otherwise controlling vegetation within the area between the perimeter fence and perimeter road
- Maintaining warning signs around the entire perimeter of the firing range as well as around the submunitions area west of Machine Gun Road and the former Open Detonation Area
- Maintenance of cultural resource properties of the Firing Range (i.e., four stone-arch bridges and the Old Timbers Lodge).

6.3.5 FWS

FWS established and is managing the Big Oaks National Wildlife Refuge (NWR) in accordance with the MOA (U.S. Army 2000a). Under the provisions of this agreement, FWS is responsible for infrastructure maintenance requirements and must adhere to certain restrictions on its activities relative to the DU Impact Area. Section IV of the MOA details current "FWS Responsibilities," which are subject to modification or termination pursuant to Section VIII of the MOA. Consistent with "Enclosure 5 – FWS/ Air Force Infrastructure Maintenance Responsibilities," FWS responsibilities currently include:

- Maintenance of all buildings, roads, road shoulders, bridges, low water crossings, and culverts not maintained by USAF, which are required for NWR operations (these requirements are updated annually by FWS to reflect their maintenance commitment for the next year)
- Providing access control signs on the east perimeter road between Gate 1B and K Road as well as the minefield area on L Road
- Road maintenance sufficient for four-wheel drive vehicles to access DU monitoring wells
- Providing, negotiating, or funding of fire suppression, emergency medical response, and local law enforcement agreements
- Payment of a pro-rated share of rent paid for use of Building 125.

6.4 RADIATION SAFETY OFFICER

The Headquarters (HQ) IMCOM RSSO currently also serves as the LRSO for USAG-RIA's NRC Materials License SUB-1435. In this capacity, the LRSO provides technical and programmatic health physics support to the USAG-RIA garrison commander for the purposes of NRC Materials License SUB-1435 and this Decommissioning Plan.

6.5 TRAINING

The Army has provided training materials and initial unexploded ordnance (UXO) and DU safety training to FWS and INANG personnel. After this initial training, FWS and INANG are responsible for training their personnel and visitors in accordance with the requirements of the Radiation Safety Plan for the JPG DU Impact Area (U.S. Army 2013c). FWS has developed a comprehensive public access plan that includes safety training and related protocols and reporting requirements (FWS 2001 a,b,c).

6.6 CONTRACTOR SUPPORT

Contractors are used to support the license termination process. Among the contractors is SAIC, who prepared this Decommissioning Plan and the Environmental Report for this project. Contractors accessing the DU Impact Area will be provided site training and will report to IMCOM. Contractors working onsite must comply with NRC regulations and applicable license requirements.

7. RADIATION SAFETY AND HEALTH PROGRAM DURING DECOMMISSIONING

Remediation of the Depleted Uranium (DU) Impact Area is not planned for license termination under restricted release criteria. Therefore, a radiation safety and health plan for remediation is not required.

The Army requires implementation of a health and safety plan for the Environmental Radiation Monitoring (ERM) program currently in effect (U.S. Army 2000b). In addition, the Army requires implementation of safety protocol and briefings to all visitors and workers who access the area north of the firing line. Additional details on these requirements are provided in the Radiation Safety Plan for the Jefferson Proving Ground (JPG) DU Impact Area (U.S. Army 2013c).

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8. ENVIRONMENTAL MONITORING AND CONTROL PROGRAM

With license termination under restricted release criteria, the Memorandum of Agreement (MOA) (U.S. Army 2000a) between the U.S. Army, U.S. Air Force (USAF), and U.S. Fish and Wildlife Service (FWS) will be continued. Physical access controls and restrictions (e.g., pad locked metal swing gates, perimeter warning signs and the perimeter chain-link fence) will continue to be implemented to prevent unauthorized entry into areas north of the firing line. The prevention of unauthorized access to areas north of the firing line, which includes the Depleted Uranium (DU) Impact Area, serves to ensure that doses to the general public and occupational doses will be maintained as low as reasonably achievable (ALARA) pursuant to Title 10, Code of Federal Regulations (CFR) Part 20.

Results of comprehensive scientific studies and the associated analysis (e.g., DU corrosion investigations, fate and transport assessments, residual radiation dose analysis, and partition coefficient [K_d] studies) clearly demonstrate the lack of a potential hazard from residual Army DU at JPG. In addition, it is noted that data from the Environmental Radiation Monitoring (ERM) program (U.S. Army 2000b) since 1983 indicate that DU contamination is confined to the DU Impact Area and has not migrated offsite (U.S. Army 2013b). Given the lack of a significant hazard to human health and the environment from the offsite migration of DU, the Army proposes to terminate the current semi-annual environmental monitoring program concurrent with termination of Jefferson Proving Ground's (JPG's) Nuclear Regulatory Commission (NRC) Materials License SUB-1435.

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9. RADIOACTIVE WASTE MANAGEMENT PROGRAM

Remediation of the Depleted Uranium (DU) Impact Area is not planned for license termination under restricted release criteria. Therefore, radioactive waste will not be generated or managed.

In the event that a DU penetrator is encountered, personnel are advised to notify supporting Army explosive ordnance disposal (EOD) or other designated personnel for proper retrieval and waste disposal through the U.S. Department of Defense (DOD) Executive Agency for Radioactive Waste at U.S. Army Garrison, Rock Island Arsenal (USAG-RIA), Illinois and comply with all other applicable requirements in the Radiation Safety Plan for the Jefferson Proving Ground (JPG) Depleted Uranium (DU) Impact Area (U.S. Army 2013b).

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10. QUALITY ASSURANCE PROGRAM

Remediation of the Depleted Uranium (DU) Impact Area is not planned for license termination under restricted release criteria. Therefore, a quality assurance (QA) program for remediation is not required.

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11. FACILITY RADIATION SURVEY

Scoping and characterization surveys were completed in 1994 and 1995 (SEG 1995a, 1996). Additional site characterization was conducted between 2006 and 2013. The purpose of the surveys and additional site characterization (Section 3) was to identify the specific areas within Jefferson Proving Ground (JPG) that are contaminated with depleted uranium (DU) and obtain site-specific data to be utilized in determining the future potential migration of the DU at JPG. These surveys effectively identified DU contamination, but residual radiation doses fall below criteria set forth for restricted conditions in 10 Code of Federal Regulations (CFR) Part 20, Section 1403. Given that remediation of the DU Impact Area is not planned for license termination under restricted release criteria, no additional radiation surveys are needed or planned.

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12. FINANCIAL ASSURANCE

This section includes the annual costs for site control and maintenance after license termination (Section 12.1), information regarding certification requirements (Section 12.2), and the Army's intent to request funding to ensure compliance with restricted release license termination (Section 12.3).

12.1 COST ESTIMATE

The cost estimate described below is developed for control and maintenance of the site because the Army is proposing institutional controls that involve access and land use restrictions for the area north of the firing line, in general, because of the potential unexploded ordnance (UXO) hazards. The cost estimate does not include costs for dismantlement, remediation, or other decommissioning-related costs because such activities are not necessary based on the residual radiation dose analysis results presented previously in Section 4. Nor does the cost estimate include U.S. Nuclear Regulatory Commission (NRC) oversight fees because such fees would not be required following termination of NRC Materials License SUB-1435.

The Army expects to incur approximately $268,000 annually for implementing institutional controls at Jefferson Proving Ground (JPG), as detailed in Appendix F. The factors included in this total cost are listed in Table 12-1. The annual institutional control costs were generated using vendor information and rates from Remedial Action Cost Engineering and Requirements (RACER™) version 11.1 (AECOM 2012) cost estimation software. These costs are assumed to be sufficient to allow an independent third party to assume responsibility for the institutional controls and associated maintenance activities at JPG. Please note that these are the costs if the Army needs to carry out the functions of the Memorandum of Agreement (MOA) (U.S. Army 2000a) in the event that both the Indiana Air National Guard (INANG) and U.S. Fish and Wildlife Service (FWS) decide to terminate their respective agreements in the MOA. If one or both agencies remain, the costs to the Army would decrease but the overall costs would remain the same.

Table 12-1. Estimated Annual Institutional Control Costs for JPG Jefferson Proving Ground, Madison, Indiana

Task/Activity/Component	Annual Cost ($)
Road Maintenance	27,000
Perimeter Mowing	26,000
Perimeter Fence Inspection	93,000
Fence Repair	32,000
Fence Sign Monitor/Replace	6,000
Mark-Up (11%)	20,000
Contingency (35%)	64,000
Total	**268,000**

Note: Costs were generated using vendor information and rates from RACER™ version 11.1 (AECOM 2012) cost estimation software.

The costs associated with maintaining institutional controls to protect against the remaining UXO hazards in areas north of the firing line include the perimeter fence inspection that would occur biweekly. Replacement of the entire installation security fence (55 miles [mi] [88 kilometer {km}] of 6-foot [ft] [2.11-meter {m}] chain-link fence topped with barbed wire surrounding the installation) may need to be completed periodically. When determined necessary, the Army will request appropriations from Congress to replace the perimeter fencing. The periodic replacement of the installation security fence was not included in the annual institutional control costs as it is unknown how often the fencing would need to be replaced for the foreseeable future and the pricing of the fencing at the time of replacement.

12.2 CERTIFICATION STATEMENT

Based on Title 10 Code of Federal Regulations (CFR) 40.36(e), Federal Government licensees must provide a certification of financial assurance for decommissioning that contains a cost estimate for decommissioning and indicates that funds for decommissioning will be obtained when necessary. Appendix D includes the Certification of Financial Assurance certifying that funding requests will be submitted annually for the purpose of implementing and maintaining institutional controls consistent with the requirements of 10 CFR Part 40 and 10 CFR Part 20, Subpart E. The duplicate signed originals of the fully executed Certification Statement will be forwarded to NRC.

12.3 FINANCIAL ASSURANCE MECHANISM

Pursuant to 10 CFR 20.1403(c), licensees requesting license termination under restricted conditions must provide financial assurance for site control and maintenance. As a Federal Government agency and enduring entity, the Army will satisfy the financial assurance requirement with a Statement of Intent (i.e., a commitment by a Federal Government licensee to request and obtain decommissioning funds from its funding body when necessary). The Antideficiency Act prohibits Federal employees from involving the Government in any obligation to pay money before funds have been appropriated for that purpose, unless otherwise allowed by law (31 United States Code [U.S.C.] Section 1341[a][1][B]). Since funding for the implementation of institutional controls extends beyond the period of Congressional appropriations signed into law to cover costs for site control and maintenance after termination of Materials License SUB-1435, the Statement of Intent allows the Army as a Federal licensee to fulfill the financial assurance requirements from 10 CFR 40.42(e). As required, the amount of this financial assurance covers all site control and maintenance costs and will be adjusted as necessary to cover the updated costs for maintaining the institutional controls over the 1,000-year period.

The U.S. Army Garrison, Rock Island Arsenal (USAG-RIA) has assumed responsibility for the management of the existing environmental monitoring program for Materials License SUB-1435 over the DU Impact Area and is the identified license holder for NRC Materials License SUB-1435 and will continue the oversight of the radiation safety program and NRC license until its termination and the foreseeable future. The Statement of Intent indicates that the Garrison Commander of USAG-RIA has the authority and responsibility to request funds for implementation and maintenance of institutional controls to ensure compliance with restricted release criteria as specified in 10 CFR 20.1403(b). Appendix D includes the Statement of Intent regarding funding requests. The duplicate signed originals of the fully executed Statement of Intent will be forwarded to NRC.

13. RESTRICTED USE CRITERIA

This section demonstrates that the Jefferson Proving Ground (JPG) Depleted Uranium (DU) Impact Area meets the requirements of Title 10 Code of Federal Regulations (CFR) Part 20, Section 1403 for restricted release license termination. Included in this discussion is the eligibility determination (Section 13.1), a discussion of institutional controls already in place to support this action (Section 13.2), site maintenance and financial assurance (Section 13.3), a discussion regarding the public advice the Army sought (Section 13.4), and a summary of dose modeling and as low as reasonably achievable (ALARA) demonstration (Section 13.5).

13.1 ELIGIBILITY DEMONSTRATION

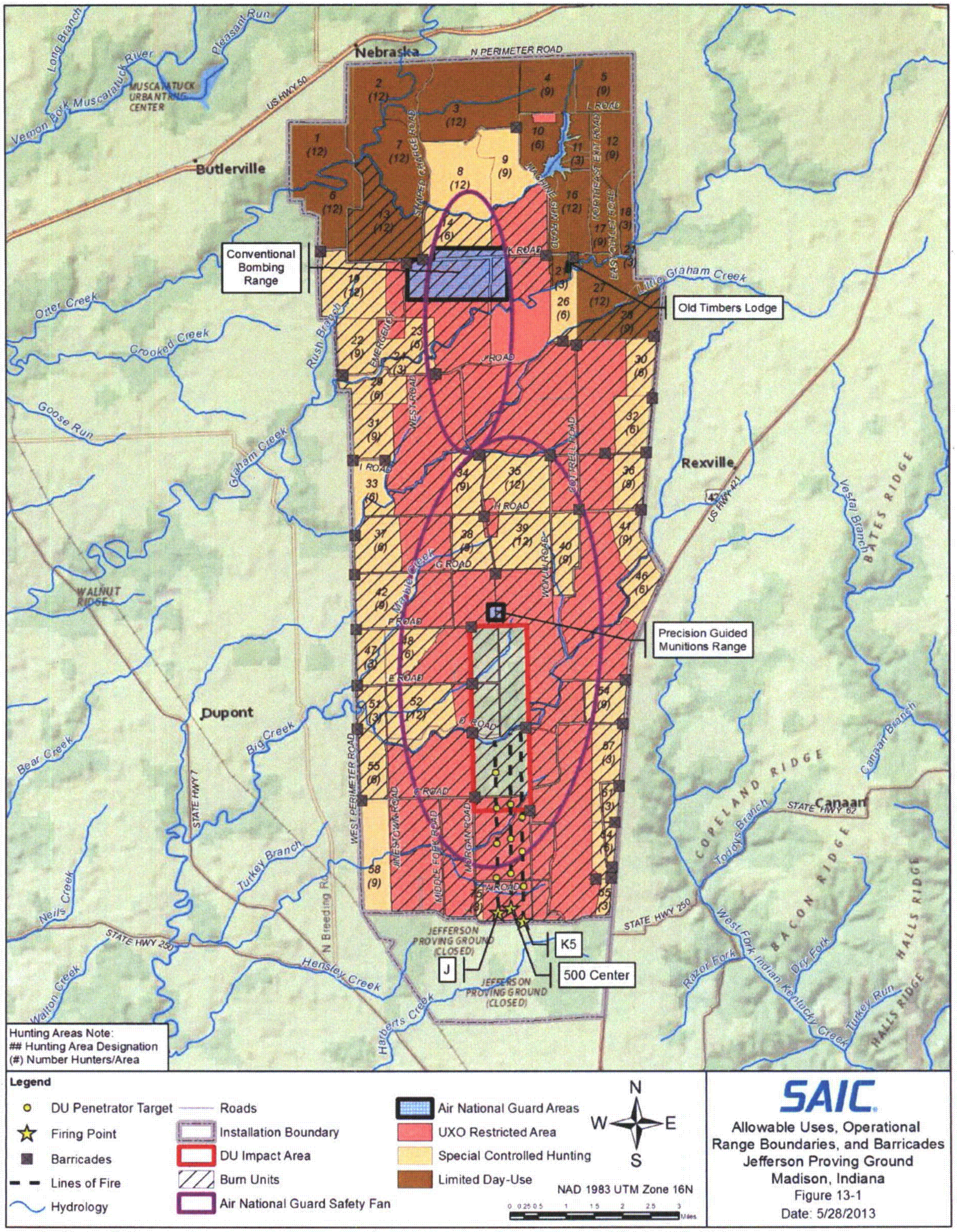
The ALARA analysis (Section 4.3) of this Decommissioning Plan demonstrates that the existing contamination levels are ALARA given that the costs of reducing the residual DU contamination intermixed with unexploded ordnance (UXO) are much higher than any accrued benefits. The ALARA analysis also concludes that UXO and DU decontamination activities necessary to remove residual DU and reduce residual radiation doses to average members of the critical group likely would result in net public or environmental harm, although no irreversible and irretrievable loss in environmental resources in the long-term is expected. The net public or environmental harm primarily is a result of the occupational hazards and the hazards of transporting contaminated soil to a distant disposal site. Furthermore, Section 4.3.4 demonstrates that further reduction of the residual radioactivity using even the least conservative UXO and DU remediation scenario, which represents the lowest remediation cost, are considered to be prohibitively expensive as defined in Section N.4 of U.S. Nuclear Regulatory Commission Regulation (NUREG)-1757, Volume 2 (NRC 2006a). Therefore, this analysis demonstrates that the Army is eligible to request release of the site under the provisions of 10 CFR 20.1403.

13.2 INSTITUTIONAL CONTROLS

UXO contamination is present on a large portion of the area north of the firing line, including the DU Impact Area (with an estimated 85 high-explosive rounds of UXO per acre (see the Environmental Impact Statement [EIS] [U.S. Army 1995a]), which includes DU contamination. In addition, portions of JPG are still being used for air to ground bombing practice using non-explosive bombs with spotting charges only by the Indiana Air National Guard (INANG) within the INANG's Jefferson Bombing Range. Figure 13-1 shows the general location of areas with UXO, the DU Impact Area, and the active bombing areas.

Because of the presence of UXO, DU, and the occasional bombing practice within Jefferson Range, access to and use of the area north of the firing line is restricted. Agricultural, residential, or industrial activities are not permitted. To control access to and use of the area north of the firing line, the Army has and will continue to use a variety of institutional controls. These institutional controls and the Army's permitting system for the U.S. Fish and Wildlife Service (FWS) and INANG are discussed. The specific institutional controls to be maintained by the Army after license termination include the following physical, legal, and administrative mechanisms:

- The Army as a Federal agency and enduring entity will retain title to the JPG property north of the firing line. The Army will control access to, and activities on, all of the JPG property north of the firing line. Access to the approximately 50,950 acres (ac) (206 square kilometers [km^2]) north of the firing line is and will continue to be restricted by a fence around the entire area. In accordance with the Memorandum of Agreement (MOA) (U.S. Army 2000a), INANG has the responsibility for maintaining the perimeter fence and overall security at JPG. "No Trespassing" and "Warning" signs are and will continue to be posted along the fence line. No demolition, excavation, digging, drilling, or other disturbance of the soil, ground, or


Conventional Bombing Range
Old Timbers Lodge
Precision Guided Munitions Range
K5
J
500 Center
Nebraska
Butlerville
Rexville
Dupont
Canaan
Hunting Areas Note:
Hunting Area Designation
(#) Number Hunters/Area
Legend
DU Penetrator Target
Firing Point
Barricades
Lines of Fire
Hydrology
Roads
Installation Boundary
DU Impact Area
Burn Units
Air National Guard Safety Fan
Air National Guard Areas
UXO Restricted Area
Special Controlled Hunting
Limited Day-Use
NAD 1983 UTM Zone 16N
SAIC
Allowable Uses, Operational Range Boundaries, and Barricades
Jefferson Proving Ground
Madison, Indiana
Figure 13-1
Date: 5/28/2013

groundwater, or use of soil, ground, or groundwater for any purpose will be permitted without written approval of the Army. General public access will not be allowed in the DU Impact Area because it contains and is entirely surrounded by UXO. Areas primarily along the inside of the perimeter and north of K Road (see Figure 13-1 for identified special controlled hunting and limited public access) will have limited, controlled, and documented public access. All visitors will receive a safety briefing on the hazards north of the firing line at JPG and will be required to sign a statement acknowledging the hazard and agreeing to hold the Army harmless.

- In 1995, the Army retroceded exclusive jurisdiction over JPG to the State of Indiana (U.S. Army 1995b). This enabled the State of Indiana and Federal Government to exercise concurrent jurisdiction (concurrent jurisdiction is the ability to exercise judicial review by different courts at the same time, within the same territory, and over the same subject matter) over this land area. The retrocession granted the State of Indiana the authority to enforce its laws for activities occurring at JPG.
- Under the Public Access Plan for the Big Oaks National Wildlife Refuge (NWR) (FWS 2012), FWS, in consultation with INANG, developed and coordinated law enforcement strategies to enforce refuge trespasses and other public use violations. Anyone who does not comply with safety regulations could forfeit his/her refuge access privileges as determined by the Big Oaks NWR Refuge Manager or by a court of law (FWS 2012). Enforcement of general trespass and other public use violations is the primary responsibility of the commissioned Refuge Law Enforcement Officers in cooperation with Indiana Conservation Officers and other law enforcement agencies, which are coordinated with INANG. FWS officials met with and established procedures for obtaining law enforcement assistance that varies based on the local legal jurisdiction. Current requirements for entry into the DU Impact Area for law enforcement are specified in the Radiation Safety Plan for the JPG DU Impact Area (U.S. Army 2013b). These requirements will be reviewed and updated, as needed, over time when law enforcement jurisdiction changes.
- Additional access controls are applied to signs around the perimeter stating, "No Trespassing." Key access for entering the area north of the firing line is limited to personnel formally authorized by the Army with distribution of keys being recorded on the Jefferson Range key control log. Quarterly inventories of locks and keys are conducted by INANG.
- The Army may authorize permits for other Federal Government agencies to use the land, but such permits will require compliance with all the controls listed above and maintenance requirements listed in this section of the plan. At the present time, the Army has an agreement with FWS for management of the Big Oaks NWR and with INANG for use of portions of the JPG as an air to ground bombing training range (U.S. Army 2000a). The Army will conduct inspections to ensure compliance with the terms of the permit, as appropriate. If violations of the permit conditions are identified, the Army retains the right to suspend the site activities of the other Government agencies until appropriate corrective action is taken.
- General records of public access for areas north of the firing line will be maintained by the Federal authority (Army or an Army-permitted Federal or state authority [INANG]) granting access to the area. Due to privacy and security access issues, the type of information collected will be limited and not maintained in an electronic database.

These institutional controls are planned to remain in place for the foreseeable future because of the presence of, and hazards associated with UXO.

13.3 SITE MAINTENANCE AND FINANCIAL ASSURANCE

As described in the previous section, the Army, or its permitted Federal or state agencies, will patrol and inspect the perimeter fence. The inspections will be documented to show the inspection date, inspector, and location of any fence damage. The Army, or its permitted Federal or state agencies, will repair any damage to the perimeter fence.

The Army, or its permitted Federal or state agencies, also will maintain access control signs at specified locations identified in the MOA (U.S. Army 2000a). The Army, or its permitted Federal or state agencies, will maintain the locked gates on the entire perimeter fence north of the firing line.

The Army has committed to request funding for site control and maintenance of institutional controls necessary after restricted release license termination. This commitment is presented in Appendix D of this Decommissioning Plan.

13.4 OBTAINING PUBLIC ADVICE

In accordance with Nuclear Regulatory Commission (NRC) requirements in 10 CFR 20.1403(d), the Army sought advice from the public to provide for institutional controls following restricted release termination of the Army's NRC Materials License SUB-1435. Section 13.4.1 summarizes the input provided by the public between 1997 and 2002. Section 13.4.2 summarizes input provided by the public in October 2008 and June 2009.

13.4.1 Public Advice Provided Between 1997 and 2002

The Army solicited local input when it planned and implemented cleanup and management activities at JPG. In 1994, the Army established the Restoration Advisory Board (RAB) as a voluntary advisory group. The RAB members included individuals from state and Federal regulatory agencies, as well as residents from the surrounding three counties (i.e., Jefferson, Jennings, and Ripley). All of the RAB meetings were open to the public, and the Army solicited comments from the general public in addition to the RAB members at the RAB meetings. Meeting minutes were documented and included in the Administrative Record (www.jpgbrac.com).

There were typically three to five RAB meetings per year. Four RAB meetings had extensive discussions of the Army's proposal for terminating the JPG DU license under restricted conditions. Among the key meetings were the RAB meetings held on 7 January 1997, 31 May 2000, 6 February 2001, and 6 February 2002 (SAS 1997, 2000, 2001, and 2002). These meetings discussed the institutional controls that the Army proposed to NRC, controls identified in the August 1999 Decommissioning Plan (U.S. Army 1999), and controls identified in the July 2001 Decommissioning Plan (U.S. Army 2001). The following list summarizes the concerns expressed by the RAB members and public on the three aspects of the proposed institutional controls identified in 10 CFR 20.1403(d), specifically:

- Whether the institutional controls provide reasonable assurance that the total effective dose equivalent (TEDE) to the average member of the critical group from residual DU will not exceed 25 millirems/year (mrem/y)
- Whether the institutional controls will be enforceable
- Whether the institutional controls will impose an undue burden on the local community or affected parties
- Whether the financial assurances will allow an independent third party to assume and carry out the responsibilities for control and maintenance of the site.

While the RAB meeting minutes do not indicate whether there were questions raised regarding institutional controls to prevent Big Oaks NWR visitors (e.g., hunters, fishermen) from inadvertently venturing into the DU Impact Area when there is no fence around that specific area, the Army did discuss the hazards and costs of installing and maintaining a fence around the DU Impact Area, given the pervasive presence of UXO (i.e., high-explosive UXO in the DU Impact Area at an estimated concentration of 85 rounds per acre).

Questions were raised about the reliability of predictions about future doses when there would be no environmental monitoring to corroborate predictions about DU concentration in the various environmental media. Furthermore, there was concern about there being insufficient data on the fate and transport of DU in the environment. Questions also were asked about whether INANG bombing practices would occur in the DU Impact Area as such actions could disturb the site and might displace and mobilize DU. Finally, there was a concern that DU is contaminated with plutonium.

At several RAB meetings (SAS 1997, 2000, 2001, and 2002), RAB members and the public were concerned about the enforceability of the proposed institutional controls. The Army indicated that unauthorized access to the DU Impact Area would be trespassing on Federal property, which is a Federal offense. Save the Valley (STV), a local community activist group, commented on the earlier License Termination Plan (U.S. Army 2001), indicating reservations about the enforceability of the institutional controls (STV 2001). While RAB members and some of the public expressed concerns about the uncertainty that was associated with projected future doses and expressed a desire for the Army to continue environmental monitoring, these individuals did not articulate a concern that license termination under restrictions would impose undue burdens on the local community.

13.4.2 Public Advice Provided in 2008 and 2009

As part of the alternate schedule and site characterization conducted under the auspices of NRC Materials License SUB-1435, Docket Number 40-08838, Amendment No. 13 and in accordance with 10 CFR 20.1403(d) requirements, the Army held meetings at the Madison-Jefferson County Public Library, 420 East Main Street, Madison, Indiana at 7:00 p.m. on 28 October 2008 and 25 June 2009. The Army also held meetings at the South Ripley Elementary School, Versailles, Indiana at 7:00 p.m. on 29 October 2008 and 24 June 2009 and at Jennings County Library, North Vernon, Indiana at 7:00 p.m. on 30 October 2008 and 23 June 2009. After a total of only five local citizens attended the October 2008 meetings (three in Madison, none in Versailles, and two in North Vernon), the Army elected to hold subsequent public availability sessions in June 2009. A total of 33 local citizens attended the June 2009 meetings (4 in North Vernon, 11 in Versailles, and 18 in Madison).

Prior to the meetings, the Army published notices in the *Madison Courier*, *North Vernon Plain Dealer*, *Versailles Republican*, *Indianapolis Star*, *Louisville Courier Journal*, and *Cincinnati Enquirer*. Figure 13-2 shows the wording of notices published in these newspapers on 21 and/or 23 October 2008. Figure 13-3 shows the wording of notices published in these newspapers on 9 and/or 11 June 2009. The specific dates (i.e., 21 and/or 23 October 2008, 9 and/or 11 June 2009) depended on the newspaper circulation dates (e.g., some newspapers only published weekly editions). Copies of the meeting attendance sheets, transcripts, and materials distributed by attendees are included in Appendix D.

Meeting attendees asked questions about the institutional controls such as who is responsible for enforcement and maintenance, how long are the controls required, and what are the plans for ensuring the controls remain adequately protective long after the license is terminated. Some meeting attendees asked questions or expressed concerns for potential DU migration and exposures (e.g., leaching into lakes on the property, migration of fragments during storms, exposures during prescribed fires conducted by FWS). Other attendees asked questions about depths of DU penetration and results of monitoring.

Public Availability Meeting Notice

In accordance with Nuclear Regulatory Commission rules, the Army will hold Public Availability meetings on

- Tuesday, October 28, 2008 from 7:00 to 9:00 PM
  at the Madison/Jefferson County Library, Madison, Indiana.
- Wednesday, October 29, 2008 from 7:00 to 9:00 PM
  at the South Ripley Elementary School cafeteria, Versailles, Indiana.
- Thursday, October 30, 2008 from 7:00 to 9:00 PM
  at the Jennings County Library, North Vernon, Indiana.

The meetings will allow the public an opportunity to provide advice into the Restricted Release License Termination Plan for the Jefferson Proving Ground (JPG) depleted uranium (DU) license. When active, JPG test fired DU armor penetrators from 1984 until 1994. An estimated 175,000 pounds of DU remains within the 2,000 acre JPG DU impact area. The Army is currently conducting an extensive site characterization of the JPG DU area in support of its pending Restricted Release License Termination Plan submittal.

For further information, call the Jefferson Proving Ground Radiation Safety Officer, Paul Cloud at 1-800-392-2015, extension 5-2381.

Figure 13-2. Wording of Newspaper Notice for October 2008 Public Availability Sessions

Public Availability Meeting Notice

In accordance with Nuclear Regulatory Commission rules, the Army will hold Public Availability meetings on

- Tuesday, June 23, 2009 from 7:00 to 9:00 PM at the Jennings County Library, North Vernon, Indiana.
- Wednesday, June 24, 2009 from 7:00 to 9:00 PM at the South Ripley Elementary School cafeteria, Versailles, Indiana.
- Thursday, June 25, 2009 from 7:00 to 9:00 PM at the Madison/ Jefferson County Library, Madison, Indiana.

The meetings are intended to seek public input into the adequacy of institutional controls for the Restricted Release License Termination Plan for the Jefferson Proving Ground (JPG) depleted uranium (DU) license. When active, JPG test fired DU armor penetrators from 1984 until 1994. An estimated 175,000 pounds of DU remains within the 2,000 acre JPG DU impact area. The Army is currently conducting an extensive site characterization of the JPG DU area in support of its pending Restricted Release License Termination Plan submittal.

For further information, call the Jefferson Proving Ground Radiation Safety Officer, Paul Cloud at 1-800-392-2015, extension 5-2381.

Figure 13-3. Wording of Newspaper Notice for June 2009 Public Availability Sessions

The primary concern raised during the October 2008 and June 2009 meetings was for the limited period of monitoring compared to the long life of the residual DU radiological hazards. Several members of the public wanted monitoring to continue to see if DU is migrating offsite after the termination of NRC Materials License SUB-1435. Some attendees recognized that NRC regulations do not require monitoring after license termination but suggested legislative changes be made to include requirements for monitoring after license termination.

An editorial appeared in the *Madison Courier* on 24 June 2009 entitled "Don't hide DU behind a fence – get rid of it" (Appendix X). The un-named author of the editorial states that "...anything short of removing all of the depleted uranium from Jefferson Proving Ground is unacceptable...the Army should

be required to monitor the area for residual effects after the DU is removed." One meeting attendee suggested removing DU from the smaller area in the "trench" where the majority of the DU remains.

Several attendees brought hand-outs during the final meeting on 25 June 2009. One meeting attendee read and presented for the official record Resolution Number 2009-01 (Figure 13-4). It was a Resolution of the Board of Commissioners for Jefferson County, Indiana, regarding the DU at the DU Impact Area. The resolution stated "...that the Army improve its plan for mitigating the risk of the depleted uranium to county residents by removing it from the ground and properly disposing of it or at a minimum agree to monitor the site..." Another attendee provided an article from the *American Forces Press Service* entitled, "DoD Finds No 'Plausible Link' Between DU, Illness" (17 January 2001) and a different attendee brought information from the World Health Organization (WHO), Department of Protection of the Environment regarding sources, exposures, and health effects from DU. Scanned copies of these hand-outs are included in Appendix G.

13.4.3 Responses to Public Concerns

This Decommissioning Plan responds to these concerns by completing the following actions:

- Presents an expanded discussion and conservative assessment of exposure scenarios, including ones that involve transport of and exposure to onsite and offsite personnel and the uncertainty associated with the estimates (Appendix C)
- Presents additional site-specific characterization data collected to ascertain the nature and extent of DU contamination, corrosion and weathering of DU penetrators, and an updated conceptual site model (CSM)
- Includes extensive fate and transport modeling for the primary mechanisms and pathways for transport of DU and potential exposure by onsite and offsite receptors
- Provides an expanded discussion of institutional controls, including the enforcement of access controls by the Army or permitted Federal or state agencies
- Provides a discussion of the license termination alternatives, including the potential impacts (safety, financial, and environmental) associated with achieving unrestricted release.

13.5 DOSE MODELING AND ALARA DEMONSTRATION

The summary of dose modeling for the situation where institutional controls remain in place is presented in Section 4.1 of this Decommissioning Plan. As summarized in Table 13-1, this analysis shows the TEDE to the average members of the critical group with institutional controls in place is less than 25 mrem/y even when using conservative assumptions and site-specific characterization data.

The summary of dose modeling for the situation where institutional controls are no longer in place is presented in Section 4.2. This analysis showed the TEDEs when institutional controls are no longer in place is less than 100 mrem/y.

RESOLUTION NO.________ - 2009 -01
A RESOLUTION OF THE BOARD OF COMMISSIONERS
JEFFERSON COUNTY, INDIANA
DEPLETED URANIUM AT FORMER JEFFERSON PROVING GROUND

WHEREAS, the Board of Commissioners of Jefferson County, Indiana understands that the Department of the U.S. Army is requesting a license termination from the Nuclear Regulatory Commission that will result in over 150,000 pounds of depleted uranium being left buried in the ground only secured by a fence and warning signs; and

WHEREAS, the Board of Commissioners of Jefferson County, Indiana are concerned about the impact of buried depleted uranium on the health and welfare of Jefferson County residents; and

WHEREAS, the Board of Commissioners are concerned about the real and perceived impact of depleted uranium on the future development of nearby property located in the cantonment area;

NOW, THEREFORE, BE IT RESOLVED by the Board of Commissioners of Jefferson County, Indiana, that the Department of the U.S. Army improve its plan for mitigating the risk of the depleted uranium to county residents by removing it from the ground and properly disposing of it or at minimum agree to monitor the site.

DULY ADOPTED by the Board of Commissioners of Jefferson County, Indiana this 25th day of June, 2009.

Tom Pietrykowski
Tom Pietrykowski

Mark Cash
Mark Cash

Julie Berry
Julie Berry

(SEAL)
ATTEST:

Sandra Shelton
Sandra Shelton, Auditor

Figure 13-4. Jefferson County Board of Commissioners Resolution

Table 13-1. TEDEs for Average Members of Critical Group
Jefferson Proving Ground, Madison, Indiana

Receptor	Location[b]	Institutional Controls	Residual Dose (mrem/y)[a]	Method
Sportsman/Recreationalist	Onsite	Failed	3.3	RESRAD-OFFSITE
Industrial Worker (FWS Worker)	Onsite	Failed	5.9	RESRAD-OFFSITE
Residential Farmer	Onsite	Failed	26.3	RESRAD-OFFSITE
Residential Farmer	Offsite	In Place	2.0	RESRAD-OFFSITE

[a] Doses for RESRAD-OFFSITE simulations are peak-of-the mean estimates from probabilistic calculations.
[b] Doses for onsite industrial workers and sportsman/recreationalist, although developed based on TEDEs for receptors without institutional controls being in place, comply with NRC's unrestricted release dose limit of 25 mrem/y prescribed in 10 CFR 20.1402 as well as dose criteria in 10 CFR 20.1403 that applies both with and without institutional controls being in place. In these situations where the TEDEs would clearly be less in the restricted scenario compared to the unrestricted scenario, the actual TEDEs were not calculated.

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APPENDIX A

NRC MATERIALS LICENSE SUB-1435, AMMENDMENT 17

Depleted Uranium Impact Area
Jefferson Proving Ground, Madison, Indiana

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MATERIALS LICENSE

Pursuant to the Atomic Energy Act of 1954, as amended, the Energy Reorganization Act of 1974 (Public Law 93-438), and the applicable parts of Title 10, Code of Federal Regulations, Chapter I, Parts 19, 20, 30, 31, 32, 33, 34, 35, 36, 39, 40, 51, 70, and 71, and in reliance on statements and representations heretofore made by the licensee, a licensee is hereby issued authorizing the licensee to receive, acquire, possess, and transfer byproduct, source, and special nuclear material designated below; to use such material for the purpose(s) and at the place(s) designated below; to deliver or transfer such material to persons authorized to receive it in accordance with the regulations of the applicable Part(s). This license shall be deemed to contain the conditions specified in Section 183 of the Atomic Energy Act of 1954, as amended, and is subject to all applicable rules, regulations, and orders of the Nuclear Regulatory Commission now or hereafter in effect and to any conditions specified below.

	Licensee			
1	U.S. Department of Army	3.	License Number	SUB-1435
2.	Rock Island Arsenal 1 Rock Island Arsenal Rock Island, IL 61299-5000	4.	Expiration Date	Until Terminated
		5.	Docket or Reference Number	40-08838

6.	Byproduct, Source, and/or Special Nuclear Material: Source	7.	Chemical and/or Physical Form: Any	8.	Maximum Amount that Licensee May Possess at Any One Time Under This License: No Limit
	Uranium		Depleted uranium metal, alloy, and/or other forms		80,000 kilograms

9. Authorized Use: For possession only for decommissioning. License renewal applications dated August 29, 1994.

<u>CONDITIONS</u>

10. Authorized place of use:

A. The licensed material shall be kept onsite, for the purpose of decommissioning, in the restricted area known as the "Depleted Uranium Impact Area". This area is located north of the firing line, at the Jefferson Proving Ground, in Madison, Indiana 47250.

B. This license has been transferred from the "U.S. Department of the Army, U.S. Army Soldier and Biological Chemical Command, Aberdeen Proving Ground, Maryland 21010-5424" to "U.S. Department of the Army, 1 Rock Island Arsenal, Rock Island, Illinois 61299-5000."

[Applicable Amendments: 9, 10, 11]

11. A. Licensed materials shall be kept under the supervision of the Radiation Safety Officer, who shall have the following education, training, and experience:

1. Education: A Bachelors degree in the physical sciences, industrial hygiene, or engineering from an accredited college or university or an equivalent combination of training and relevant experience in radiological protection. Two years of relevant experience are generally considered equivalent to 1 year of academic study.

2. Health physics experience: At least 1 year of work experience in applied health physics, industrial hygiene, or similar work relevant to radiological hazards associated with site remediation. This experience should involve actually working with radiation detection and measurement equipment, not strictly administrative or "desk" work.

Enclosure

MATERIALS LICENSE

MATERIALS LICENSE SUPPLEMENTARY SHEET	License Number: SUB-1435
	Docket or Reference Number: 40-08838
	Amendment No. 17

3. Specialized knowledge: A thorough knowledge of the proper application and use of all health physics equipment used for depleted uranium and its daughters, the chemical and analytical procedures used for radiological sampling and monitoring, methodologies used to calculate personnel exposure to depleted uranium and its daughters, and a thorough understanding of how the depleted uranium was used at the location and how the hazards are generated and controlled.

B. The licensee, without prior NRC approval, may appoint a RSO provided: a) the licensee maintains documentation demonstrating that the requirements of condition 11A are met; and b) the NRC is informed of the name of the new RSO within 30 days of the appointment by letter to Document Control Desk, Director, Office of Federal and State Materials and Environmental Management Programs, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555-0001.

[Applicable Amendments: 8, 9, 10, 16]

12. Except as specifically provided otherwise in this license, the licensee shall conduct its program in accordance with the statements, representations, and procedures contained in the documents, including any enclosures, listed below. The NRC regulations shall govern unless the statements, representations, and procedures in the licensee's application and correspondence are more restrictive than the regulation.

A. Letter and attachments for license renewal dated August 29, 1994,

B. Letter dated May 25, 1995,

C. Application with attachments dated September 29, 1995, and

D. JPG Security Plan included with the letter dated December 10, 2003.

E. Request for change of licensing official and signed NRC Form 313 dated November 8, 2004.

F. Request for change of licensing official and signed NRC Form 313 dated October 25, 2007.

G. Request for change of licensing official and signed NRC Form 313 dated February 4, 2008.

[Applicable Amendments: 3, 4, 6, 9, 10, 11, 12, 13, 14, 15]

MATERIALS LICENSE

MATERIALS LICENSE SUPPLEMENTARY SHEET	
	License Number: SUB-1435
	Docket or Reference Number: 40-08838
	Amendment No. 17

13. The Army shall submit a Decommissioning Plan for NRC review and approval under an alternate schedule identified in its May 25, 2005, Field Sampling Plan; its responses to action items from a September 8, 2005, public meeting by letter dated October 26, 2005; its Field Sampling Plan addendum dated November 2005 and all subsequent addendums; its responses to NRC's request for additional information by letter dated February 9, 2006; and its May 2, 2012 letter. The Army will also submit an Environmental Report using the guidance in NUREG-1748 for NRC to use in preparing an Environmental Impact Statement. The Decommissioning Plan and Environmental Report will be submitted no later than August 30, 2013.

    [Applicable Amendments: 9, 10, 13, 14, 15, 17]

FOR THE U.S. NUCLEAR REGULATORY COMMISSION

Date: 12/27 /12

/RA/
Andrew Persinko, 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

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APPENDIX B

MEMORANDUM OF AGREEMENT

Depleted Uranium Impact Area
Jefferson Proving Ground, Madison, Indiana

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JEFFERSON PROVING GROUND FIRING RANGE
MEMORANDUM OF AGREEMENT (MOA)

This is a Memorandum of Agreement (MOA) among the Department of the Army (Army), the Department of Air Force (Air Force), and the Department of the Interior-United States Fish and Wildlife Service (FWS), all hereafter collectively referred to as the "parties".

I. BACKGROUND AND PURPOSE

1. As a result of the Base Closure and Realignment Act (BRAC) of 1988, the Army's mission at Jefferson Proving Ground (JPG) terminated in September 1995. The JPG property consists of about 55,000 acres located in southeastern Indiana. It is composed of an approximate 4000-acre cantonment area and an approximate 51,000-acre firing range area (Firing Range). The purpose of this MOA is to establish the framework for authorizing the future use of the Firing Range by the U.S. Fish and Wildlife Service (FWS) and continued use by the Air Force. The cantonment area of JPG is being transferred under the BRAC process and is outside the scope of this agreement.

2. Due to unexploded ordnance (UXO), depleted uranium (DU) and other environmental contamination from past Army activities, the Firing Range area is not suitable for commercial or residential development. Despite the UXO and DU contamination, the Firing Range provides wildlife habitat of regional and national significance. In addition, portions of the Firing Range are being used by the Air Force as a bombing range (Bombing Range). The Bombing Range consists of an approximate 983-acre conventional bombing range and an approximate 50-acre laser bombing range, as well as large safety fans, when in use, for each range and associated air space (see map at Enclosure 1). These safety fans overlay significant portions of the Firing Range and are off limits to unauthorized personnel during flight operations involving training munitions or laser energy. The Air Force Bombing Range activities involve training munitions (i.e. an inert munition with a spotting charge) and laser energy, which have had no known significant adverse impact on the wildlife at the Firing Range. As a result of the unique property conditions associated with the Firing Range, the FWS is interested in establishing a National Wildlife Refuge (Refuge) to preserve significant wildlife habitat values, and the Air Force requires continued use of the Bombing Range as a mission-essential training facility.

3. In order to support the establishment of the Refuge and the continued use of the Bombing Range, the Army agrees to the following:

a. The Army will grant the FWS a real estate permit for the entire Firing Range except for the Bombing Range and the Old Timbers Lodge and associated acreage (See Enclosure 2).

b. The Army will grant the Air Force a real estate permit for the Bombing Range and the Old Timbers Lodge and associated acreage (See Enclosure 3).

The FWS and the Air Force real estate permits will be subject to the terms and conditions set forth in this MOA.

4. The restoration requirements of this MOA and the permits issued under it are authorized by 10 U.S.C. § 2691.

II. OVER-ARCHING PRINCIPLES

The parties recognize the importance of having periodic meetings/conference calls, at least quarterly, among the Jefferson Proving Ground Commander, the Refuge Manager, and the Bombing Range Commander. The relationships between the parties will be governed by the following overarching principles:

1. The Army will consult and coordinate with the other parties to ensure that all Army activities (e.g., remediation activities, UXO demonstration projects, or other future activities) are consistent with Refuge and Bombing Range activities.

2. The FWS will consult and coordinate with the other parties to ensure that all Refuge activities (e.g., development of the interim public access plan, the comprehensive public access plan, the Comprehensive Conservation Plan, any modifications to a public access plan, reviews of requests to conduct non-FWS activities, refuge management activities, etc.) are consistent with Army and Bombing Range activities. The FWS specifically agrees that Refuge activities will be consistent with existing environmental conditions and will not otherwise increase the Army's environmental remediation costs.

3. The Air Force will consult and coordinate with the other parties to ensure that all Bombing Range activities (e.g., development of the site access plan (including any modifications to the site access plan), reviews of requests to conduct non-Air Force activities, training operations, etc.) are consistent with Army and FWS activities. The Air Force specifically agrees that Bombing Range activities will be consistent with existing environmental conditions and will not increase the Army's environmental remediation costs.

4. Except as otherwise provided in this MOA, all disputes between the parties relating to the terms and conditions of this MOA will be subject to the dispute resolution procedure set forth in Section VI.

III. ARMY RESPONSIBILITIES

1. Environmental Remediation.

a. The Army will provide the FWS and Air Force with baseline information concerning the environmental condition of the Firing Range utilizing such reports as The Final Study Cleanup and Reuse Options (Mason and Hanger Report 1992), the Environmental Sampling Plan for the Open Detonation Unit (1994), The Resource Conservation and Recovery Act Facility Assessment (1992), The Community Environmental Response Facilitation Act Report (1994), The Depleted Uranium Decommissioning Plan (Draft 1999), The Archives Search Report for Ordnance and Explosive Waste Chemical Warfare Materials (1995) and the Environmental Impact Statement for Disposal and Reuse (1995).

b. The Army will retain all authority, responsibility, and liability for remediation of all contamination resulting from past Army activities or present on the Firing Range on the date of this MOA, including UXO, DU, and other contamination. In addition, the Army is responsible for all remediation resulting from present and future Site activities as set forth in paragraph III(3). Except as otherwise provided in this MOA, the FWS and Air Force shall not have authority, responsibility, or liability for remediation of UXO, DU, and other contamination (see paragraphs IV(3)(a) and (b), V(6))(a) and (b), and V(8)(b)). The Army shall not be responsible for any environmental requirements resulting from operation of the Refuge or the Bombing Range.

c. For purposes of the regulation proposed as 32 CFR 178, *Closed, Transferred, and Transferring Ranges Containing Military Munitions* (Range Rule), should it become a final rule, and any Department of Defense (DoD) Directive or Instruction relating to closed, transferred, or transferring ranges, to the extent any of them apply to the Firing Range, the Army will remain the "responsible DoD component". Unless otherwise required by the Range Rule or DoD Directive or Instruction, the designation of the Army as the "responsible DoD component" will not alter the parties' liabilities under this MOA.

d. The Army is pursuing a license termination under restricted release conditions for the current license issued by the U.S. Nuclear Regulatory Agency (NRC) for its possession of DU for decommissioning at the Firing Range. This license indicates the licensed material (i.e., DU) is onsite in the area known as the "DU Impact Area", located in the southern portion of the Firing Range. The parties recognize the Army will be solely responsible for finalizing the NRC license termination and conducting any actions required by the License Termination Plan at the Firing Range.

2. UXO.

a. UXO Training Materials. The Army will provide training materials and initial UXO and DU safety training for FWS and Air Force personnel. The training materials will include general information regarding the types of munitions used at the Firing Range but are not intended to be an exhaustive/all inclusive listing. After the training, and based on training materials provided by the Army, the FWS and Air Force will be responsible for providing UXO and DU safety training to all of their respective personnel and visitors based on such training materials and knowledge of the FWS and the Air Force of local site conditions.

b. Emergency UXO Removal. If the FWS or Air Force discovers UXO, which poses an imminent and substantial hazard to Refuge or Bombing Range operations (e.g., UXO has migrated to the 'surface of a roadway), the FWS or Air Force will immediately restrict access to the UXO Site and notify the Army. The Army will provide for timely removal of UXO found which it determines to be an imminent and substantial hazard to Refuge or Bombing Range operations. The Army will not be required to remove UXO it determines does not pose an imminent and substantial hazard to Refuge or Bombing Range operations (See Enclosure 4 - UXO Response Standing Operating Procedures [SOP]).

c. Non-Emergency UXO Removal. The FWS and Air Force accept that there is no Army plan or budget authority to remove UXO in the Firing Range. However, the Army will make a good faith effort to request non-emergency UXO removal in connection with Army Reserve and/or Army National Guard training exercises to support Refuge or Bombing Range operations. Any type of non-emergency UXO removal in 'the Firing Range will be subject to the License Termination Plan as approved by the NRC. The FWS and Air Force recognize that any such Army support is contingent on the availability and timing of Army Reserve or Army National Guard exercises. To obtain Army non-emergency UXO removal support, the FWS and Air Force will follow these procedures:

(1) FWS Non-Emergency UXO Removal Support. The FWS will request non-emergency UXO removal support from the Army. To facilitate the support process, the FWS will incorporate building designs that minimize ground disturbance and will provide the Army a minimum 2-year advance notice of their request to complete non-emergency UXO removal. The Army will make a good faith effort to request UXO removal in connection with Army Reserve and/or Army National Guard Training exercises to support Refuge operations. If the Army is not able to obtain non-emergency UXO removal support as part of a training exercise, the FWS agrees to withdraw its request and terminate any plans/operations requiring non-emergency UXO support.

(2) Air Force Non-Emergency UXO Removal Support. The Air Force may request non-emergency UXO removal support from the Army in accordance with paragraph III.2.c. above or it may conduct its own non-emergency UXO removals. Any Air Force non-emergency UXO removals must be conducted by properly certified personnel and in accordance with Department of Defense Explosive Safety Board (DDESB) and all other applicable requirements. If the Air Force elects to conduct its own non-emergency UXO removal action, the Army and FWS will have no responsibility for any costs resulting from the UXO removal action.

3. **Future Site Activity.**

The Army is specifically authorized to conduct the following activities on the Firing Range:

a. Army Environmental Restoration Activities. The Army is authorized to conduct environmental restoration and remediation activities to the extent required by law. For purposes of this MOA, environmental restoration and remediation include NRC license termination activities. The Army assumes no liability should its restoration and remediation activities interfere with FWS or Air Force operations.

b. UXO Removal Technology Demonstration Projects. The Army reserves the right to authorize UXO Removal Technology Demonstration Projects and other similar UXO related projects on the Firing Range.

c. Property Administration. The Army reserves the right to enter the property to conduct property administration activities (e.g., site inspections, etc.).

Any Army proposals to conduct other activities on the Refuge or Bombing Range will be processed in accordance with the terms and conditions of this MOA (see paragraph IV(4) or paragraph V(4)).

4. **Future Property Transfer.**

The Army will not transfer fee title or other property interests in the Firing Range without consulting with the FWS and Air Force. If in the future the Firing Range is determined suitable for transfer, the Army shall, to the extent legally authorized, provide the FWS and Air Force the right of first refusal on their respective property interests before conveying any property interests. If the Air Force no longer requires use of the Bombing Range and the property is no longer needed for other military purposes, the Army will offer the FWS a real estate permit for the Bombing Range subject to the same terms of this agreement or any other mutually agreeable terms.

5. **Tort Claims.**

The Army will be responsible for accepting and processing any tort claims for incidents arising out of UXO, DU, or any other conditions related to the Army's past, present, or future use of the Firing Range. The FWS and Air Force will cooperate in providing information relating to any such tort claims. Any liability on the part of parties will be determined in accordance with the Federal Torts Claim Act and other applicable laws.

IV. FWS RESPONSIBILITIES

1. National Wildlife Refuge.

a. The Refuge will be called Big Oaks National Wildlife Refuge. It will be managed as a unit of the National Wildlife Refuge System in accordance with the National Wildlife Refuge Administration Act of 1966 as amended (16 U.S.C. 668 Ct. seq.) and other applicable laws, regulations, and policies. Following the issuance of the real estate permit, the FWS will be responsible for all natural resource management decisions on the Refuge. As the Refuge includes the DU Impact Area, management of the Refuge will be subject to the License Termination Plan as approved by the NRC.

b. The FWS will develop a Comprehensive Conservation Plan (CCP) outlining its management plan for the Refuge. The CCP will provide natural resource management at a level typical of units of the National Wildlife Refuge System.

c. The FWS will conduct any National Environmental Policy Act (NEPA) analysis required to support establishment of the Refuge.

d. The FWS will be responsible for infrastructure maintenance and repairs as outlined in Enclosure 5 (FWS/Air Force Infrastructure Maintenance Responsibilities).

2. Site Security.

a. The FWS will be responsible for providing UXO, DU and environmental contamination Safety/Awareness Training to all Refuge personnel and visitors (see paragraph ffl.2.a. above). The FWS will develop an interim public access plan prior to the Army executing a real estate permit. After the interim public access plan, the FWS will develop a comprehensive public access plan that identifies appropriate public uses of the property and ensures that all visitors are provided UXO, DU and environmental contamination Safety/Awareness Training. The public access plan will include: (a) types of public use, (b) UXO, DU and environmental contamination Safety Training protocols (e.g., training materials, training rosters, and waivers), and (c) annual public use reporting requirements. The interim public access plan and the comprehensive public access plan and any revisions will be subject to Army approval.

b. The FWS will provide staffing at a level consistent with the safe operation of the Refuge. With the expectation of limited or no UXO cleanup in the future, public use levels will be low and may be limited to hunting, gathering, fishing, and guided tours as determined by the interim or comprehensive public access plan. All visitors will be escorted or receive a safety briefing on the hazards found on the property. If the FWS fails to maintain adequate public access control, the Army reserves the right to suspend the FWS's right of access to the Firing Range until such time as the FWS takes appropriate corrective action.

3. Environmental Remediation.

a. The FWS shall not be responsible for any environmental requirements related to the Army's past, present, or future activities at the Firing Range or the Air Force activities at the Bombing Range. However, the FWS will be responsible for all environmental compliance and remediation requirements resulting from operation of the Refuge.

b. The FWS shall not be responsible for remediation of UXO, DU, and other environmental contamination related to past, present, or future Army activities, or present on the Firing Range on the date of this MOA, or resulting from Air Force Bombing Range activities. If a FWS Refuge activity will result in increased remediation costs for the Army (e.g. UXO removal, fencing, or Site remediation), the FWS shall terminate the activity.

c. The FWS will not undertake any Refuge activities that interfere with the Army environmental remediation program at the Firing Range.

4. Other Activities on the Refuge.

The FWS will be responsible for reviewing all requests to conduct non-FWS activities on the Refuge (i.e. requests from other organizations to conduct activities not otherwise authorized by the CCP); not otherwise allowed by this MOA. All requests for non-FWS activities on the Refuge will be reviewed in accordance with the National Wildlife Refuge Administration Act and other applicable laws, regulations, or policies. The interim or comprehensive public access plan will be revised as necessary to ensure that any approved non-FWS operations on the Refuge are conducted in a safe manner.

5. Tort Claims.

The FWS will be responsible for accepting and processing any tort claims for incidents arising out of its operation of the Refuge. The Army and Air Force will cooperate in providing information relating to any such tort claims. Any liability on the part of the parties will be determined in accordance with the Federal Torts Claim Act and other applicable laws.

V. AIR FORCE RESPONSIBILITIES

1. Air Force Bombing Range.

a. The Air Force will operate a Bombing Range which includes an approximate 50-acre laser bombing range, an approximate 983-acre conventional bombing range, and the Old Timbers Lodge with associated acreage of approximately 5 acres, which shall be excluded from the real -estate permit for the Refuge. The bombing ranges, when in use, will have large safety fans that will be off limits for FWS personnel and visitors during flight operations involving training munitions or laser energy. While the safety fans overlay significant portions of the Firing Range, their land area is included in the real estate

permit for the Refuge. As the laser bombing range safety fan includes the DU Impact Area, management of the Bombing Range will be subject to the License Termination Plan as approved by the NRC. The Air Force will comply with Air Force Instruction 13-2 12, Test and Training Ranges, concerning range maintenance, ammunition, explosives, and dangerous articles (AEDA), and range residue cleanup/decontamination on the Bombing Range.

b. The Air Force will conduct any NEPA analysis required to support operation of the Bombing Range.

c. The Air Force will take the following actions to ensure that its operation of the Bombing Range is not inconsistent with the establishment of the Refuge:

(1) The Air Force will limit its total annual bombing sorties to 3000 sorties per year (including non-Air Force sorties). The Air Force is authorized to conduct 4000 sorties in any one-year period provided the additional Sorties are conducted in accordance with applicable laws and regulations. The Air Force may only exceed the 3000 sorties per year cap once every three years. Any increase in sorties above these levels will be negotiated in good faith by the parties.

(2) The Air Force will provide wildfire suppression support on the Refuge for situations arising from Air Force actions or activities, as to be determined by the Bombing Range Commander and the FWS Refuge Manager.

2. **Perimeter Fence/Road and Warning Signs.**

a. The Air Force will be responsible for patrolling and maintaining the perimeter fence and related infrastructure to ensure the overall security of the Firing Range. The perimeter fence infrastructure includes warning signs, the road system associated with the perimeter fence, and mowing the perimeter fence area. The Army and FWS staff will report o the Air Force in a timely manner any damage to the perimeter fence that they observe in the course of performing their respective activities on the Firing Range.

b. The Air Force will maintain warning signs around the entire perimeter, the submunitions area west of Machine Gun Road, the DU area and the former Open Detonation area. If additional fencing, cleanup, or site security improvements are required due to past, present, or future Army activities, the Army will be responsible for the additional requirement. The Air Force agrees to negotiate in good faith regarding appropriate arrangements to assist the Army in meeting the new requirements.

3. Maintenance of Firing Range Infrastructure.

The FWS/Air Force infrastructure maintenance responsibilities are provided in Enclosure 5. The properties permitted to the Air Force (i.e., the Old Timbers Lodge and the four stone arch bridges) shall be preserved in accordance with the Jefferson Proving Ground Cultural Resource Management Plan dated August 1996. The Army and Air Force will prepare an Interservice Support Agreement to cover the Army's historic preservation responsibilities for the Oakdale School House. If other infrastructure maintenance requirements are subsequently identified, the Air Force agrees to negotiate in good faith regarding appropriate arrangements to assist the Army in meeting the new requirements.

4. Other Bombing Range Activities.

The Air Force will be responsible for reviewing all requests to conduct non-Air Force operations (including Army and FWS requests) on the Bombing Range. All requests for non-Air Force operations on the Bombing Range will be reviewed in accordance with the provisions of Air Force Instruction 13-2 12 and the License Termination Plan as approved by the NRC. The comprehensive site access plan will be revised as necessary to ensure that any approved non-Air Force operations on the Bombing Range are conducted in a safe manner.

5. Site Security.

a. The Air Force will be responsible for providing UXO, DU and environmental contamination Safety/Awareness Training to all Bombing Range personnel and visitors. Prior to the Army executing a new real estate permit, the Air Force will develop a comprehensive site access plan that includes: (a) types of official use, (b) UXO, DU and environmental contamination Safety Training protocols (e.g., training materials, training rosters, and waivers), and (c) annual official use reporting requirements. The comprehensive site access plan and any revisions will be subject to Army approval.

b. The Air Force will provide staffing at a level consistent with the safe operation of the Bombing Range. It is anticipated that the Air Force access will consist primarily of Bombing Range personnel, support personnel, and official visitors. If the Air Force fails to maintain adequate access control, the Army reserves the right to suspend Air Force's right of access to the Firing Range until such time as the Air Force takes appropriate corrective action.

6. Environmental Remediation.

a. The Air Force shall not be responsible for any environmental requirements related to the Army's past, present, or future activities at the Firing Range or the FWS activities at the Refuge. However, the Air Force will be responsible for all environmental compliance and remediation requirements resulting from its operation of the Bombing Range.

b. The Air Force shall not be responsible for remediation of UXO, DU, and other environmental contamination related to past, present, or future Army activities, or present on the Firing Range on the date of this MOA (except as provided in paragraph V.8.b. below), or resulting from FWS Refuge activities. If an Air Force Bombing Range activity will result in increased environmental remediation costs for the Army (e.g. UXO removal, fencing, or site remediation), the Air Force will be solely responsible for these increased costs or shall terminate the activity.

c. The Air Force will not conduct any Bombing Range activities that interfere with Army environmental remediation activities at the Firing Range.

7. **Tort Claims.**

The Air Force will be responsible for accepting and processing any tort claims for incidents arising out of its operation of the Bombing Range. The Army and FWS will cooperate in providing information relating to any such tort claims. Any liability on the part of the parties will be determined in accordance with the Federal Torts Claim Act and other applicable laws.

8. ***Existing Permit to the Air Force***

a. Pending issuance of the new real estate permit (Enclosure 3), the existing permit between the Department of the Army and the Department of the Air Force, DACA 27-4-83-03, dated 23 July 1982, to use property on JPG will continue in effect without change. Upon the effective date of the new permit, the existing permit will terminate.

b. Nothing in this MOA will be construed to affect any liability or responsibility of the Air Force or Army established by the existing permit between the Department of the Army and the Department of the Air Force, DACA 27-4-83-03, dated 23 July 1982, or any prior permits between the Air Force and Army relating to the Firing Range.

9. **Licensing to Indiana Air National Guard**

The Air Force may grant a license to the Indiana Air National Guard to assume its rights and responsibilities under the real estate permit. Any such license may include and apply all the responsibilities of the Air Force under this MOA and the permit to the Indiana Air National Guard, excluding only the authority to amend this MOA or the real estate permit.

VI. DISPUTE RESOLUTION PROCEDURE

1. Except as otherwise provided in this MOA, all disputes between the parties relating to the terms and conditions of this MOA will be subject to the following dispute resolution procedures:

a. Informal - All parties to this agreement shall make reasonable efforts to informally resolve disputes at the Installation Commander, the Bombing Range Commander, and the Refuge Manager Level. If the parties cannot resolve a dispute informally, any party may invoke dispute resolution procedures by requesting a Level I meeting. The request to invoke dispute resolution shall include a written summary of the dispute, the party's position, and any other information necessary to the resolution of the dispute. In the event that a dispute involves a matter of national significance, the parties may mutually agree to elevate the dispute directly to the Level II dispute resolution process.

b. Level I - The Level I dispute resolution shall consist of a meeting/conference call among the Army Materiel Command (AMC) Point of Contact (POC), the FWS's Regional Office POC, and Air National Guard Readiness Center POC. Any agreed resolution shall be in writing and signed by all the parties. If agreement cannot be reached within 30 days, AMC shall state its position in writing and provide it to the other parties. Within 30 days of receipt of the AMC statement of position, the other parties may submit a written notice to AMC elevating this matter to Level II for resolution. If the matter is not elevated to Level II dispute resolution within 30 days, the other parties will be deemed to have agreed with the AMC statement of position.

c. Level II - The Level II dispute resolution shall consist of a meeting/conference among the Department of the Army (DA), HQ FWS POC, and HQ Air Force POC. The agreed resolution shall be in writing and signed by all the parties.

2. No resolution of a dispute under this provision shall result in a change to the MOA or to any permit issued pursuant to it unless the modification is executed in accordance with paragraph VIII below or the terms of the permit.

VII. FUNDING

Unless otherwise agreed, all parties will be solely responsible for funding their respective responsibilities under this Memorandum of Agreement. Nothing in this agreement shall be interpreted to require obligation or payment of funds in violation of the Anti-Deficiency Act, 31 U.S.C.Section 1341.

VIII. EFFECTIVE DATE, MODIFICATION, AND TERMINATION

1. This agreement may be executed in multiple copies, each of which shall be considered an original document. This agreement shall take effect upon the date last executed by the parties, arid shall remain in effect for 25 (twenty five) years. This agreement may be renewed for additional 10 (ten) year periods upon mutual agreement.

2. Modifications to this agreement may be submitted in writing by any party at any time and shall become effective upon the written acceptance of all the parties. Such modifications must be signed by the signatories hereto or their successors in office.

3. This agreement may be terminated by any party by providing a written 180 (one hundred eighty) day notice to the other parties. A decision to terminate this agreement is not subject to the dispute resolution provision of this MOA. In the event of termination, any Air Force and FWS built improvements wilt be disposed of following applicable disposal regulations.

IX. ENTIRE AGREEMENT

It is expressly understood and agreed that this written instrument and its enclosures when executed embody the entire agreement among the parties regarding the use of the Firing Range, and there are no understandings or agreements, verbal or otherwise, among the parties except as expressly set forth herein.

APPROVED BY:

PAUL W. JOHNSON
Deputy Assistant Secretary of the Army
(Installations and Housing)

Date 12 MAY 2000

JAMIE RAPPAPORT CLARK
Director
U.S. Fish and Wildlife Service

Date 5/15/00

JIMMY G. DISHNER
Deputy Assistant Secretary
Of the Air Force (Installations)

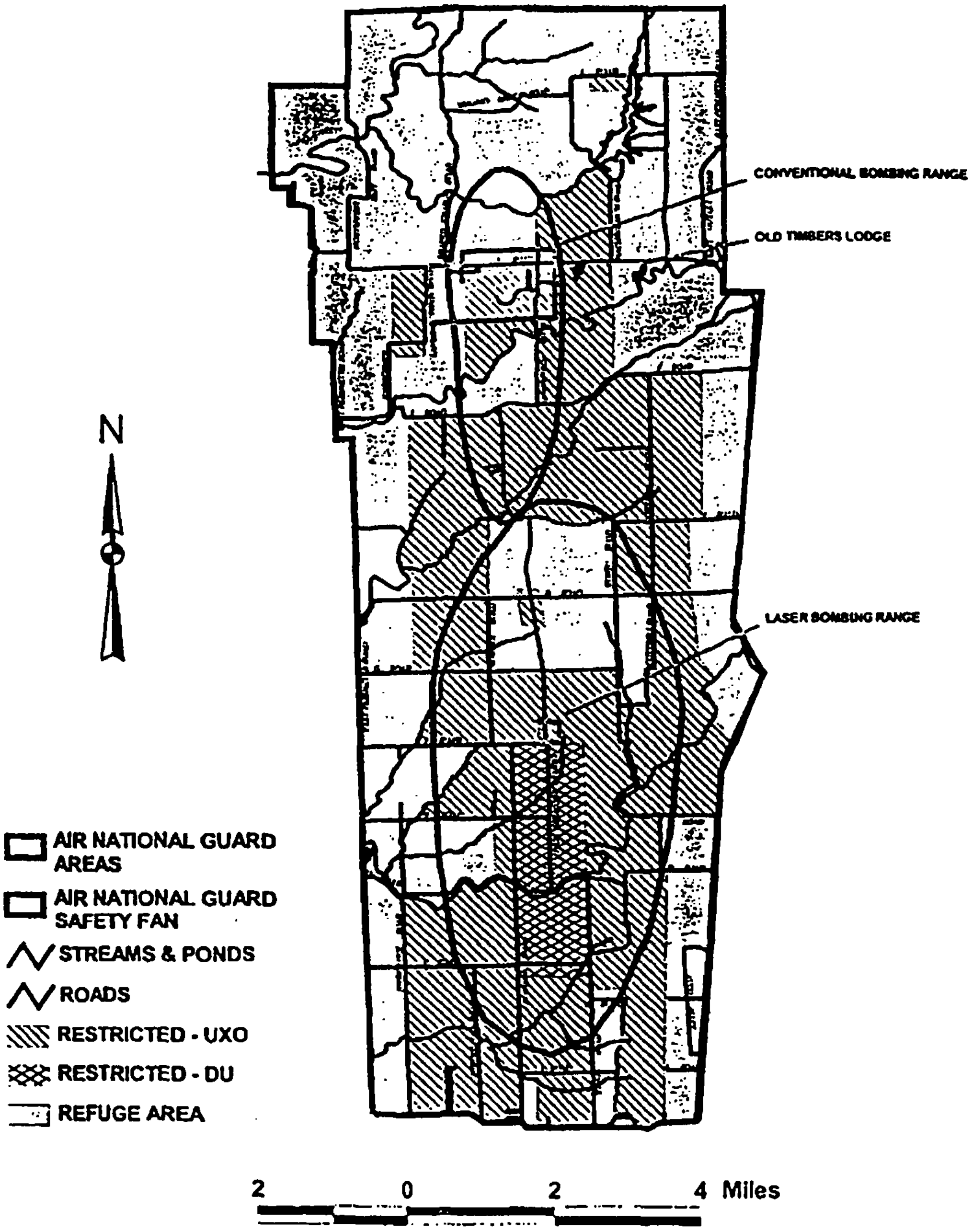
Date 5/11/2000

Enclosures

1. Site Map
2. FWS Real Estate Permit
3. Air Force Real Estate Permit
4. UXO Response Standing Operating Procedures
5. FWS/Air Force Infrastructure Maintenance Responsibilities

ENCLOSURE 1

JEFFERSON PROVING GROUND
SITE MAP



ENCLOSURE 2

NO.__________

DEPARTMENT OF THE ARMY

PERMIT TO FISH AND WILDLIFE SERVICE

TO USE PROPERTY LOCATED ON JEFFERSON PROVING GROUND

THE SECRETARY OF THE ARMY, hereinafter referred to as the Secretary hereby grants to the United States Fish and Wildlife Service, hereinafter referred to as the grantee, a permit for the establishment of a National Wildlife Refuge at the Jefferson Proving Ground (JPG), over, across, in and upon the lands identified in Exhibit "A," attached hereto and made a part hereof, hereinafter referred to as the premises. The Secretary and the grantee are collectively hereinafter referred to as the "Parties".

THIS PERMIT is granted subject to the following conditions.

1. This permit is hereby granted for a term of twenty-five (25) years, with renewable ten (10) year periods upon mutual agreement of the Parties. This permit may be terminated earlier, by either the Secretary or grantee, by providing 180 days written notice.

2. The consideration given by the grantee is the management of the Property as a National Wildlife Refuge as well as the care and maintenance of the property as specified in the Memorandum of Agreement (MOA) attached hereto and made part of hereof . . .

3. All correspondence and notices to be given pursuant to this permit shall be addressed, if to the grantee, to ______________ and if to the Secretary, to the District Engineer, Louisville District, ______________ with a copy furnished to the JPG Commander, ______________, or as may from time to time otherwise be directed by the panics. Notice shall be deemed to have been duly given if when enclosed in a properly sealed envelope or wrapper addressed as aforesaid, and deposited, postage prepaid, in a post office regularly maintained by the United States Postal Service.

4. The use and occupation of the premises shall be without cost or expense to the Department of the Army, and under the general supervision of the JPG Commander, and in accordance with the terms and conditions of the MOA, attached hereto and made apart hereof. In the event of a conflict between the MOA and this permit, the MOA shall be the controlling instrument.

5. The grantee acknowledges that it has inspected the premises, knows its condition, and understands that same is granted without any representations or warranties whatsoever and without obligation on the part of the Department of the Army, except as provided in the MOA.

6. In accordance with the MOA, the grantee shall, at its own expense and without cost or expense to the Department of the Army, maintain and keep the premises at a level sufficient to support Refuge operations and in accordance with the tasks in Enclosure 5 of the MOA.

7. The Department of the Army shall not be responsible for providing utilities to the grantee and it shall be the grantee's responsibility for obtaining any utilities necessary for its use and occupation of the premises at no expense to the Department of the Army.

8. No additions or alterations of the premises shall be made without the prior written approval of the JPG commander.

9. On or before the expiration of this permit or the termination by either party, in accordance with paragraph one (1), the grantee shall vacate the premises, remove its property therefrom and restore the premises to a condition satisfactory to the JPG commander, ordinary wear and tear and damage beyond the control of the grantee excepted.

10. The grantee shall comply with all applicable Federal, state, interstate, and local laws and regulations wherein the premises are located.

11. The Army will provide the grantee with baseline information concerning the environmental condition of the premises in accordance with paragraph Hi I (a), of the MOA, documenting the known history of the property with regard to storage, release or disposal of hazardous substances on the property. Upon expiration or termination of this permit, the grantee shall, at its own expense and without cost or expense to the Department of the Army, document any storage, release or disposal of hazardous substances in excess of 40 CFR Part 373 reportable quantities and any petroleum products in excess of 55 gallons. A comparison of the two assessments will assist the Army in determining any environmental restoration requirements of the grantee. Any such requirements will be completed by the grantee in accordance with the Environmental Remediation provisions in the MOA and paragraph nine (9) of this permit.

12. It is understood that the requirements of this permit pertaining to maintenance, repair, protection, and restoration of the premises and providing utilities and other services, shall be effective only insofar as they do not conflict with the MOA or any other agreement, pertaining to such matters made between local representatives of the Army and grantee in accordance with existing regulations.

13. Access to and use of JPG shall be controlled in accordance with the grantee's Site Access Plan that is attached hereto and is made apart hereof. The Army must first approve any variation from this Plan and a revised Site Access Plan shall be made part of this permit.

14. The grantee shall not use the Premises for the storage, treatment or disposal of non-Department of Defense owned hazardous or toxic materials, as defined in 10 U.S.C 2692, unless authorized under 10 U.S.C. and properly approved by the Government.

15. NOTICE OF THE PRESENCE OF LEAD BASED PAINT AND COVENANT AGAINST THE USE OF THE PROPERTY FOR RESIDENTIAL PURPOSES.

The grantee is hereby informed and does acknowledge that all buildings on the Property, which were constructed or rehabilitated prior to 1978, are presumed to contain lead-based paint. For those buildings the grantee uses and occupies it shall comply with all applicable federal, state, and local laws and regulations pertaining to lead-based paint and/or lead-based paint hazards. The grantee shall restrict access (e.g., secure buildings to the extent practical, post warning signs, etc.) to all unoccupied buildings except those buildings located in UXO Restricted Areas (See Site Map at MOA Enclosure 1). The grantee shall restrict access to the UXO Restricted Areas in accordance with the Site Access Plan. The grantee shall not permit the use of any of the buildings or structures on the Property for residential habitation. Residential habitation does not include use of the Old Timbers Lodge for conference purposes including overnight visits on a non-permanent basis. The grantee assumes all lead based paint related liability arising from its use of the property.

16. NOTICE OF THE PRESENCE OF ASBESTOS AND COVENANT:

The grantee is hereby informed and does acknowledge that friable and non-friable asbestos or asbestos-containing materials (ACM) has been found on the Property. The grantee acknowledges that it will inspect any building it proposes to occupy as to its asbestos content and condition and any hazardous or environmental conditions relating thereto. The grantee shall restrict access (e.g.. secure buildings to the extent practical, post warning signs, etc.) to all unoccupied buildings except those buildings located in UXO Restricted Areas (See Site Map at MOA Enclosure 1). The grantee shall restrict access to the UXO Restricted Areas in accordance with the Site Access Plan. The grantee shall be deemed to have relied on its own judgment in assessing the condition of the property with respect to any asbestos hazards or concerns. The grantee covenants and agrees that its use and occupancy of a building will be in compliance with all applicable laws relating to asbestos. The grantee assumes all asbestos related liability arising from its use of the property.

17. Prior to the start date of this Permit the grantee will provide a map with clear identification of the buildings it shall occupy. This map will be updated annually by the grantee.

THIS PERMIT is not subject to Title 10, United States Code, Section 2662, as amended.

IN WITNESS whereof, I have hereunto set my hand by authority of the Secretary of the Army, this _______ day of _______, _______.

____

This permit is also executed by the grantee this ________________ day of ___________, _______.

____

Interim Public Access Plan for the Proposed
Big Oaks National Wildlife Refuge

Prepared by:
U. S. Fish and Wildlife Service

Lee Herzberger
Refuge Manager
Muscatatuck National Wildlife Refuge

Reviewed by:
Air National Guard

Maj. William Nolen
Commander
Jefferson Range

Approved by:
U. S. Army

Maj. Mark A. Welch
Commander
Jefferson Proving Ground

Introduction

Approximately 50,000 acres of the decommissioned military base known as Jefferson Proving Ground (JPG) is proposed for inclusion into the National Wildlife Refuge (NWR) System via a Memorandum of Agreement (MOA) with the U.S. Army (Army). The area will become Big Oaks NWR. The primary purposes for this overlay NWR are derived from 2 specific acts:

> 1) The Fish and Wildlife Act of 1956 [16 USC 742a-742j] as amended authorizes the Secretary of the Interior to acquire interests in property "...for the development, advancement, management, conservation, and protection of fish and wildlife resources..."
>
> 2) The Endangered Species Act authorizes the Secretary of Interior to acquire interests in lands "to conserve fish, wildlife, and plants, including those that are listed as endangered or threatened..." [16 USC 1534).

The mission of Big Oaks NWR derives from these two purposes and is "to preserve, conserve, and restore biodiversity and biological integrity for the benefit of present and future generations of Americans." There is also a potential for limited public use in areas designated for such activities. This Interim Public Access Plan (Plan) was developed to allow the Army to review and approve safety procedures prior to public use occurring on Big Oaks NWR. This Plan is in accordance with the terms and conditions of the MOA between the U. S. Fish and Wildlife Service (FWS), Army, and Air Force (AF), and in the event of a conflict between the MOA and this agreement, the MOA shall be the controlling document.

Much of the proposed Big Oaks NWR contains unexploded ordnance (UXO), depleted uranium (DU), and other contaminants. The existence of these contaminants causes safety, management and funding concerns specific to Big Oaks NWR. The FWS accepts that there is no Army plan or budget authority to remove UXO in the Firing Range. However, the Army has agreed to make a good faith effort to request UXO removal in connection with Army Reserve and/or Army National Guard training exercises to support refuge operations. To facilitate the support process, the FWS will incorporate building designs that minimize ground disturbance and will provide the Army a minimum 2-year advance notice of their request to complete UXO removal. If the Army is not able to obtain UXO removal support as part of a training exercise, the FWS agrees to withdraw its request and terminate any plans/operations requiring non-emergency UXO support.

In the central portion of JPG is an active 1,033-acre AF training area known as Jefferson Range. Jefferson Range is composed of a 983-acre air-to-ground bombing and strafing range and a 50-acre Precision Guided Munitions (PGM) range. Both the 983-acre range and the 50-acre range have associated safety fans that extend over a portion of the area proposed as Big Oaks NWR (Fig. 1). A composite footprint of approximately 5,100 acres supports the primary target area and a composite footprint of approximately 14,860 acres supports the PGM target area. During flight operations no personnel other than AF personnel will be allowed access inside the weapons footprints. The use of both footprints will be coordinated with the Refuge Manager through monthly scheduling or as necessary to meet mission requirements. When not in use, FWS personnel will have access to the safety footprints. Safety fans and other closed areas will be barricaded as a precaution. The scheduling of public use on Big Oaks NWR that may conflict with AF activities will be coordinated through periodic meetings between the Refuge Manager and the AF Range Commander designed to eliminate conflicts and ensure safety.

In the event of an aircraft accident, the Jefferson Range Control Officer (RCO) will be the on-scene commander in charge until relieved by the appropriate military authority. Fire and medical support will be

directed to the perimeter gate most advantageous to the crash site. Due to the dangers posed by military aircraft, no persons be allowed access to a crash site until deemed appropriate by the on-scene official. The Jefferson Range Access Plan protocols concerning aircraft accidents will be adhered to by the FWS, and the Refuge Manager will coordinate and cooperatively work with the Jefferson RCO or other on-scene commander.

Safety Briefing Protocols

To ensure visitor safety, the Army will provide safety briefing materials that contain basic information on site history, the hazards of UXO, arid the appropriate action when UXO or DU is encountered. The FWS will require all staff and visitors to undergo a safety briefing and will provide safety pamphlets containing this information and a map of Big Oaks NWR. FWS will also brief visitors on other hazards based on local site conditions. All Public Access Permits will be tracked by a permit number. An annual database will be maintained that records individual permit information (e.g., name, address, date of birth, date of safety briefing, etc.). An annual fee or daily fee will be charged for recreational use at Big Oaks NWR. Entrance fees will be waived for official duties conducted by contractors, FWS staff, AF staff, Army staff, and others designated by the Refuge Manager, but everyone will receive a safety briefing (AF visitors will receive briefing in accordance with the AF site access plan).

Entry Procedures

Visitors will check-in and undergo an appropriate safety briefing at the refuge office (presently in Building 125) and be issued a Public Access Permit. The visitor will then be given directions to the access gate controlled by a gate attendant. The gate location will be the sole access point for unescorted FWS visitors and is located adjacent to Gate la on the East Perimeter Road (Gate "lb"; Fig. 2). Visitor check-out will also occur at the refuge office. AF visitors, including Old Timbers Lodge guests, will be checked-in and out in accordance with the AF site access plan.

Types of Public Use

The FWS will provide staffing at a level consistent with the safe operation of the refuge. With the expectation of limited or no UXO cleanup in the future, public use levels will be low and limited to hunting, fishing, wildlife observation and photography, and guided tours (Table 1). Activities not covered within the Plan will not be allowed unless first reviewed and approved by the Army and declared compatible by the FWS.

Access

All public activities on the refuge will be controlled and limited within 2 zones identified in consultation with the Army. These areas are 1) Limited Day Use Recreation and 2) Special Control Hunt Zones; a third zone would have no public access and would be considered closed to all types of entry except on established roads or under emergency conditions (Fig. 1). The Limited Day Use Zone will be used for hunting (deer and turkey), fishing (Old Timbers Lake), and limited opportunities for wildlife observation and photography, and guided (accompanied by FWS staff) environmental education and interpretation tours. The Special Control Hunt Zone will only have public access during a limited deer and turkey hunting season, and limited guided tours. All of these recreational units were previously used in the Army recreation program (Fig. 1).

Public use areas will be delineated by maps and by signs placed on their boundaries as required by NWR

policies. Recreational opportunities during posted hours and periods will be available to the general public provided they have completed all necessary safety requirements, proper state licenses, appropriate permits for lottery seasons, and there are areas/staff available for the requested activity. Unescorted access will be limited to April through November (Table 1). Recreation units will have maximum capacity limits at any one time for all off-road visitor activities (Table 1, Fig. 1). Guided tours oriented toward environmental education, wildlife observation, interpretation, and the unique story of the property will be scheduled and completed without exposing the public participants to undue risk.

Protocols on How Public Use will be Monitored, Limited, and Controlled

Public access will be limited to specific days of the week and by seasonal periods (e.g., fishing, deer, and turkey seasons) (Table 1). The Army and the FWS will periodically reevaluate public access to determine if different limits are more appropriate.

The standard protocol for public access will be a check-in/check-out procedure to specific areas (e.g., Area 1, see Fig. l) for those members of the public that have undergone a safety briefing. They will be allowed in areas identified as suitable for that type of activity (e.g., deer hunting in a Special Control Hunt Area; fishing in Old Timbers Lake). A daily entrance log/database will be kept of all public use on Big Oaks NWR. Information on types and locations of public use will be compiled in an annual report that will be distributed to the Army, AF and the FWS Region 3 Office.

Prior to unescorted public access occurring (June 3, 2000), the AF will install road barricades on the East Perimeter Road and the FWS will place closed area signs on these barricades to limit public access into interior areas of the refuge (Fig. 2). A total of 19 barricades will be placed around the periphery of the southern Special Control Hunt Zone. These barricades will be located at the point where all interior roads leave the East and West Perimeter Roads. The barricades on the West Perimeter Road will be in place by deer season (November 1, 2000). Other than during the limited deer and turkey hunts, these barricade gates will remain closed and locked at all times. FWS will control access into these areas during the annual turkey and deer hunts with the previously described protocols. Besides these hunt periods, only AF and FWS personnel or required contractors will be allowed access to these interior areas and the safety fan footprints. Closed area signs will also be placed alternating with the warning signs placed by the Army for closed access areas, especially for those areas adjacent to recreation units. Signs will be placed on existing structures (i.e., fence posts, buildings, etc.), live trees, or on posts with weighted bases to avoid ground intrusion of sign posts.

As described in the MOA, the FWS will work closely with the AF on controlling visitor access and monitoring refuge visitors. The AF will be responsible for maintaining the perimeter fence and overall site security at JPG. The FWS will notify the AF of any damage to the perimeter fence in a timely manner.

The FWS will not tolerate individuals who violate safety regulations. For this reason, anyone who does not comply with safety regulations will forfeit his/her refuge access privileges as determined by the Refuge Manager or by a court of law. The FWS will also continue access restrictions made by the Army to specific individuals because of documented safety violations.

Enforcement of refuge trespass and other public use violations will be the primary responsibility of commissioned Refuge Law Enforcement Officers and cooperatively by Indiana Conservation Officers and other law enforcement agencies General trespass, poaching, and other violations will be cooperatively enforced by these agencies. The FWS will meet with local law enforcement agencies and develop coordinated law enforcement strategies (these strategies will be in place by June 3, 2000) that will be coordinated with the AF. Procedures for obtaining law enforcement assistance will be based on legal jurisdiction where the incident occurs (e.g., in Ripley County the Ripley County Communication Supervisor will be contacted, likewise, in Jefferson or Jennings Counties the appropriate Communication Radio Dispatch Centers will be contacted). For emergency response situations, the cooperating agency will coordinate activities with a 24 hr point of contact (POC) listed in Attachment 1.

Fire suppression capabilities will be negotiated with a local Volunteer Fire Department and will be in place by June 3, 2000. The agreement will include protocols on suppression of wild fires and on-call assistance during prescribed fires. Protocols will instruct fire fighters to not leave roadways and to follow other Army safety directives. For fire department response after hours, the local fire department will be instructed to coordinate with the POC and to cut the lock on the gate most advantageous to their response. In this case, the fire department response will only occur if it is apparent that the fire could cause loss of life or property damage outside the perimeter fence.

Key Control

The AF will change all locks on the perimeter fence and will issue an appropriate number of perimeter and interior gate keys to the FWS for official use. These keys will be controlled in accordance with standard lock and key control protocols (Air National Guard 181st Fighter Wing Instruction 32-1003). All keys will be signed for on the Jefferson Range key control log. The FWS will inventory these keys quarterly in accordance with these key control protocols. The FWS will coordinate distribution of keys with law enforcement and emergency response agencies. The FWS will be responsible for the control of these keys. The party responsible for missing keys shall bear the cost for the re-coring of locks as applicable. The Jefferson Range Commander has the ultimate responsibility for lock and key control on the range and refuge.

Use of Refuge by Old Timber's Lodge (AF) Guests

The FWS will schedule priority refuge events for Old Timbers Lodge with the Jefferson Range AF Commander, at all other times the Old Timbers Lodge area will be off limits for refuge visitors. The refuge will allow Old Timbers Lodge guests access to refuge recreational activities on days/times those activities are available to the general public. Old Timbers Lodge guests must obtain a valid Big Oaks NWR Public Access Permit to participate in these activities and these guests must participate in an AF safety briefing. While on the refuge, all rules and regulations of the refuge will apply to Old Timbers Lodge guests.

Old Timbers Lodge guests must check-in and check-out at the refuge office to participate in recreational opportunities (e.g., fishing at Old Timbers Lake). If guests do not check-in, especially for fishing at Old Timbers Lake, they cannot be guaranteed the opportunity to participate in the recreational activity. For permitted deer or turkey hunts, Old Timbers Lodge guests must either have a valid state lottery permit for the specific hunt or participate in a reserved hunt drawing during the hunting season at the refuge office.

Table 1. Public use limits (use-days) for activities on Big Oaks NWR[a]:

Activity	Description of where use will occur	Maximum one-time capacity	When allowed
Deer Hunting	See Public Access Map	423	November (6 days archery and 9 days gun)
Turkey Hunting	1/2 of the number hunters/area given on Public Access Map	212	April to Mid-May (15 Days)
Fishing	Max. 10 boats and Max. 40 on shore at Old Timbers Lake. No fishing allowed on any other body of water.	60[b]	5 - 10 days per month; April through October
Wildlife Observation and Photography	1/2 of the number persons/area given on Public Access Map; only within Limited Day Use Zone	78[b]	5 - 10 days per month April through October
Guided tours (interpretation and environmental education)	Dependent on conveyances available and activity. By definition, accompanied by FWS staff.	12-50	By reservation

[a] Based on staff and funds available in FY 2000.
[b] Based on parking and trail availability.

Attachment 1

24 Hour Contact List

Joseph R. Robb
Refuge Operations Specialist
Office: 812-273-0783
Home: 812-265-6633
Cell Phone: 812-498-1154

Donna Stanley
Refuge Law Enforcement Officer
Office: 812-522-4352
Home: 812-523-3414
Cell Phone: 812-528-1998

Stephen A. Miller
Refuge Operation Specialist
Office: 812-273-0783
Home: 812-358-4413
Cell Phone: 812-498-1155

Jason Lewis
Wildlife Biàlogist
Office: 812-273-0783
Home: 812-574-6015
Cell Phone: 812-498-1156

Teresa Vanosdol-Lewis
Wildlife Biologist
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Home: 812-574-6015
Cell Phone: 812-498-1157

ENCLOSURE 3

NO.__________

DEPARTMENT OF THE ARMY

PERMIT TO THE DEPARTMENT OF THE AIR FORCE

TO USE PROPERTY LOCATED ON JEFFERSON PROVING GROUND

THE SECRETARY OF THE ARMY, hereinafter referred to as the Secretary hereby grants to the Department of the Air Force, hereinafter referred to as the grantee, a permit for the continued use of a Bombing Range at the Jefferson Proving Ground (JPG), over, across, in and upon the lands identified in Exhibit "A", attached hereto and made a part hereof, hereinafter referred to as the premises. The Secretary and the grantee are collectively hereinafter referred to as the "Parties".

THIS PERMIT is granted subject to the following conditions.

1. This permit is hereby granted for a term of twenty-five *(25)* years, with renewable ten (10) year periods upon mutual agreement of the Parties. This permit may be terminated earlier, by either the Secretary or grantee, by providing 180 days written notice.

2. The grantee agrees to the care and management of the property as specified in the Memorandum of Agreement (MOA) attached hereto and made a part hereof.

3. All correspondence and notices to be given pursuant to this permit shall be addressed, if to the grantee, to ____________________, and if to the Secretary, to the District Engineer, Louisville District, ____________________ with a copy furnished to the JPG Commander, ____________________, or as may from time to time otherwise be directed by the parties. Notice shall be deemed to have been duly given if when enclosed in a properly sealed envelope or wrapper addressed as aforesaid, and deposited, postage prepaid, in a post office regularly maintained by the United States Postal Service.

4. The use and occupation of the premises shall be without cost or expense to the Department of the Army, and under the general supervision of the JPG Commander, and in accordance with the terms and conditions of the MOA, attached hereto and made apart hereof. In the event of a conflict between the MOA and this permit, the MOA shall be the controlling instrument.

5. The grantee acknowledges that it has inspected the premises, knows its condition, and understands that same is granted without any representations or warranties whatsoever and without obligation on the part of the Department of the Army, except as provided in the MOA.

6. In accordance with the MOA, the grantee shall, at its own expense and without cost or expense to the Department of the Army, maintain and keep the premises at a level sufficient to support Bombing Range operations and in accordance with the tasks in Enclosure 5 of the MOA.

7. The Department of the Army shall not be responsible for providing utilities to the grantee and it shall be the grantee's responsibility for obtaining any utilities necessary for its use and occupation of the premises at no expense to the Department of the Army.

8. No additions or alterations of the premises shall be made without the prior written approval of the JPG commander.

9. On or before the expiration of this permit or the termination by either party, in accordance with paragraph one (I), the grantee shall vacate the premises, remove its property therefrom and restore the premises to a condition satisfactory to the JPG Commander, ordinary wear and tear and damage beyond the control of the grantee excepted.

10. The grantee shall comply with all applicable Federal, state, interstate, and local laws and regulations wherein the premises are located.

11. The Army will provide the grantee with baseline information concerning the environmental condition of the premises in accordance with paragraph III I (a), of the MOA, documenting the known history of the property with regard to storage, release or disposal of hazardous substances on the property. Upon expiration or termination of this permit, the grantee shall, at its own expense and without cost or expense to the Department of the Army, document any storage, release or disposal of hazardous substances in excess of 40 CFR Part 373 reportable quantities and any petroleum products in excess of 55 gallons. A comparison of the two assessments will assist the Army in determining any environmental restoration requirements of the grantee. Any such requirements will be completed by the grantee in accordance with the Environmental Remediation provisions in the MOA and paragraph nine (9) of this permit.

12. It is understood that the requirements of this permit pertaining to maintenance, repair, protection, and restoration of the premises and providing utilities and other services, shall be effective only insofar as they do not conflict with the MOA or any other agreement pertaining to such matters made between local representatives of the Army and grantee in accordance with existing regulations.

13. Access to and use of JPG shall be controlled in accordance with the grantee's Site Access Plan that is attached hereto and is made a part hereof. The Army must first approve any variation from this Plan and a revised Site Access Plan shall be made part of this permit.

14. The grantee shall not use the Premises for the storage, treatment or disposal of non-Department of Defense owned hazardous or toxic materials, as defined in 10 U.S.C 2692, unless authorized under 10 U.S.C. and properly approved by the Government.

15. The grantee may grant a license to the Indiana Air National Guard to exercise its rights to use the premises subject to the terms of this permit.

16. NOTICE OF THE PRESENCE OF LEAD BASED PAINT AND COVENANT AGAINST THE USE OF THE PROPERTY FOR RESIDENTIAL PURPOSES.

The grantee is hereby informed and does acknowledge that all buildings on the Property, which were constructed or rehabilitated prior to 1978, are presumed to contain lead-based paint. For those buildings the grantee uses and occupies it shall comply with all applicable federal, state and local laws and regulations pertaining to lead-based paint and/or lead-based paint hazards. The grantee shall restrict access (e.g. secure buildings to extent practical, post warning signs, etc.) to all unoccupied buildings except those buildings located in the UXO Restricted Areas (see Site Map at MOA Enclosure 1). The grantee shall restrict access to the UXO Restricted Areas in accordance with the Site Access Plan. The grantee shall not permit the use of any of the buildings or structures on the Property for residential habitation. Residential habitation does not include use of the Old Timbers Lodge for conference purposes including overnight visits on a non-permanent basis. The grantee assumes all lead based paint related liability arising from its use of the Property.

17. NOTICE OF THE PRESENCE OF ASBESTOS AND COVENANT:

The grantee is hereby informed and does acknowledge that friable and non-friable asbestos or asbestos-containing materials (ACM) has been found on the Property. The grantee acknowledges that it will inspect any building it will occupy as to its asbestos content and condition and any hazardous or environmental conditions relating thereto. The grantee will restrict access (e.g. secure buildings to the extent practical, post warning signs, etc.) to all unoccupied buildings except those buildings located in the UXO Restricted Areas (see Site Map at MOA Enclosure 1). The grantee shall restrict access to the UXO Restricted Areas in accordance with the Site Access Plan. The grantee shall be deemed to have relied solely on its own judgment in assessing the condition of the Property with respect to any asbestos hazards or concerns. The grantee covenants and agrees that its use and occupancy of a building will be in compliance with all applicable laws relating to asbestos. The grantee assumes all asbestos related liability arising from its use of the Property.

18. This permit supercedes Permit No. DACA 27-4-83-03, dated 23 July 1982, as amended. Said Permit No. DACA 27-4-83-03 is hereby terminated, effective the date of execution of this permit.

THIS PERMIT is not subject to Title 10, United States Code, Section 2662, as amended.

IN WITNESS whereof, I have hereunto set my hand by authority of the Secretary of the Army, this ________________ day of __________________, ________________.

This permit is also executed by the grantee this ____________________ day of ____________________, ____________________.

____

JEFFERSON RANGE ACCESS PLAN

(Revised 12 Apr 00)

Prepared by:
Air National Guard

Major William Nolen
Commander
Jefferson Range

Reviewed by:
U.S. Fish and Wildlife Service

Lee Herzberger
Refuge Manager
Muscatatuck National Wildlife Refuge

Approved by:
U.S. Army

Major Mark Welch
Commander
Jefferson Proving Ground

JEFFERSON RANGE ACCESS PLAN

This Operating Instruction will provide access procedures onto Jefferson Range. All access onto Jefferson Range and Old Timbers Lodge will be coordinated through Jefferson Range Operations Center (JROC).

Jefferson Range Operations Center (JROC) describes the range primary operations area. This area encompasses those buildings located at the intersection of Bomb Field and K roads. All access to the JROC is through Big Oaks National Wildlife Refuge.

Jefferson Range consists of 983 acres used as the primary training range. Geographical boundaries for this area illustrated in Attachment 1.

A 50 acre Precision Guided Munitions (PGM) target is located approximately 6nm south of the primary range. Geographical boundaries for this target are illustrated in Attachment 2.

Old Timbers Lodge and approximately 5 acres surrounding the lodge will be considered part of Jefferson Range for the purposes of this access plan.

Four gates allow access to the primary range. These gates are located as follows:

Intersection of Machine Gun and K roads
Intersection of Shape Charge and K roads
Intersection of Bethel Hole and J roads
Intersection of Cottrell and J roads

Range Personnel. All assigned personnel will be issued one key for perimeter gates and one key for range gates. Entry/Exit will be made through the gate most advantageous to their needs. Upon entry/exit the perimeter gate will be closed and locked.

Visitors. All visitors will coordinate range visits through the JROC. Visitors will be met at the appropriate perimeter gate and escorted to the JROC. Upon completion of visit, visitors will be escorted to appropriate gate for departure. There will be no unescorted visitors to and from Jefferson Range.

Contractors. Prior to any contractor performing duties on JPG real estate, coordination will be made through JROC and FWS office on all planned activities. Those contractors scheduled per Air Force (AF) requirements will be assigned a specific key for the duration of their activity. This key will be to an exclusive use lock located on the perimeter gate/interior gate nearest the planned activity and will only be utilized during duty hours.

Gate. All locks presently on all perimeter gates will be replaced by AF to ensure access by FWS, Army and AF personnel only. All locks will be changed prior to the issuance of a real estate license.

Fence. AF personnel and/or contractors will maintain the perimeter. Range personnel/contractors will perform weekly inspections of entire perimeter fence. All discrepancies will be reported so that any necessary repair action may be taken. FWS personnel are required to report any fence discrepancies to Jefferson Range NCOIC so the appropriate action may be taken. AF personnel or the designated contractor will perform fence repairs. Inspection documentation will include 1) date of inspection, 2) name of inspector, 3) description of damage, and 4) the location of the damage. Holes in the fence large enough to permit human access, damaged gates and missing "windchimes" of the creek barriers will be repaired within 72 hours of being documented. For every incident of damage a record shall be maintained documenting the action taken to make repairs. If any repairs take more than 72 hours, the Army shall be notified and milestones shall be given for completion of the repair.

Barricades. To ensure no trespass of the PGM target safety footprint and the interior of JPG, gate style barricades will be placed on all access roads into the footprint and interior areas. These barricades will be located at the point where all interior roads leave the East and West Perimeter Roads. Other than during the limited deer and turkey hunt, these barricade gates will remain closed and locked at all times. Only AF, Army and FWS personnel or required contractors will be allowed access to the footprint and interior areas of JPG. During the annual turkey and deer hunt, FWS will control access into these areas.

Key Control. All range personnel will be assigned 4 keys for range access. These keys include the perimeter gate keys, PGM target/interior road gate keys, range keys and building keys. Spare keys for these four series of keys will be kept in the JROC. All keys will be signed for on the Jefferson Range key control log. The FWS will be assigned the appropriate number of keys for distribution to FWS personnel. The FWS will be responsible for the control of these keys. The FWS will distribute the local law enforcement units perimeter gate keys from the FWS key allotment. The Army site staff will be issued 2 sets of keys and will be responsible for the control of these keys. Quarterly lock and key inventories will be made of all issued keys. In the event of a lost or missing key, the individual responsible for that key shall bear the cost for re-coring of applicable locks. Lock and Key Control guidance will be from 181st FW Instruction 32-1003. The Jefferson Range Commander has the ultimate responsibility for lock and key control on the range and refuge.

Safety Signs. The appropriate UXO safety signs will be maintained on the perimeter fence and gates. Gate numbers will be posted on all gates. Range and footprint gates will be posted with both Bombing Range and Laser Range danger signs. Radiation hazard signs will be maintained on DU field perimeter. Safety signs will be maintained on the west side of Machine Gun Road from K Road to Little Otter Creek.

Safety Brief. All visitors and contractors will receive a safety briefing from Jefferson Range Safety NCO. The safety brief will cover UXO, DU, driving hazards, flying operations and FWS operations. At no time will visitors or contractors be permitted to leave the JROC without first receiving an initial safety briefing.

Communications. Good communications between range, Army site staff and FWS personnel are a must to ensure a safe working environment for all concerned. The Range Operations Officer (ROO) will furnish FWS with a monthly flying schedule. The ROO will also inform FWS of any scheduled use of the PGM target. Use of this target will preclude any activity inside the safety footprint All maintenance of the facilities will be coordinated with the Refuge Manager. At a minimum, monthly meetings will be conducted between the Refuge Manager and the Range Operations Officer to better facilitate a smooth work environment.

Weapons Safety Footprint. Two composite weapons safety footprints are associated with Jefferson Range. A composite footprint of approximately 5,100 acres supports the primary target area and a composite footprint of approximately 14,860 acres supports the PGM target area. During flight operations no personnel other than AF personnel will be allowed access inside the weapons footprints. The use of both footprints will be coordinated with the Refuge Manager through monthly scheduling or as necessary to meet mission requirements. When not in use, FWS personnel will have access to the safety footprints.

Emergency Response. Any emergency requiring an immediate response wilt be accomplished through the Ripley County Communication Supervisor. Emergency response personnel will be directed to Gate 8 for entrance and directions to the location of the emergency. AF personnel will provide escort to the incident location. Emergency response personnel will be informed of any hazards associated with the emergency. The Army site and staff and FWS will be notified of all needs for emergency response.

Aircraft Accident. In the event of an aircraft accident, the Range Control Officer (RCO) will be the on-scene commander until relieved by the appropriate authority. Emergency response will be through the Ripley County Communication Supervisor. Fire and medical support will be directed to the perimeter gate most advantageous to the crash site. Due to the dangers posed by military aircraft, no persons will be allowed access to a crash site until deemed appropriate by the on-scene commander. Access to an aircraft or pilot in a designated restricted area will be accomplished by the appropriate Jefferson Range vehicle. Only the necessary rescue personnel will be permitted access to any restricted area. Access to aircraft or pilot outside of a restricted area will be made by the appropriate vehicle for the situation. The Army site staff and FWS will be notified immediately of any aircraft mishap.

Fire Response. Request for fire response will be made through the Ripley County Communication Supervisor. Fire fighters will be directed to Gate 8 for entrance and directions to the fire. Fire fighters will not leave any roadway to fight fires per US Army directives. In the event of a need for fire department response after duty hours, the local fire department will be instructed to cut the lock on the gate most advantageous to their response. In this case, fire department response will only occur if it is apparent that the fire will cause life or property damage outside JPG. A complete list of AF and FWS contacts Will be provided all local fire departments in the area. Attachment 4 lists the Jefferson Range contacts available on a 24-hour basis.

Law Enforcement Response. Request for law enforcement response will be made through the Ripley County Communication Supervisor or the appropriate law enforcement agency. Caller will state the nature of the emergency, location of the emergency and the most accessible gate to respond to the emergency. Local law enforcement units will have perimeter gate keys issued to them from the FWS key allotment. All local law enforcement units will be issued a 24-hour contact list of Jefferson Range personnel.

Old Timbers Lodge. Access to Old Timbers Lodge will be through Gate 1B. The sponsor that has reserved the lodge will contact Jefferson Range to arrange a time for key sign out and the required safety briefing. The sponsor and all guests will be required this safety brief. A single key to Gate 1B will be assigned the sponsor. The sponsor is responsible for the behavior and safe conduct of his/her guests. If the sponsor and/or guests wish to take part in recreational activities of Big Oaks NWR, those activities will fall under the rules and guidelines of the refuge. Use of Old Timbers Lodge does not guarantee hunting and fishing activities on the refuge. Attachment 3 depicts that area around the lodge to be maintained by the AF.

Attachment 4

24 Hour Contact List

Major Bill Nolen
Jefferson Range Commander
Office: 812-689-7295
Home: 317-738-2719
Cell Phone: 317-441-3653

Major Matt Sweeney
Jefferson Range Operations Officer
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Cell Phone: 812-528-0974

Senior Master Sergeant Jim Bergdoll
Jefferson Range NCOIC
Office: 812-689-7295
Home: 812-265-2372

Master Sergeant Kerry Brinson
Jefferson Range Asst NCOIC
Office: 812-689-7295
Home: 812-839-3557

Master Sergeant Todd Bass
Jefferson Range Safety NCOIC
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